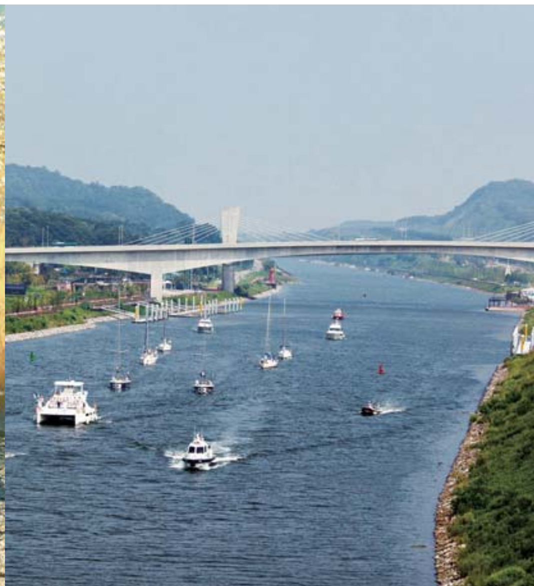
WATER
AND GREEN GROWTH

Beyond the Theory for Sustainable Future



VOLUME 2 2015 CASE STUDIES

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WATER AND GREEN GROWTH

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VOLUME 2 2015

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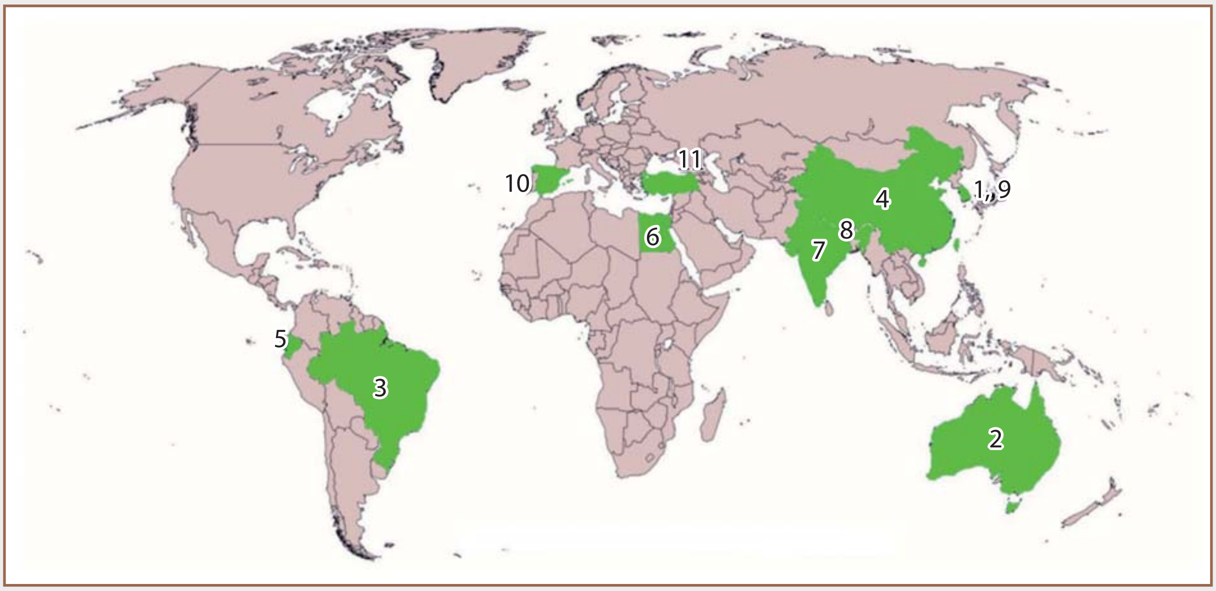

Water and Green Growth Case Study Report 1

Republic of Korea

Lake Sihwa Water Quality Improvement Project

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About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

Disclaimer
This report is an output of the staff of Research Center for Water Policy and Economy at K-water Institute. The findings, interpretations,arguments, and conclusions expressed in this report do not necessarily reflect the views of K-water Institute, K-water, their Board of Directors, and the World Water Council.

Prepared for
Ministry of Land, Infrastructure and Transport, Republic of Korea and K-water (Korea Water Resources Cooperation) in cooperation with the World Water Council.

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I. Introduction

1. Purpose of the Case Study

It is being recognized worldwide that in order to attain sustainable development, the narrow focus on economic growth must be discarded and an inclusive approach to growth that considers the environmental and social dimensions must be taken. At the center of this shift in the global growth paradigm is water.

Water is not only necessary for life but is an essential factor in economic activity based on which societal change has taken place. If in the past we could only use water by being near a well or a spring, today no matter where we are, we can use water by turning on the tap. In the course of this change, which saw rapid global development, water was degraded in the name of economic growth. In the case of developed countries, reflection on the concept and practice of sustainable development began. In contrast, the Republic of Korea began to take an interest in water quality and pollution problems only after suffering immense losses from the Nakdong River Phenol Accident and the degradation of water in Lake Sihwa in the 1990s. This late reflection became the seed of the Korean government's green growth strategy, and even today economic, environmental, and social considerations are all being reflected in Korea's policies.

Among Korea's green growth policies, the Lake Sihwa Water Quality Improvement Project is the most representative case demonstrating the role and importance of water and is an example that decouples economic development and environmental degradation. In this case study, we investigate how Lake Sihwa, whose development traces back to 1975, through institutional and policy changes, became the water quality improvement success story and contributed to Korea's green growth from an institutional perspective. Moreover, the case will reveal how important the green concept—the consideration of the environmental and social aspects in addition to the economic one—is in the efficient and effective management of water resources for green growth.

2. Case Study Methodology

2-1. Institutional Economics Approach

The institution is at the center of many social science explanations of recent political, economic, and social trends and developments. Such approaches, especially in academia that focus on the institution, are generally called new institutionalism (Ha, 2004).

Institutionalism took off with the claim that there were limits to explaining economic development with the existing modernization theory[1]. Unlike modernization theory's claim that all countries follow the same development path, the reality has been more varied.

Countries have responded differently to international crises such as the oil shocks of the 1970s; and with regard to the twin goals of democratization and economic development, different means have been used. As a

1) This trend in the social sciences is related to the rise of the theory of the state that emphasizes the state's role as an independent variable and to the social determinism that developed out of pluralism. This research trend of the so-called reappearance of the state represents a convergence in thought with the recent trend of Marx's emancipatory theory of the state in which the state is emancipated through a social economically deterministic approach to state and political economy—in other words, the theory of the state that declares the predominance of the state over society. However, theorists of the state view the relation between international organizations and social economy actors as somewhat fixed, and therefore view the spectrum of possibilities for change as limited. That is, the theory has not developed to the point of recognizing the concept of the institution, through which varied paths to change are possible as regards state-society interactions.

result, interest in each country's social, economic, and political institutions has arisen, and so have attempts to explain through these institutions each nation's internal durability and the diversity of policies among countries (Lee, 1993, p.235).

Within traditional neoclassical economics, the problem of the significant influence that institutions exert on main economic actors has been excluded from research, being instead considered as part of the field of history or the other social sciences. As such, neoclassical economics has traditionally treated institutions simply as given exogenous variables. Recently, however, the question of institutions has become a main topic of interest within the field, and active research toward its systematic investigation is under way.

Such research has unfolded in the forms of the theory of ownership and transaction cost theory, and as these methods of institutional analysis show mutual resemblance and relevance in their methodological starting points and in their approaches, these forms of research fall under the common name of new institutionalism.

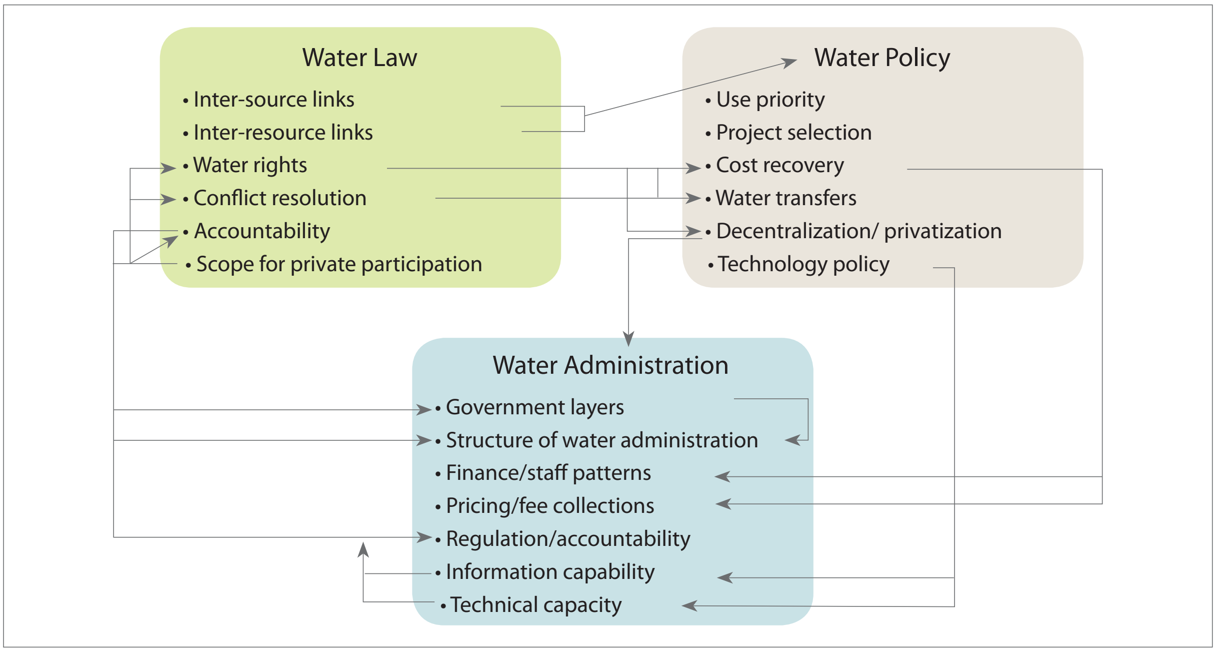
Human behavior can be modeled at moments of decision by observing the degree of preference or restriction. Human character based on economic rationality is an important analytical premise. For instance, profit-seeking man weighs costs and utility in situations of choice and attempts to maximize what he wants according to given rules and patterns. Thus, to explain the effect that institutions exert on the outcomes of human behavior, institutions could be defined as the behavioral rules that control what is permissible and proscribed; and to explain the production and change of institutions, institutions can be understood as a means to understand social change (North, 2005).

In this case study research, such an institutionalist approach will be used as the base to investigate how each examined country's water-related project attained what outcomes under which institutions and which policies. That is, the present research will explore how the economic, social, political, environmental, and technical exogenous factors of the country in which the project took place, together with the country's water-related institutional framework and relevant policy mix led to the success or failure of the water-related green growth project.

In basing the water and green growth case study research on the new institutionalist approach, it is necessary to take a look at related theories. From the perspective of new institutionalism, the cause of institutional change can be society's history (historical institutionalism), society's process of adaptation (sociological institutionalism), or society's members' rational choice to establish an institution to reduce transaction costs (rational choice institutionalism).

2-2. Analytical Framework

This research utilizes the analytical framework presented in Saleth and Dinar's (2004) *The Institutional Economics of Water* as the base to evaluate the water-related project's outcomes following from changes in institutions and policies. In their work, Saleth and Dinar applied and evaluated endogenous and exogenous factors of change to analyze the interaction between institutions and water sector performance. Exogenous factors refer to national or regional political systems, legal systems, populations, economic factors, and natural and environmental factors. Water sector "covers surface, subsurface, and reclaimed or recycled sources" (p.94) and "includes all water uses—both consumptive and non-consumptive—and all major water issues ranging from quantity-quality conflicts to drought-flood syndromes" (pp.94-95). Viewing institutions as "[covering] the legal framework, policy regime, and administrative or organizational arrangements" (p.95), Saleth and Dinar define water institution as "an entity defined interactively by three main components: water law, water policy, and water administration" (p.95).



<Figure 1> Saleth and Dinar's (2004) Analytical Framework

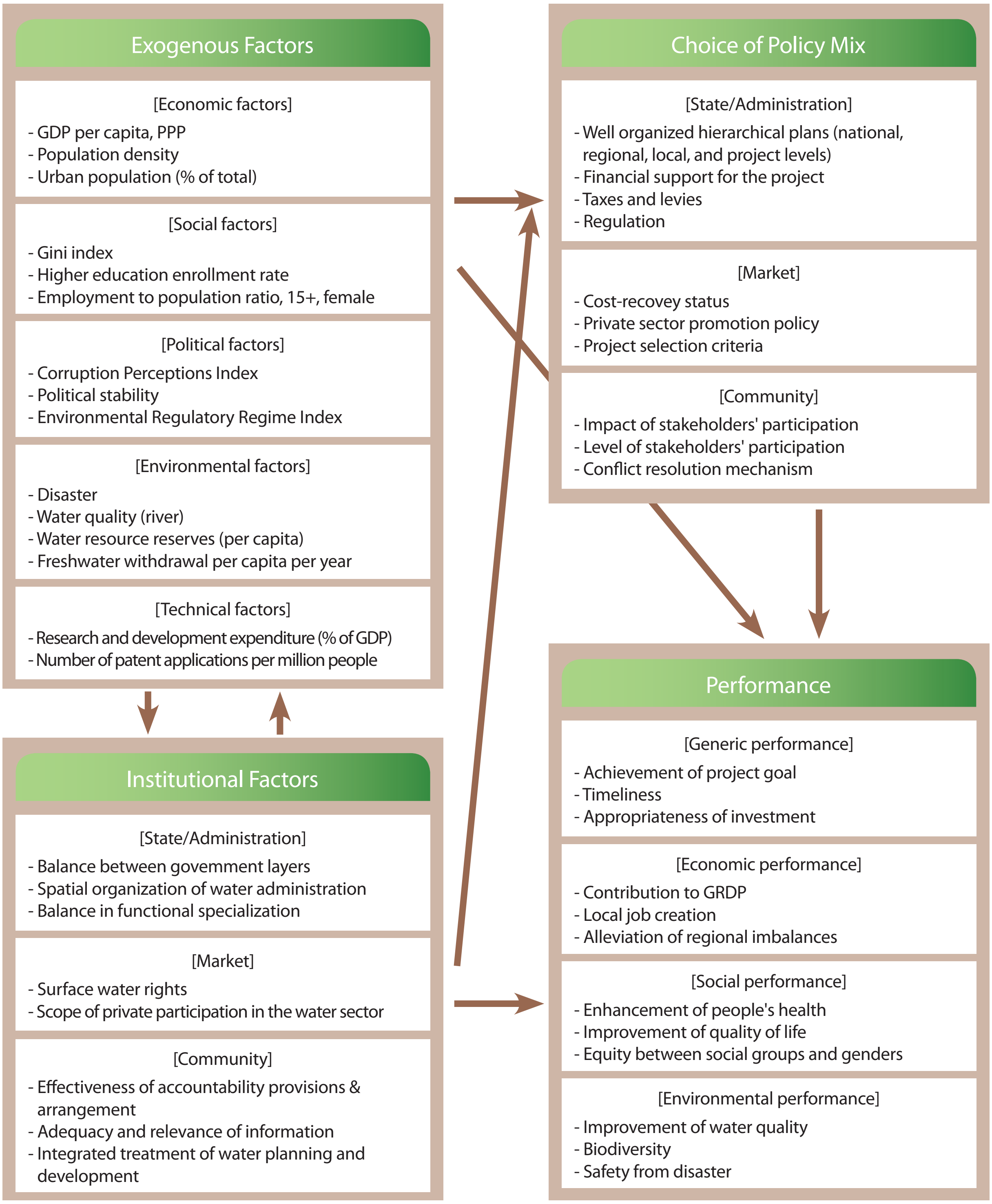
As this case study research examines what economic, social, and environmental outcomes were brought about by institutions and policies as they pertain to the water and green growth-related project, it does not divide water institution into law, policy, and administration, but reorganizes the analytical elements according to Figure 2.

This case study research recategorizes from Saleth and Dinar's (2004) institutional framework the water-related project's policies, as well as law and administration elements, into state, market, and community. The reason for this recategorization is that there have been strong debates about the drivers and instruments of economic and social development and environmental conservation based on the state, the market, and community. In addition, even if economic conditions, the populations' characteristics, and exogenous factors were identical, the results of the water-related project could vary based on whether the applicable institutional framework were predominantly state-driven, market-oriented, or community-centered.

3. Organization of the Report

The purpose of this case study is to investigate the economic, social, political, environmental, and technological levels in which Korea's Lake Sihwa Water Quality Improvement Project took place; the policies and institutions that mark the project's course from its planning stage in 1975 until the present; and the changes in those policies and institutions over that time. From this investigation, the project's performance is analyzed and lessons are drawn. This is done following the basic structure shown in Figure 2, with exogenous factors examined first, then institutional factors and the policy mix considered together, and performance analyzed last. The detailed structure of the report follows below.

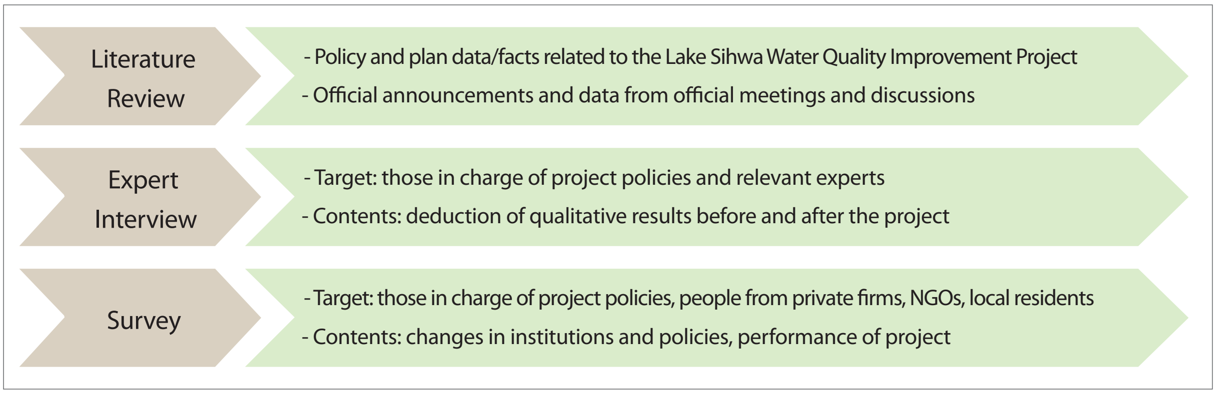
First, the Lake Sihwa Water Quality Improvement Project is summarized. This case study divides the project into two stages before and after the rise of the lake's acute water quality problem as a national issue in 1996. Secondly, the external environment during the Lake Sihwa development period is characterized in terms of its economic, social, political, environmental,



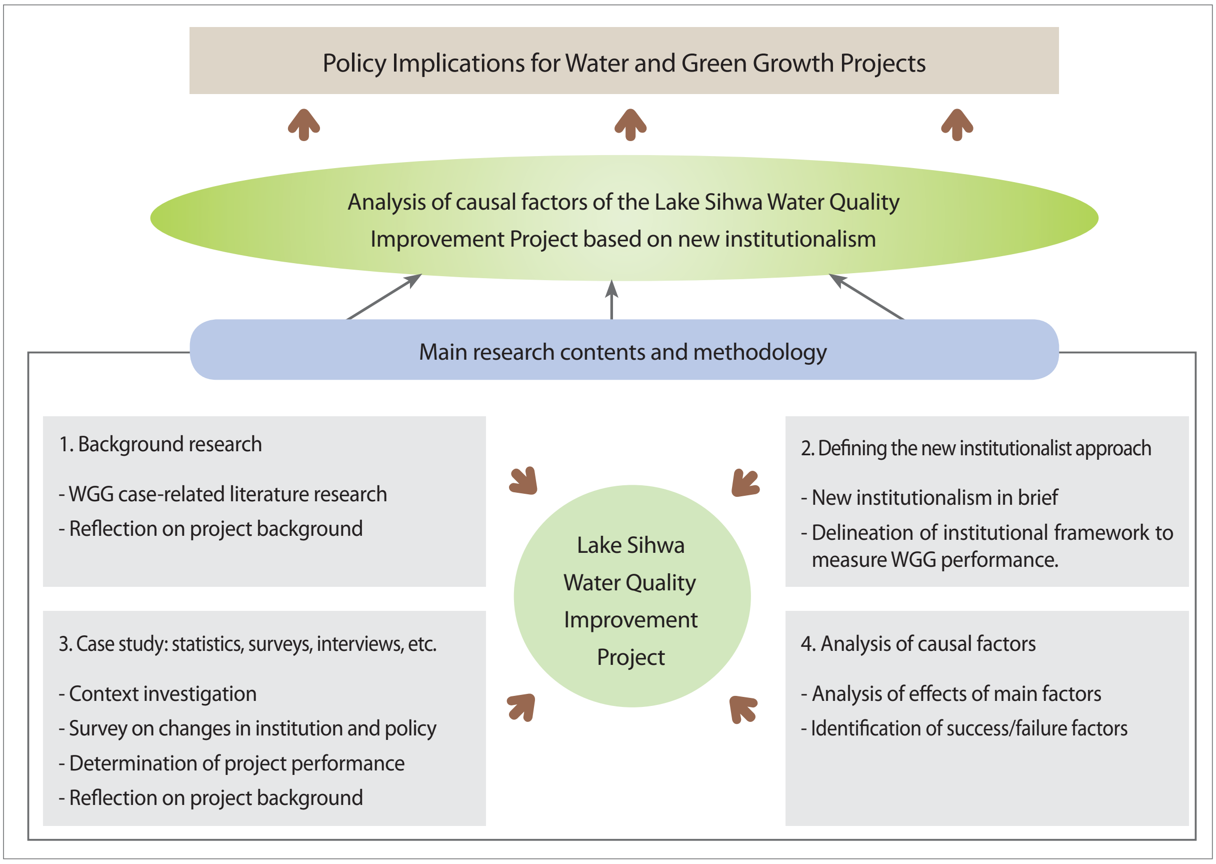
<Figure 2> Institutional Framework Modified from Saleth and Dinar (2004)

and technological aspects, i.e. exogenous factors. Statistics from the World Bank, OECD, and other sources, as well as survey results, and expert interviews are used to analyze how exogenous factors influenced policies and institutions affecting the Lake Sihwa project (see Figure 3).

Thirdly, the institutional change, focusing on applied policies of the project period, is examined across state, market, and community dimensions. Fourth, the project's performance is evaluated in terms of economy, environment, and society. Lastly, overall lessons are drawn from the foregoing analysis.



<Figure 3> Methods of the Case Study



<Figure 4> Research Context Structure

II. An Overview: Lake Sihwa Water Quality Improvement Project

1. About Lake Sihwa

A man-made lake, Lake Sihwa is surrounded by the cities of Siheung, Ansan, and Hwaseong in Gyeonggi Province. The lake came into being with the completion of the 12.6km Sihwa Seawall in January 1994, as a part of the large-scale comprehensive reclaimed land development that had been planned since the 1970s.

The basin area spans 476.5km^2 and is flat like other areas of the West Sea coast (Korea Water Resources Corporation, 2005, p.21). The lake holds 332 million tons of water. The water level is 1.0m below sea level, the deepest point is 18m deep, and the yearly seawater intake is 380 million tons, with a retention time of 300 days.[2] To the basin's north lie, the Banweol (15.39km^2) and Sihwa (16.46km^2) industrial complexes, as well as the Sihwa Multi-Techno Valley (MTV) (9.26km^2). To the east are the Banweol, Samhwa, Donghwa, and other small rivers and streams. To the south are land reserved for agriculture (36.36km^2), land reserved for other uses, and land for the planned Songsan Green City (56.89km^2).

The Lake Sihwa Development Project divides into the two periods before and after the rise of Lake Sihwa's acute water pollution to national attention in 1996.

1-1. Stage 1: Economy-Centered Development ('87-'96)

The economy-focused development period comprises the time from the establishment of plans for the reclamation and development of lands on the West Sea coast in 1975 to the rise of Lake Sihwa's pollution as a national environmental issue in June 1996.

Lake Sihwa's development was planned in order to eliminate absolute poverty and for self-sufficient food production that would support economic growth. The Ministry of Agriculture and Fisheries (MOAF; present Ministry of Agriculture, Food, and Rural Affairs, or MAFRA) established a plan in 1975 to reclaim and develop land in the West and South Sea coasts. In line with the plan, a two-year survey was undertaken beginning in 1982. In result, the Sihwa District was selected as a possible development site. However, in October 1984, the Ministry of Construction (MOC; present Ministry of Land, Infrastructure, and Transport, or MOLIT) reported to the President that it would develop the same land as an industrial site. Following negotiations by the involved ministries, the Lake Sihwa basin became the object of a conglomerated plan involving industrial sites, satellite cities[3], and

Lake Sihwa's Location

Satellite Image

Source: Google Earth(both images)

<Picture 1> Lake Sihwa Location and Satellite Image

2) Lake Shihwa Management Committee http://www.shihwaho.kr/location.php

<Table 1> Historical Overview of Lake Sihwa's Development

	President Park Jeonghee (~1979)	Jeon Duhwan ('81-'88)	Roh Taewoo ('88-'93)	Kim Youngsam ('93-'98)	Kim Daejoong ('98-'03)	Roh Muhyun ('03-'08)	Lee Myungbak ('08-'12)
Political environ-ment	Strong centralized state	Transition period to small government		1st local government head election (1995)	Decentralized state		
				Env. Office > Ministry of Env. (1994)			
	Military junta		Democratization ('87-'92)	Civilian government			
Economic environ-ment	Heavy chemical industry promotion (1970s)	Reorganization of industry ('81-'87)	Econ. liberalization ('87-'92)	Globalization, Tech. intensive ind. promotion ('93-'97)	Innovation-led economic growth (2000s ~)		
	Strong govern -mental intervention	Growth of labor power		World econ. Recession/ policy failure > 1997 financial crisis (IMF)	Market-driven economic growth with tech-intensive and innovation-led industry/ Promotion of value added business		
		Growth of conglomerates					
Environ-mental movement	Weak environmental movement	Birth of environmental NGOs and growth Nakdong Phenol Leak ('91)		National level environmental. movement Lake Sihwa Pollution ('96)	Spread of environmental movement		
	1975	1987	1994	1996	2001	2004	2012
Main events related to the Sihwa project	Korea Rural Community Corporation established Southern and Western Tideland Development Plan ('75)	Sihwa seawall construction began ('87)	Jan. seawall completed	Apr. water quality degradation reported via TV	Feb. Sihwa lake switched to seawater lake	Jan. Sihwa District Sustainable Development Council established	Oct. Sihwa Comprehensive Management Plan phase 3 confirmed
				July. Water quality improvement plan announced	Aug. Sihwa Comprehensive Management Plan established	Oct. Environmental improvement Roadmap confirmed	Dec. Sihwa lake Total Coastal Pollutant Loads Plan established

agricultural lands. In February 1985, the Lake Sihwa basin's development began in earnest.

However, after the completion of the seawall in January 1994, the lake's water quality began to deteriorate. On April 25, 1996, SBS TV broadcasted a scene on a massive release of lake and marsh water into the adjacent West Sea. From this point on, Lake Sihwa came to symbolize unprecedented water pollution and became a societal issue.

1-2. Stage 2: Balanced Environmental and Economic Development ('96.4-'12.12)

The period of balanced environmental and economic development subdivides into two smaller periods: April 1996 to December 2003 is when central government agencies, local governments, and district residents mobilized to address the water pollution problem, and January 2004 to December 2012 is when the knowledge and experience gained in the course of the

3) In this case study, the term satellite city is used to refer to an urban area outside a major city where a particular economic activity or cluster—in this case, an industrial site—is concentrated.

		
Source: K-water	Source: K-water	Source: Ministry of Oceans and Fisheries, Republic of Korea

<Picture 2> Constructing and Connecting the Sihwa District Seawall and the Completed Sihwa Seawall

<Table 2> Timeline of Policies and Key Events: Stage 1

	Timeline of Policies and Key Events: Stage 1
1975	Agricultural Development Corporation (present KRC) establishes plans to reclaim and develop mudflats of the West and South Seas for agriculture
1982.4	Agricultural Development Corporation undertakes survey for reclaimable land
1985.8	Economic Planning Board confirms Sihwa District development first plan
1987.6	Seawall construction begins (led by Industrial Sites and Water Resources Development Corporation, present K-water)
1988.9	Environmental Impact Assessment by the Han River Basin Environmental Office
1994.1	Sihwa Seawall completed
1996.4	Water quality problem is televised

preceding sub-period were utilized to implement eco-friendly development.

1-2-1. Period of Water Quality Improvement Efforts

Construction of the seawall finished in January 1994. However, as wastewater flow prevention facilities and treatment facilities were sorely lacking, Lake Sihwa's water quality began to rapidly deteriorate. In April 1996, an SBS TV report made Lake Sihwa's pollution a national issue. In July, the President ordered the Ministry of Environment (MOE) to restore the water quality. MOE, coordinating with related agencies, announced plans to invest 449.3 billion won until 2001 in water quality restoration measures (Korea Water Resources Corporation, 2005, p.101).

The Board of Audit and Inspection determined the fundamental cause of the lake's pollution to be "a comprehensive lack of environmental awareness" (Korea Water Resources Corporation, 2005, p.88). The water quality restoration measures included the installation of oxidation ponds, constructed wetlands, and temporary intercepting sewers as well as circulation of seawater in the short term, and the expansion and building of wastewater treatment plants and intercepting pipes in the long term. Consequently, water quality markedly improved. However, with the intake of seawater, neither the water in Lake Sihwa nor in its marshes could be used for agriculture. In February 2001, the government formally abandoned plans to develop Lake Sihwa as a freshwater lake. Following this change in policy, management of the lake shifted from the Ministry of Construction and Transportation (MOCT; present MOLIT) to the Ministry of Maritime Affairs and Fisheries (MOMAF; present Ministry of Oceans and Fisheries, or MOF). MOMAF confirmed the Lake Shihwa[4] Comprehensive Management Plan. To implement this

4) MOMAF, which made the Lake Shihwa Comprehensive Management Plan and the Lake Shihwa Management Committee, spells "Shihwa" with the extra "h" on its Lake Sihwa Website: www.shihwaho.kr. Many other sources use the "Sihwa" spelling.

plan, along with related organizations, MOMAF founded the Lake Shihwa Management Committee in 2002. MOMAF in 2003, for the purposes of water quality restoration and clean energy production, added plans for a tidal power plant to the Lake Sihwa Water Quality Restoration Measures in what became the Lake Shihwa Comprehensive Management Plan. Meanwhile, with the aim of jointly solving the problems of water quality and air pollution, MOCT, in September 2000, founded the Sihwa District Policy Council composed of itself, MOE, the Ministry of Agriculture (MA; present MAFRA), the Ministry of Commerce, Industry and Energy (MOCIE; present Ministry of Trade, Industry and Energy, or MOTIE), Gyeonggi Province, the cities of Siheung and Hwaseong, the Korea Water Resources Corporation (present K-water), and the Korea Agricultural and Rural Infrastructure Corporation (KARICO; present Korea Rural Community Corporation, or KRC). However, the Sihwa District Policy Council did not include district residents, civil society organizations, or any party opposed to the development plans. In January 2004, upon MOCT's proposal, the Sihwa District Sustainable Development Council, inclusive of all Lake Sihwa stakeholders, was formed.

1-2-2. Period of Eco-Friendly Development

The Sihwa District Sustainable Development Council is a decision-making body involving the participation of government, business, residents, and civil society. At the council's founding the chair was held solely by MOCT's New Town Planning Department's chief; in January 2005, the council's governance changed to accommodate government and civilian co-chairs. The council in October 2004 established the Water Quality and Atmosphere Restoration Roadmap. In June 2007, the 10.48 million m^2 originally planned for the Sihwa Multi-Techno Valley (MTV) was reduced to 9.26 million m^2. In April 2008, by the directive of the Ministry of Land, Transport, and Maritime Affairs (MLTM; present MOLIT), the Sihwa District Sustainable Development Council became a formal organization.

In July 2010, at the 8th meeting of the Lake Sihwa Management Committee, the Total Pollutant Load Management System was adopted. In January 2012, technical indicators for the Total Pollutant Load Management System were instituted. In August 2011,

<Table 3> Timeline of Policies and Key Events: Stage 2-1

	Timeline of Policies and Key Events: Stage 2-1
1996.7	Announcement of Lake Sihwa Water Quality Improvement Measures—449.3 billion KRW to be invested until 2001
1996.11	Board of Inspection and Audit audits Sihwa Freshwater Lake Water Quality Restoration Project—Korea Water Resources Corporation regional chief and 14 public officials censured
1997.3	Sihwa Seawall sluicegate opened and seawater let in
1998.12	MOAF abandons Lake Sihwa for irrigation water
1999.5	Fossilized dinosaur egg discovered on reclaimed land on the south bank
2000.3	Cultural Heritage Administration designates 16 million m^2 where the dinosaur egg fossil was discovered as natural monument no. 414
2000.9	Sihwa District Policy Council formed comprising MOCT, ME, MOMAF, MA, MOCIE, Gyeonggi Province, Siheung, Ansan, Hwaseong, Korea Water Resources Corporation, and KARICO
2001.2	Government formally abandons plans to have Lake Sihwa a freshwater lake; confirms plans for saltwater lake (MOMAF takes charge of lake's management)
2001.8	MOMAF establishes Lake Shihwa Comprehensive Management Plan (745.1 billion KRW to be invested until 2006)
2002.12	Lake Shihwa Management Committee formed by Prime Minister's directive
2003.10	Construction of a tidal power plant added to Sihwa District Development Plan
2004.1	Sihwa District Sustainable Development Council formed

<Table 4> Timeline of Policies and Key Events: Stage 2-2

	Timeline of Policies and Key Events: Stage 2-2
2004.9	Lake Shihwa Management Committee confirms improvement plan for the Lake Sihwa Comprehensive Management Plan (raise project budget by 270.1 million KRW)
2004.10	Environmental Improvement Roadmap is announced (water and atmospheric quality included)
2005.1	Sihwa District Sustainable Development Council adopts joint chair system
2007.6	Sihwa MTV development area reduced from 10.5 to 9.26 million m^2
2007.8	Sihwa MTV groundbreaking (K-water to develop 9.26 million m^2 by 2016)
2008.2	Lake Shihwa Comprehensive Management Plan Stage 2 Implementation Plan established
2008.4	Sihwa District Sustainable Development Council launches as a formal organization
2010.7	Total Pollutant Load Management System adopted (8th meeting of Lake Shihwa Management Committee)
2011.8	Sihwa Tidal Power Plant begins its partial operation
2012.1	Total Pollutant Load Management technical indicators instituted
2012.2	South bank urban (Songsan Green City) development of reclaimed land begun
2012.10	Comprehensive Management Plan stage 3 confirmed (until December 2016)
2012.12	Lake Sihwa Total Pollutant Load Management Master Plan adopted

the Sihwa Tidal Power Plant that had been installed to facilitate seawater circulation for restoring water quality and to provide electricity, began its partial operation.

III. The Case Study

1. Exogenous Factors

The exogenous factors present a picture of the general context in which a project is carried out. This section presents the general national level context in which the Sihwa Lake Restoration Project occurred across the economic, social, political, environmental, and technological dimensions.

1-1. Economic Factors

1-1-1. Economic Growth and Structural Change

During the development of the Lake Sihwa Basin, Korea experienced rapid economic growth. Per capita GDP, during the Stage 1-relevant period from 1987 to 1996, grew on average 11.5% yearly. During the Stage 2, 1996-2012, annual growth was 5.2%. Consequently, Korea in GDP per capita terms developed as the world's 15th largest economy in 2012[5].

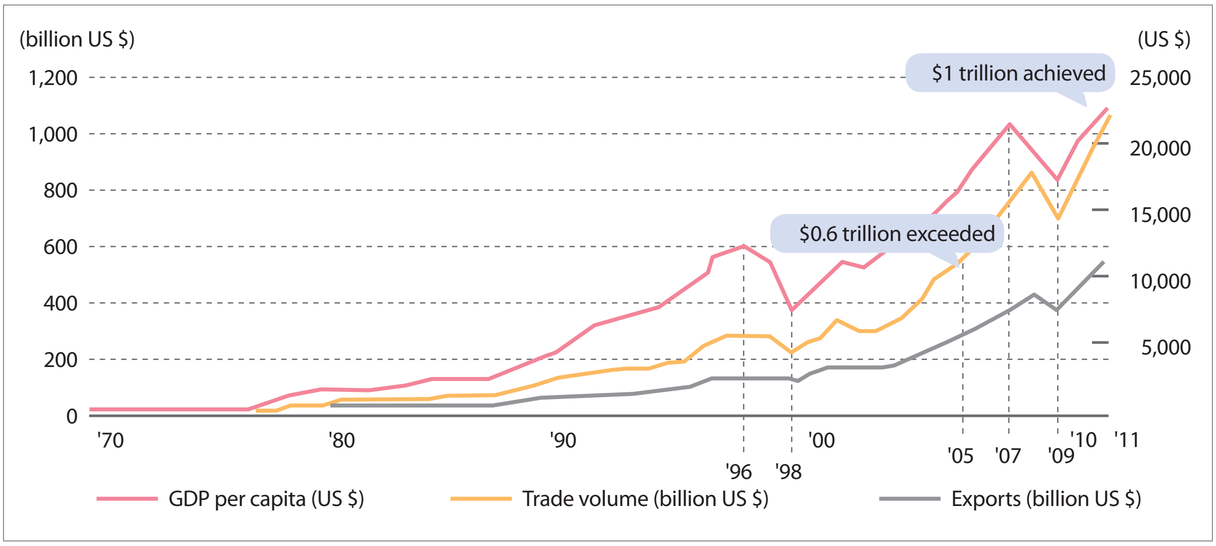
Along with economic growth, Korea's industrial structure underwent considerable change. Agriculture, forestry, and fisheries were key industries through the 1960s. While the industrial structure comprised of 45.5% agriculture, forestry, and fisheries, 41.3% services, and 10.3% mining and manufacturing in 1953, by 2011 the structure had changed to consist of 58.1% services, 31.4% mining and manufacturing, and 5.9% construction. The share of agriculture, forestry, and fisheries had dramatically decreased from 45.5% to 2.7% during that time. As a share of manufacturing, heavy and chemical industries increased 39.8% in 1970 to 88% in 2012 (GDP current prices). Noteworthy is the fact that Korea quickly transitioned to an open economy. From 15.2% of GNI in 1970, the value of exports climbed to 58.2% by 2012, and imports increased from 24.1% to 54.5%.

5) World Bank Database (Accessed October 2013)

<Table 5> GDP per Capita, PPP (Current International $)

1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2,376	2,737	3,083	3,543	3,983	4,364	4,951	5,655	6,465	7,094	7,960	8,970	9,614	10,326	11,355	12,465	13,481
1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
14,329	13,512	15,047	17,197	18,151	19,656	20,180	21,624	22,783	24,247	26,101	26,689	26,680	28,613	29,786	30,722	-

Source: World Bank Indicators



Source: Bank of Korea

<Figure 5> Trend of GDP per Capita, Trade Volume, and Exports in Korea

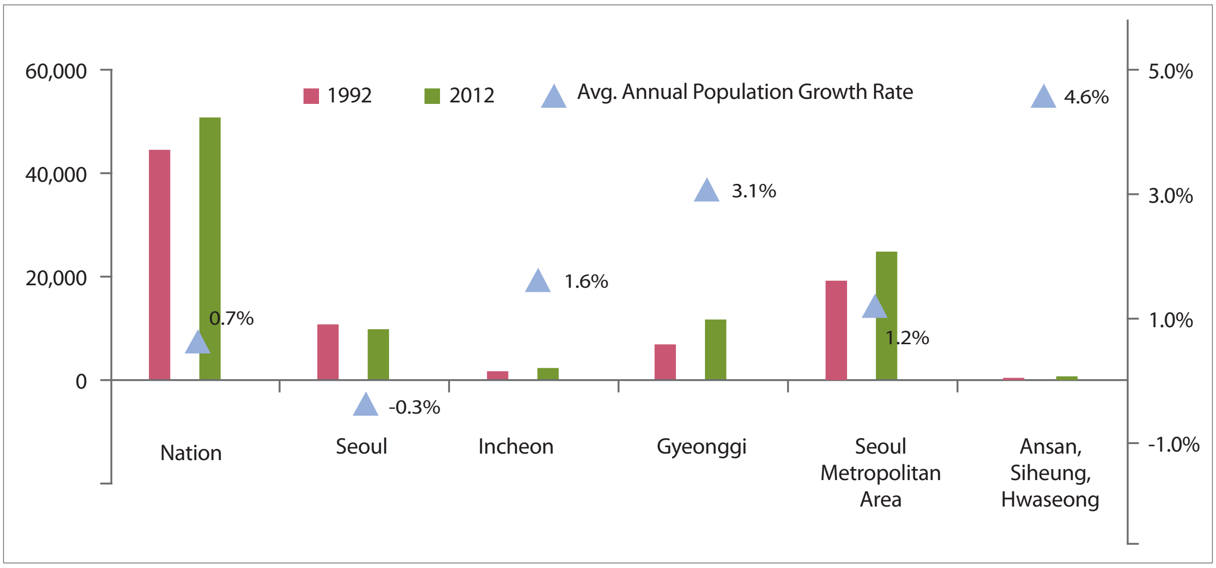
1-1-2. Population Movement and Urbanization

Today, Korea's population is 49.8 million (2011), and its population density is 513 people/km^2. In 1960, the population was 25.0 million, and the population density was 260 people/km^2. By 1975, it had risen to 357 people/km^2. At the time, the population density of Seoul was 10,987 people/km^2, 30 times the national average. In 1996, at the end of the first stage of Lake Sihwa's development, the national population and population density were 45.5 million people, and 461 people/km^2. From 1992 to 2012, Seoul's compound annual growth rate in population was -0.3%, that of the Seoul Metropolitan Region was 1.2%, Siheung, Ansan, and Hwaseong was 4.6% and that of the nation was 0.7%.

After the 1960s, Korea experienced rapid industrialization and urbanization. The distribution of population among urban and rural areas shows a reverse of what it was 50 years ago. In 1970, Korea's urban population as a percentage of total population was only 40.7%. In 1975, the distribution was fairly even, with the urban population at 48.0%. However, urbanization continued increasing the proportion of city-dwellers to 73.8% in 1990, 79.6% in 2000, 81.3% in 2005, and 83.2% in 2011, which exceeds the urban proportion of developed countries such as the United States (82.4%), United Kingdom (79.6%), and Germany (73.9%).

1-1-3. Effect of Economic Factors

The Sihwa District Development Project took place as part of Korea's national economic development plan. To lead economic growth, Korea sought to industrialize, with a focus on the heavy and chemical industries. The development of the Sihwa District came about in order to achieve this policy objective. As the economic importance of agriculture declined, the plan to enlarge agricultural land was adjusted. Specifically, in order to remove polluting factories from and ease the population



Source: Ministry of Security and Public Administration, Republic of Korea (MOSPA)

<Figure 6> Annual Population Growth Rates in Korea

<Table 6> Population Density in Korea, people/km²

	1975	1980	1985	1990	1995	2000	2005	2010	2011
Nation	357	386	413	434	457	476	497	509	513
Seoul	10,987	13,774	15,921	17,532	17,491	17,132	17,009	17,473	17,397

Source: Ministry of Security and Public Administration, Republic of Korea (MOSPA)

<Table 7> Urban Population as a Percentage of Total Population

	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011
Korea	40.7	48.0	56.7	64.9	73.8	78.2	79.6	81.3	82.9	83.2
Japan	71.9	75.7	76.2	76.7	77.3	78.0	78.6	86.0	90.5	91.3
USA	73.6	73.7	73.7	74.5	75.3	77.3	79.1	80.7	82.1	82.4
Germany	72.3	72.6	72.8	72.7	73.1	73.3	73.1	73.4	73.8	73.9
United Kingdom	77.1	77.7	78.5	78.4	78.1	78.4	78.7	79.0	79.5	79.6

Source: UN 「http://esa.un.org/unpd/wup, World Urbanization Prospects, the 2011 Revision」 2012.6

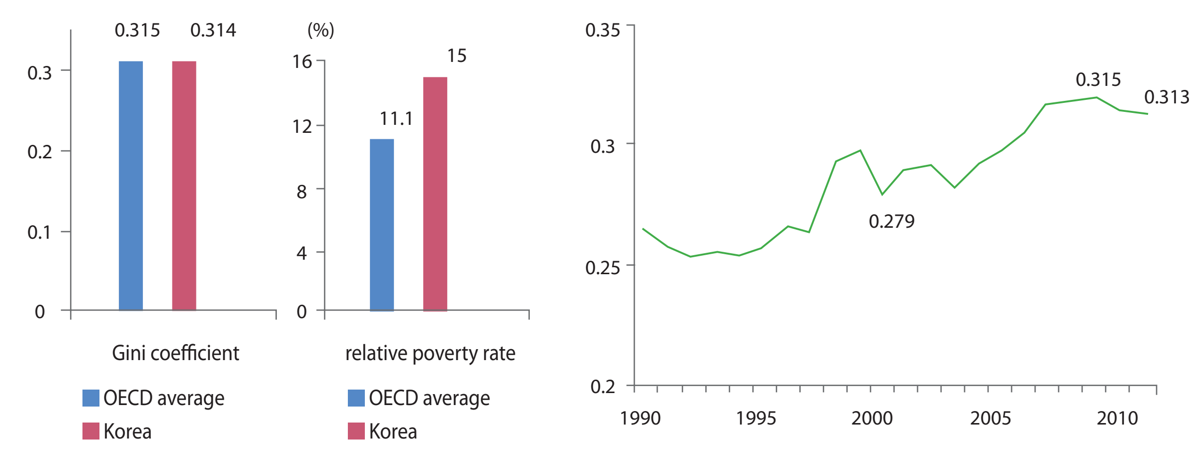
concentration in the Seoul area, the establishment of industrial sites and satellite towns in Sihwa District was set as a main goal.

1-2. Social Factors

1-2-1. Income Inequality

Korea's Gini index[6] in 2011 of 0.314 is near the OECD average. The rapid economic growth after 1960 continuously served to reduce imbalances among classes and to raise per capita income. However, following the Asian financial crisis of 1997, income inequality worsened. Based on the Gini coefficient, Korea's social and economic inequity does not appear that large. However, the concentration of economic power in the capital region, evident in its possessing 47.2% of GDP is a negative aspect of the unbalanced growth policy.

6) The Gini index, or coefficient, is a measure of income inequality from 0 to 1, where a low coefficient indicates even, equitable income distribution while a high coefficient indicates uneven, inequitable distribution.



Source: Figure on left, OECD (2013) ; Figure on right, Statistics Korea

<Figure 7> GINI Coefficient and Relative Poverty Rate

1-2-2. Education Level and Equality of Opportunity

In 1975, the percentage of those receiving a university or higher education was 7.7%, but the higher education enrollment rate climbed to 12.8% in 1980, 31.6% in 1985, 48.9% in 1995, and 103.1% in 2010 in gross terms. While the disparity in enrollment rates by gender was not high when total tertiary education enrollment was less than 10%, it became as high as 30% in 1998 when over 80% of men were enrolled in tertiary education. Even so, the female tertiary enrollment rate increased greatly from 4.3% in 1975 to 85.7% in 2010.

Women's labor participation rate rose from 42.8% in 1980 to 55.2% in 2012. The employment rate also saw a large increase, from 41.3% in 1980 to 53.5% in 2012. As the secondary education completion rate among women rose quickly from 6.5% in 1980 to 85.7% in 2010, employment opportunities for the highly educated also significantly rose. The number of female university graduates employed in 1980 rose from only approximately 129,000 to approximately 3.4 million in 2010.

<Table 8> Higher Education Enrollment Rate (%)

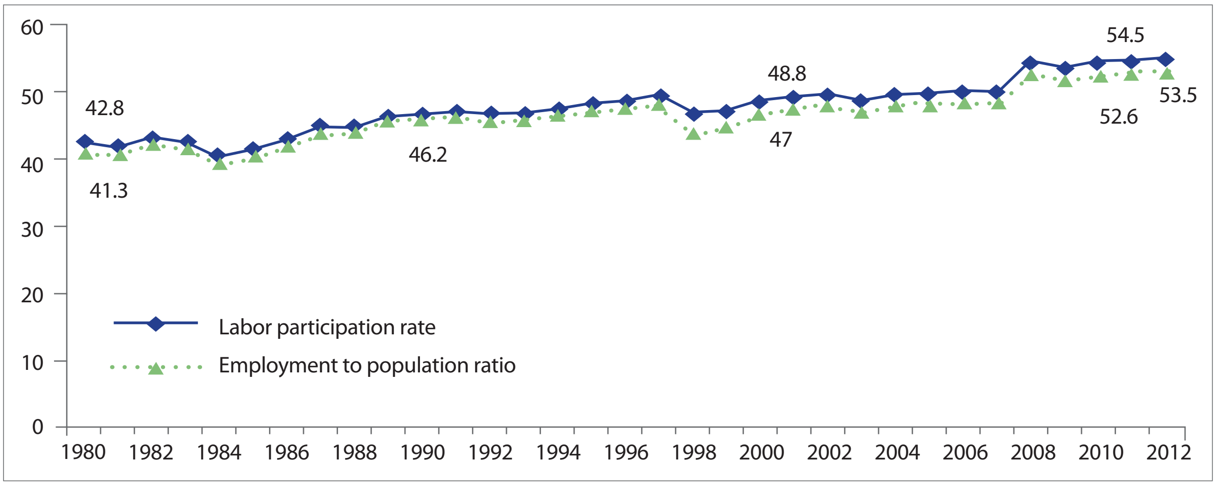
	1975	1980	1985	1990	1995	2000	2010
Total	7.7	12.8	31.6	36.8	48.9	78.8	103.1
Female	4.3	6.0	20.3	23.5	35.5	59.3	85.7
Male	11.0	19.3	42.1	49.3	61.4	96.5	118.8

Note: Gross enrollment ratio. Tertiary (ISCED 5 and 6). Total is the total enrollment in tertiary education (ISCED 5 and 6), regardless of age, expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.
Source: UNESCO

The proportion of female university graduates employed among the total employed population rose in the same period from 14.1% to 39.6%. However, the proportion of employed women having received a high school education or less remains higher than that of employed highly educated women. Among OECD countries, Korea's employment rate for highly educated women was the lowest in the OECD's 2012 statistics (OECD, 2012)

1-2-3. Effect of Social Factors

Romer (1986; 1990; 1994), Lucas (1988), Barro (1990), and other early endogenous growth theorists explain endogenous growth as arising from the mutual influencing of various growth factors amidst which increased investment in education leads to an increase in human capital, that in turn leads to technological progress and the accompanying rise in productivity contributing to economic growth. The high tertiary education completion rate, in which women are significantly represented, is a key element of Korea's



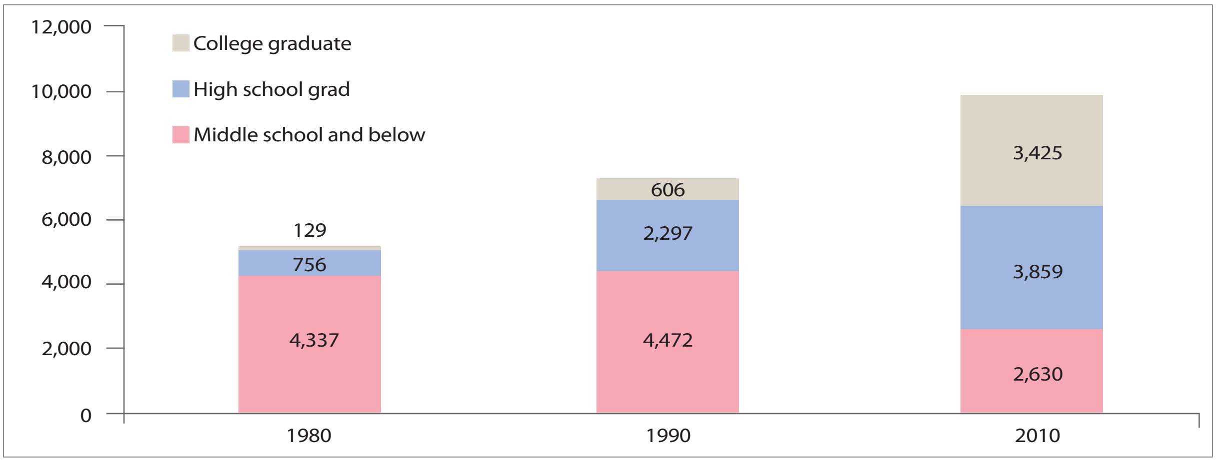
Source: Statistics Korea
Note: Labor participation rate: the ratio of those 15 or older who are employable (whether employed or unemployed) to the entire population

<Figure 8> Labor Participation Rate, Female (% of Female Population Ages 15+)

<Table 9> Labor Participation Rate, Female (% of Female Population Ages 15+)

	1980	1985	1990	1995	2000	2005	2010	2011	2012
Labor Participation Rate	42.8	41.9	47	48.4	48.8	50.1	54.5	54.9	55.2
Unemployment Rate	3.5	2.4	1.8	1.7	3.6	3.4	3.4	3.2	3.1
Employment Rate	41.3	40.9	46.2	47.6	47	48.4	52.6	53.1	53.5

Source: Statistics Korea



Source: Statistics Korea

<Figure 9> Number of Female Employees by Educational Level (Thousands)

rapid growth. Additionally, a high level of political participation and rapid growth in citizen activity were among the contributing elements. This kind of social asset base as regards to the Lake Sihwa Water Quality Restoration Project served as the foundation of the Sihwa District Sustainable Development Council, which mobilized participation of district residents and civil society in high-level decision-making. It is being noted how for most countries citizen participation rises as the education level rises, and much research has already been done on this phenomenon. Representative studies on this link between education and social capital include Bourdieu (1983), Coleman (1988; 1990), Putnam (1993), and Jung (2003).

1-3. Political Factors

1-3-1. Bureaucratic Integrity

In Transparency International's Corruption Perceptions Index (CPI),[7] Korea has scored roughly around 5 out of a best possible score of 10 since 1995. With a score of 5.6 in 2012, Korea ranked 45th among 176 countries, an improvement from 4.29 in 1995 (Table 10).

1.3.2. Political Stability

Korea's political stability, after ranking in the 62.99th percentile, subsequently fell and then reached a high of the 61.55th percentile; after which recently in 2011 ranked in the 55.19th percentile. From the 2000s, except 2004, 2005, and 2007, the political stability rank has stayed in the 50s. The big fall in percentile rank in 2009 can be attributed to the political instability associated with the outbreak of mad cow disease. Korea's politics has been dogged by decreasing stability. Through institutionalization, stability has been increased but is not adequate. The organization of the Korean government too has undergone changes about 60 times since its establishment. Changes have occurred almost every year. The law and institutions have also been easily changed with each new government. Changes that suit different times are needed, but political instability and the ambiguity in the scope of politics instead has been amplified.

1-3-3. The Effect of Political Factors

Korea's bureaucracy has tended to follow long-term career paths rather than short-term opportunism (Kim, 1990, p.102). Accordingly, Korea has maintained a lower level of corruption than other countries facing similar political, economic, and social circumstances. From the aspect of political stability, Korea experienced two military coups but has managed to maintain relatively high political stability.

This political stability and relative lack of corruption can be seen positively as having helped to solve the large-scale conflict over the Sihwa District Development Project. From the government side, the Ministries of Land, Infrastructure and Transport; Agriculture and Forestry; Maritime Affairs and Fisheries; and Environment satisfactorily solved the large conflict. Despite the sudden coming into force of the local autonomy system in 1997, the central and local governments rationally solved their differences. What is more, no corruption scandal has surfaced amid the government-civil society, organization-local, and resident-business relations. A high level of trust has been maintained, and decision-making based on mutual agreement is being respected.

<Table 10> Corruption Perceptions Index

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Score	4.29	5.02	4.29	4.2	3.8	4	4.2	4.5	4.3
Rank	27	27	34	43	50	48	42	40	50
No. of nations	41	54	52	85	99	101	91	102	133
	2004	2005	2006	2007	2008	2009	2010	2011	2012
Score	4.5	5	5.1	5.1	5.6	5.5	5.4	5.4	5.6
Rank	47	40	42	43	40	39	39	43	45
No. of nations	146	159	163	180	180	180	178	183	176

Source: Transparency International (http://www.transparency.org/)

7) Transparency International annually publishes the Corruption Perceptions Index, an index of the perceived degree of corruption among public officials and politicians in a given country. A score of 7 indicates that a society is generally free of corruption, while a score of 3 indicates that a society's leadership is on the whole corrupt.

<Table 11> Political Stability and Absence of Violence

	1996	1998	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Estimate	0.515	0.417	0.297	0.162	0.207	0.399	0.453	0.253	0.408	0.291	0.186	0.101	0.233
P-Rank	62.99	60.10	58.17	48.56	50.96	61.06	61.55	53.85	60.10	54.55	50.71	50.47	55.19

Source: Worldwide Governance Indicators, World Bank
Note: Estimate of governance (ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance) Percentile rank among all countries (ranges from 0 (lowest) to 100 (highest) rank).

1-4. Environmental Factors

1-4-1. Water Resources

According to the National Water Resources Plan by MLTM (2011), South Korea has an average annual precipitation of 1,277mm, which is 1.6 times more than the world's average of 807mm. In per capita terms, however, Korea's yearly rainfall (2,629m^3) amounts to only one sixth of the world's (16,427m^3). Mountains occupy 65.3% of the land and topsoil is shallow meaning that water flows rapidly off the land and into the sea without being absorbed or retained during the rainy season. Therefore, the coefficient of river discharge variation[8] of Korea's rivers is between 90 and 270, much higher than that of major rivers in other countries[9] (MLTM, 2011, pp.7-10). The concentration of population in large urban areas, such as the Seoul Metropolitan Area, and regional differences in precipitation lead to high regional variations in renewable freshwater resources per person per year.

1-4-2. Water-related Disasters

Water-related disasters occur most often during the roughly 30-day *changma* rainy season, during which more than half of annual precipitation is concentrated. Between June and October, two or three typhoons, out of about 28 generated annually in the Northwest Pacific, brings heavy rains and floods to the Korean Peninsula (Korea Meteorological Administration, 2007). In fact, damages from typhoons in the 10 years from 2002 to 2011 amounted to 13.8 trillion won, while those from heavy rains amounted to 5.6 trillion won, together making up 91.6% of water-related damages for those years (MOLIT and K-water 2013, p.69).

1-4-3. Change in River Water Quality

In terms of biochemical oxygen demand (BOD),[10] the water pollution of the Han River at Noryangjin reached a peak of 8.3ppm in 1978 which comes under the Grade 4 of river water quality (Koo, 1996, p.77). That is, the water quality in 1978 was inadequate for drinking, though it could be used as industrial water resources. Figure 10 shows that the water quality of the four largest rivers in Korea has improved and kept between a BOD of 3 and 5 ppm since the second half of the 1980s. These correspond to Grades 2 and 3 of river water quality.

Korea's main rivers' pollution problems included a heavy metal contamination of potable water in 1989, the so-called trihalomethane (THM) contamination event in drinking water in 1990, and others which led to serious accidents. The phenol pollution disaster in the Nakdong River in 1991[11] provided special

8) The ratio of maximum discharge to minimum discharge.

9) For instance, the Nile River in Egypt has a coefficient of 30, the Rhine in Germany 18, and the Mississippi in the U.S. 3 (MLTM, 2011, p.10)

10) BOD indicates how fast biological organisms consume oxygen in water. A low BOD is an indicator of good quality water, while a high biochemical oxygen demand indicates polluted water.

11) Tapwater that had been contaminated with phenols and not properly treated was supplied to Daegu residents for five days. Many residents reported suffering from diarrhoea and vomiting, and many pregnant women expressed concerns about their conceived child. President Roh Tae-woo censured the polluting company, Doosan Electro-Materials Co., Ltd as having committed "an unforgivable crime" (Lee, 1991, p.1)

impetus to the environmental movement, facilitating the introduction of Water Use Levy, the designation of Counter Measure Areas, and other environmental policies.

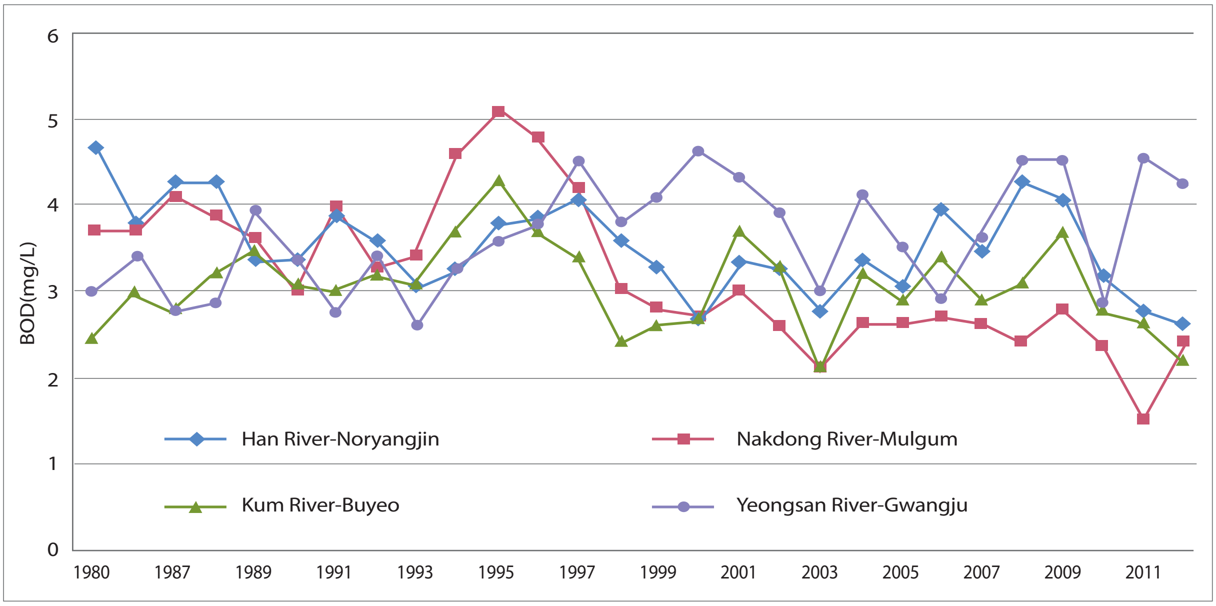
1-4-4. Impact of Environmental Factors

Among environmental causes, the degradation of Korea's water environment and the rise in society's interest are seen to have had the biggest effect. The mid-1990s, which saw Lake Sihwa's pollution become a major issue, followed upon the heels of major water-related environmental problems from the late 1980s such as the pollution of the four major rivers. Moreover, it was the time when the Department of Environment was promoted to ministry status. The Ministry of Erivironment(MOE) received the responsibilities of managing water and sewerage, as well as potable water quality, and led the interagency four major rivers water quality restoration measures. The Lake Sihwa water quality degradation problem naturally became a representative environmental disaster and easily became a national issue. As a result, the conditions were in place for diverse and extraordinary measures for the lake's restoration.

Alongside this, owing to Korea's high population density, in spite of the relatively large volume of annual precipitation (1,227mm/year), per person water resources is limited. In addition, the incidence of two thirds of annual rainfall in the summer repeatedly causes floods in the summer and droughts in the spring. In light of this, securing water resources and preventing and preparing for floods for increased food security and economic development were key items on the national policy agenda. The reason that Lake Sihwa was first planned as a freshwater lake was to secure the water resources necessary to irrigate the vast area planned for agricultural development. As explained above, however, due to the environmental problem that arose and became an issue, the lake became a saltwater lake.

1-5. Technical Factors

In 2011, Korea's research and development (R&D) expenditure as a share of GDP, at 4.03%, was second in the world after that of Israel (Table 12). Compared to 2000, the amount spent more than tripled from 138.5 billion won to 498.9 billion won, and its share of GDP also rose appreciably from 2.3% to 4.03% (Figure 11).



Source: Ministry of Environment, Republic of Korea

<Figure 10> Water Quality of the Four Largest Rivers in Korea

In terms of absolute numbers, Korea's number of triadic patent families[12] is in the world's top tier. In 2010, Korea ranked fifth in the number of triadic patent families (2,182), after Japan (15,067), the USA (13,837), Germany (5,685), and France (2,447). Since 2005, Korea has maintained fifth place. Korea's average annual rate of increase in the number of triadic patent families from 2002 to 2010 was 7.6%, second among the major countries after China (24.2%).

Korea's comparatively high level of technology made a scientific approach to solving the Lake Sihwa problem possible. In the first place, it formed the base of communication founded on scientific evidence and literature. That is, it had a large effect on the search for diverse solutions including water quality monitoring, the setting of water quality goals, oxidation ponds, constructed wetlands, and intercepting sewers and their effective implementation. In particular, considering the technical difficulty and electricity generating effect of the large-scale civil engineering feat of installing the world's largest tidal power plant (254MW) in an existing seawall, the applicability of Korea's advanced technology is evident.

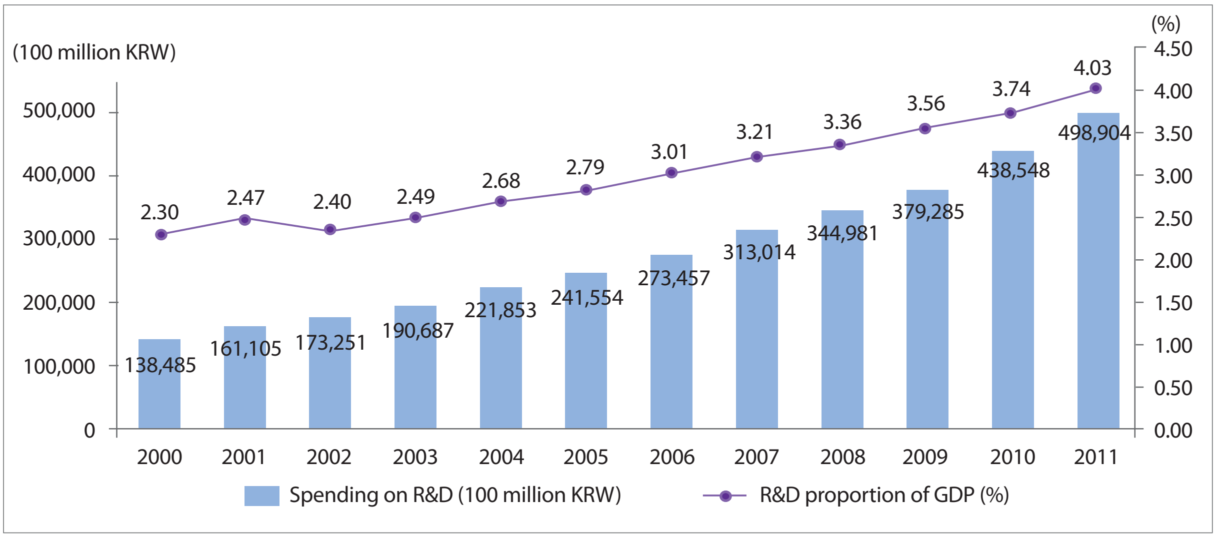
1-6. Concluding Remarks

The economic, social, political, environmental, and technological contexts influence the formation, change, and performance of institutions, and likewise

<Table 12> Comparison of R&D Spending among Selected Countries

Index	Measure	Korea(2011)	USA(2009)	Japan(2010)	Britain(2010)	China(2010)
R&D	0.1 billion US $	450.2	4,015.8	1,788.2	398.6	1,043.2
times(Korea =1)	times	1.0	8.9	4.0	0.9	2.3
Pct. of GDP	%	4.03	2.90	3.26	1.76	1.77

Source: National Science and Technology Commission·KISTEP, Report on the survey of R&D in Science and Technology 2011, Republic of Korea

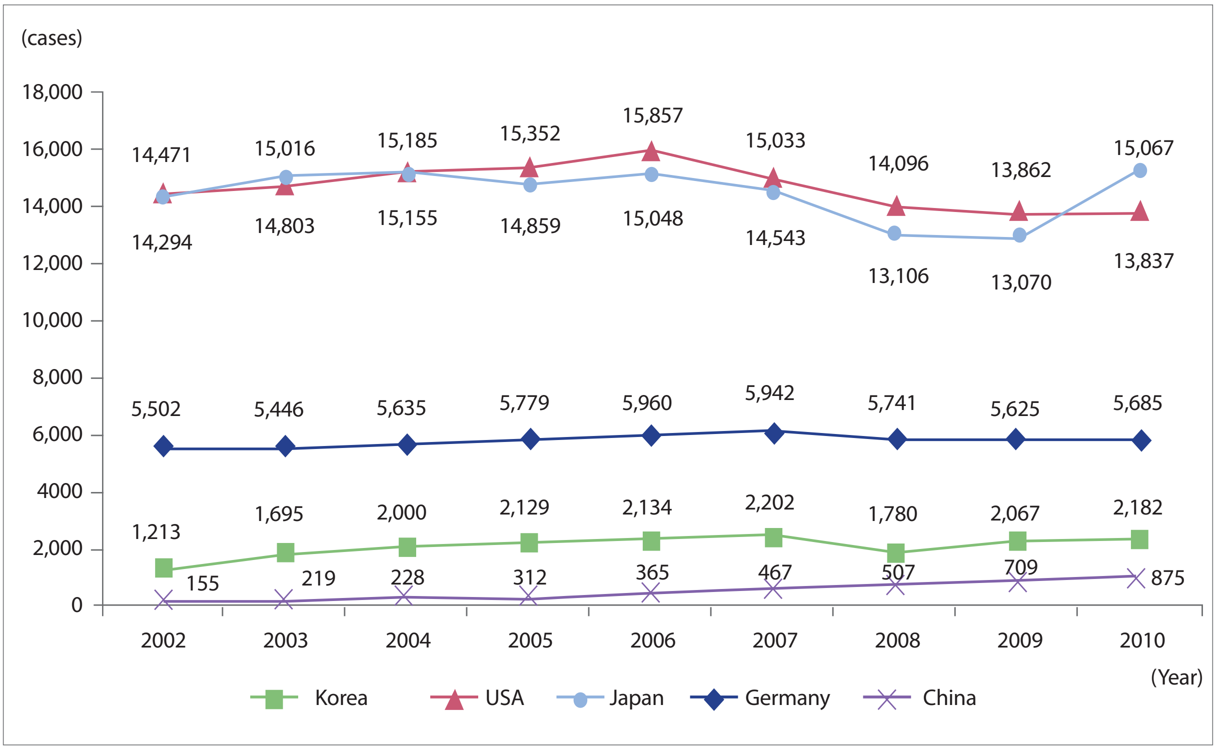


Source: National Science & Technology Commission · KISTEP, Report on the survey of R&D in Science and Technology 2011, Republic of Korea

<Figure 11> Korea's R&D Expenditure

12) Triadic Patent Families is defined as the number of patents applied for at the European Patent Office (EPO) and the Japan Patent Office and registered at the US Patents and Trademarks Office (USPTO) in order to protect identical inventions across OECD countries.

it influences the choice of policies taken and their performance. This logic is apparent in the Lake Sihwa case. The drive toward heavy and chemical industries and the food security policy of the 1970s served as the background of the Lake Sihwa Development Project. In the economy-centered first half of the project, institutional means led by the central government guided the project. Economic development plans, national territorial plans, and industrial site development plans were drawn by the central government; and through the controlling of interagency interests, policies were adopted and implemented. After 1994, Lake Sihwa's water quality problem became a society-wide issue. As environmental problems became major issues of interest in the first half of the decade, the Lake Sihwa development project underwent significant change. Namely, the development-focused project transitioned into a project aiming at development and environment balance. Through this course, during which the environmental movement gained momentum, environmental organizations became core actors in decision making. From the implementation of the local autonomy system in 1997, local governments changed from implementers of orders from the central government to entities reflecting the interests of the region. Ultimately, this social, environmental, and political change greatly affected the formation and development of the joint decision making organization, the Sihwa District Sustainable Development Council. In the development of this participatory governance scheme, Korea's high tertiary education completion rate likely helped to raise the possibility of communication and to easily encourage the participation of lay persons. Granted this development, the central government still held substantial influence and leadership. This can be attributed to the relative lack of corruption in the bureaucracy and the stable political environment. Furthermore, Korea's high level of technology played a positive role in the selection and performance of alternatives for Lake Sihwa's water quality restoration.



Source: OECD, Main Science & Technology Indicators 2012/1

Note: Triadic Patent Families: This is defined as the number of patents applied for at the European Patent Office (EPO) and the Japan Patent Office and registered at the US Patents and Trademarks Office (USPTO) in order to protect identical inventions across OECD countries.

<Figure 12> Triadic Patents in 2002-2010, by Nation

2. Water Governance and Institutions

The preceding section overviewed the influence of exogenous factors on the institutional causes and performance of the Lake Sihwa Development Project. This section examines the direct and indirect influences that institutional factors have on the project. These institutional factors can be divided into legal, administrative, and policy elements (Saleth and Dinar, 2004). In this section, the influence of these institutional factors on state-driven, market-oriented, and community-centered projects' planning, execution, and results is explored. For this purpose, legal, administrative, and policy factors are recategorized and analyzed as government, market, and community-centered factors. Particularly, in order to investigate, among the institutional factors, the effect of policies with greater mutability and elasticity, the section is divided into sub-sections.

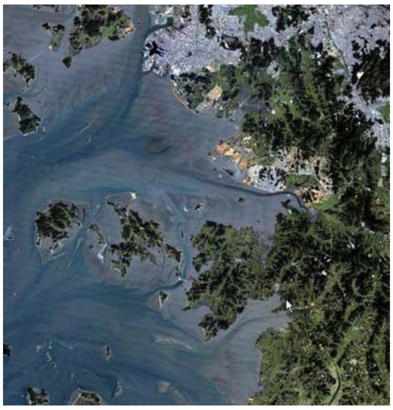
2-1. State-driven Institutions

Since the full-fledged start of the Lake Sihwa development project in 1985 until the rise of the lake's pollution as a national issue in 1996, and from the shift to an eco-friendly development policy path to the Lake Sihwa of today, the government played a central role as both originator and decider of key policies.

In the background was Korea's economic growth-centered policy. In order to achieve this rapid economic growth, comprehensive plans at national level were drafted by central government ministries. The confirmation of those plans was concluded by a body directly under the President.

Once the Lake Sihwa water quality problem became a societal issue in 1996, the President ordered an audit by

1977



1988

1994

2001

2005

2012

Source: Lake Shihwa Management Committee

<Picture 3> The Coastal Change of Lake Sihwa

the Board of Audit and Inspection. The comprehensive water quality restoration measures undertaken by MOE came about with the President's order. This strong central government leadership had a positive effect on the implementation of the comprehensive plan. Admittedly, with the central government keeping information on Lake Sihwa's situation to itself, there was a limit to reflecting the different interests of local governments and civil society. The Sihwa District development project case amply illustrates how such limitation was overcome through the formation of the Sihwa District Sustainable Development Council, which allowed the central government to retain a leadership role while allowing a high level of participation by the local community.

2-1-1. Laws and Administration

Balance between Government Layers (Structure and Power)

Until the economic growth-focused era of the 1980s, the central government led land use and development planning and the establishment of major national policies and plans and their implementation. In the case of the Sihwa District development plan, the Ministry of Agriculture and Forestry and the Ministry of Construction had the lead roles. At times they conflicted over the use of the land, but in conflicts among agencies of the central government, disagreements were settled through consultation or through the mediation by a higher government body such as the Economic Planning Board (EPB). Until the mid-1990s, the local government had little influence regarding the Sihwa District development project. In 1988, the local autonomy system was revived, and in 1991, the first local elections were held through local assembly. However, the assembly was only half a local assembly as there was no election for the local assembly chief; the reason for which was that the assembly relied on central government funds and authority. In addition, the local governments viewed the Sihwa District Development Project and the central government's leadership role favorably, as they saw that the project could positively stimulate the local industry. Thus, they took a hands-off stance toward the central governments actions, and the interests of central and local governments did not collide.

In the period after the completion of the Sihwa Seawall in 1994 and during the efforts to restore water quality, MOAF, MOCT, MOE, MOMAF, the Ministry of Culture and Sports (MOCS; present Ministry of Culture, Sports and Tourism, or MCST) and related agencies took part in policy making and implementation, diversifying the actors. On March 4 1994, the local autonomy law provisioning the inclusion of local assembly chief elections in the so-called four major local elections and allowing the elections from 1995, passed the National Assembly. This was announced on March 16. Following on June 27, 1995, the four major local elections took place, ushering in elected heads of local government and members of the 2nd local assembly. With this establishment of the local autonomy system, the status of local governments was elevated.

Thereafter, in the meeting for water quality restoration following the President's order in 1996 (in which MOE established water quality restoration measures), MOCT, MOAF, the Korea Water Resources Corporation, the Rural Development Corporation (present Korea Rural Community Corporation, or KRC), and local governments of the cities of Siheung, Ansan, and Hwaseong took part. Moreover, in 2001 for better operation of the Lake Sihwa Water Quality Restoration Measures, the interagency Lake Shihwa Management Committee was formed. It composed of the Vice-Minister of MOMAF as the committee's chairman, seven other representatives from the central government, six from local governments, three from K-water and related organizations, and four from civil society organizations for a total membership of 21. This close to half represented the central government, with the other half representing the locality. In this way the local governments attracted interest and gained capability, and lodging local level problems. Through efforts to raise local quality of life and strengthened by the administrative decentralization, they, in suggesting the direction of development with regard to Lake Sihwa, intended to reflect the interest of the region in central government policies. However, the central government was still in charge of formal policy decision-making while the local governments were merely participating in that process. They emphasized the need for a larger budget in the implementation of the water quality improvement measures and their status as victims from the water pollution. However, they clould only suggested basic measures.

After it was settled in December 2000 to accept Lake Sihwa a saltwater lake, the opinions of the local residents were collected, and a local bond formed. These efforts were made to minimize frictions with the residents. The influence of the local governments had grown to the point that the Korea Water Resources Corporation and KARICO would have to make requests to them unlike before. However, there was no consensus among local governments with regard to the direction of Lake Sihwa's development, with each having its own view.

Between 2000 and 2003, the Sihwa Organizations Policy Council existed as a formal consultation body, but it failed to play an effective role. With popular opposition to the Sihwa District Long-Term Comprehensive Plan developed around this time, MOCT in 2003 proposed to civil society organizations that all stakeholders participate together in a council. In 2004, the formal body for consultation between the government and residents called the Sihwa District Sustainable Development Council was formed. Since the formation of the council, all major policies related to Lake Sihwa have gone through the council. This council is not just for water quality improvement but has been a policy making and revising body with respect to development planning as well. While the execution of policies was done by MOCT and other parts of the central government, discussion on pending issues took place in the consultative group of the council. Moreover, the decision making system within the council was not one of majority rule but of consensus so that the views of local governments could be maximally reflected and a balanced consultation could be drawn.

Spatial Organization of Water Administration

Lake Sihwa does not fall under Korea's general water management system. While Korea's water management is based on river basins, Lake Sihwa is managed as a seawater lake. Korea's water management is generally led by the central government. However, within water quantity management, water for domestic use and industrial use and flood prevention falls under the purview of MOLIT, and water for agricultural use is managed by MAFRA. The water quality of rivers is MOE's jurisdiction. The management of Korea's rivers is divided into national rivers and local rivers, and the management of local rivers is the jurisdiction of local governments. Basin management is phased in parts. MOE manages the basins of the Han, Nakdong, Geum, and Yeongsan-Seomjin Rivers through a water system management committee for each of these four major rivers. These committees draft water quality improvement plans and decide on the use of water system funds. Related departments and ministries, local governments, civil society organizations, businesses, and experts participate in these committees. However, their water quality management function is limited, and the participation of local governments and other stakeholders is mere tokenism.

In the case of Lake Sihwa's management, there is a more progressive governance and decision making system. The execution of policies does take place at the central government level, but discussion on local water management issues goes through the Sihwa District Sustainable Development Council and thereby allows the inclusion of local perspectives.

Balance in Functional Specialization

In 1975, after the adoption of the West and South Sea Coastal Land Reclamation and Development Plan by the Agricultural Development Corporation (present KRC) until the completion of the Sihwa Seawall, all policies related to the lake were established by the central government. The uses of Lake Sihwa and the reclaimable land was a point of disagreement between MOAF and MOC. The cause was that while MOAF went ahead with its agricultural reclamation for food production plans, MOC and the Industrial Sites and Water Resources Development Corporation (present K-water) requested the land to build factories and residential zones. In order to minimize their differences, they convened 9 meetings from the end of 1984 to September 1986 along with related organizations (MOC, MOAF, the Industrial Sites and Water Resources Development Corporation, the Agricultural Development Corporation, and the Korea Research Institute for Human Settlements (KRIHS)), but all ended in vain (Korean Association for Public Administration, 2007, p.61). However, when the EPB, which had been promoting national investments in heavy and chemical industries, judged that it was more appropriate to dedicate a large portion of the Sihwa District for industrial use over agricultural use. As a consequence, the construction of industrial and urban sites and counter facilities fell to the jurisdiction of the Industrial Sites and Water Resources Development Corporation, while developing agricultural land and matters related to the freshwater lake were settled to be taken over by the then Ministry of Agriculture, Forestry, and Fisheries (MAFF; present MAFRA) after it had received license to reclaim the land. It was decided that water for agriculture would be supplied by turning Lake Sihwa into a freshwater lake. In March 1987, the Industrial Sites and Water Resources Development Corporation signed a contract with Hyundai Engineering and Construction to build the seawall, and the construction completed in 1994.

Following the construction of the Sihwa Seawall and before the rapid, acute water quality degradation became a national issue, MAFF and MOCT were direct stakeholders. The Korea Water Resources Corporation was in charge of overseeing the creation of the industrial land.

The role of MOE gained importance after the lake’s pollution in 1996. As the release of the lake water into the sea was decided, MOMAF was granted the lead role. Moreover, with the discovery of the dinosaur egg fossil in the reclaimed area, the Ministry of Culture and Tourism (MCT; present MCST) also took an interest in the project. As part of the measures to address the water pollution, the Environmental Offense Prevention Council was launched, raising the authority of MOE. However, the responsibility and implementation was with MOCT and the Korea Water Resources Corporation.

During the first half the 2000s, around the time of the conversion of Lake Sihwa into a saltwater lake, a power shift occurred among government ministries. While MOCT had led the project until that time, the status of MOE and MOMAF was elevated. In "the environment over development" mood of the time, MOE had a greater voice. With the conversion of Lake Sihwa into a saltwater lake, MOMAF took the lead over the lake’s management. Thus, a government-wide, comprehensive and systemic direction in management was made.

After the formation of the Sihwa District Sustainable Development Council in 2004, Lake Sihwa is being managed through a socially inclusive and democratic process where issues related to the Sihwa District are consulted on by the stakeholders before being decided.

2-1-2. State-driven Policies

Well-Organized Hierarchical Plans (National, Regional, Local, and Project Levels)

Korea's development occurred under the seven Five-Year Economic (and Social) Development Plans that began in 1962 and ended in 1997. The second Five-Year Plan (1967-71) aimed to build self-sufficiency in food production and industrialize the nation, and the third Five-Year Plan (1972-76) sought to develop the heavy and chemical industries. Under these national objectives, the Agricultural Development Corporation in 1975 established the West and South Sea Coastal Reclamation Development Plan and from 1982 to 1984 undertook a basic survey. In 1985, the corporation, through MOAF, applied for license from MOCT to fill and reclaim land in public waters. During the same period, in 1984, MOCT reported its Territorial Enlargement Project Launch Plan to the President. In response, the EPB confirmed the Sihwa District Development Priority Launch Plan. Following this plan, a survey for the appropriateness of developing Sihwa District land was undertaken and the establishment of a master plan was assigned. After consultations among ministries was finisned, the Sihwa District Development Master Plan was announced in 1986.

When the completion of the Sihwa Seawall in 1994 led to the lake's water quality degradation and made the problem a societal issue, the government systemically introduced water quality improvement measures. In 1996, under the lead of MOE, related agencies, the Korea Water Resources Corporation, the Agricultural Development Corporation, and local level stakeholders, began efforts to tackle the problem under the Lake Sihwa Water Quality Improvement Measures. In 2001, Stage 1 of the Lake Shihwa Comprehensive Management Plan was implemented, in 2008, Stage 2, and since 2012, Stage 3 of the plan is being implemented. To establish the plan and follow through with it, for example in deliberating and regulating, the Lake Shihwa Management Committee was formed. This committee is composed of government, local authorities, and related organizations. Therefore, it has the character of a mixed public-private organization. Lake Sihwa's water quality improvement is being carried out with the Comprehensive Management Plan as its base; but in the first half, it suffered from the challenges of determining financial and managerial responsibility. Currently, the plan is being implemented with more stability with the roles of each ministry, department, organization, and local government set and the financial burden distributed.

Financial Support for the Project(Subsidies & ODA)

For the water quality improvement, K-water, KRC, MOLIT, MOE, and local governments in the Lake Sihwa region are bearing the costs according to the scope of their responsibility. In addition, the government is not providing K-water or KRC with special subsidies related to the project. Even for local governments, besides the environmental subsidies generally provided, there are no special subsidies related to the project. Finally, as part of the measures for improving water quality, to induce reductions in wastewater discharge, no subsidies making up for part of the cost incurred by firms in the industrial zones are provided.

Taxes and Levies

In the Lake Sihwa Water Quality Improvement Project, there are neither additional taxes or levies nor extra charges nor tax reduction benefits. However, for firms that exceed their wastewater discharge quota, the pollution quota excess tax introduced in 2007 is charged according to the Water Quality and Ecosystem Conservation Act Chapter 4 Article 7.

At the national level, buildings and facilities that discharge pollutants are charged a water quality tax (the Charges for Release of Pollutants in Excess of Total Quantity) since 1992. This is one of the environmental improvement taxes, according to the polluter pays principle. This charge is paid to the Environment Improvement Special Account. This then supports the water quality improvement project and the development of environmental technologies that are a part of the Environmental Improvement Plan.

Regulations

Until the 1980s, there were few sources of pollution and no need for special regulations to prevent water quality deterioration (as it was before Sihwa District was developed,). When factories and residential areas were built in the area with the lack of enough wastewater treatment plants, the wastewater was dumped into and polluted Lake Sihwa. The deterioration of the water quality occured until measures for water quality improvement were implemented, and guidance and monitoring were in place. However, regulations were weak. In fact, up until the first half of the 1990s when major water quality incidents occurred in Nakdong River and the other major rivers, water quality regulation systems were concentrated in the four major river basins. Even with the issue of Lake Sihwa's water quality in 1996, environmental regulations still were not strictly applied. The Water Quality and Ecosystem Conservation Act Chapter 4 Article 6 instituted later, in 2007, was applied to the area surrounding Lake Sihwa among other regions. Accordingly, firms that exceeded their pollution and discharge quotas could be forced to halt operations, have their facilities closed, or be subject to fines.

In July 2010, the Lake Shihwa Management Committee introduced the Total Pollutant Load Management System to bring about improvement in the lake's environment. This was a response to changes in environmental conditions arising from the circulation of seawater in the lake as a result of the regions development pressure and the installation of the tidal power plant. This system recognized that the building and operation of basic environmental facilities and the circulation of seawater could bring about partial results. More importantly, it was introduced under the understanding that systemic management of environmental problems such as land-based pollution sources had to be managed in the long term. The target area covers the sea and basin areas, that directly affect Lake Sihwa's interior including Ansan, Siheung, and nearby towns and cities. From July 1, 2013 until December 31, 2017, the total amount of each type of pollutant that can flow into the Lake Sihwa Administrative Zone is being set and the pollutant discharge loads are being managed within the discharge quota limits.

Since the establishment of the Sihwa District Sustainable Development Council, efforts are being made to prevent future environmental accidents. This is a remarkable progress as such prevention efforts are made whenever new projects begin, rather than implementing regulations after an accident has occurred. From the beginning, environmentally friendly development plans are being made. For example, in the Sihwa MTV project, all the members of a civil society organization-including public-private membership consulted together and participated in the development plan to establish a plan preventing causes of water quality pollution before they arise.

2-2. Market-oriented Institutions

The Sihwa District Development Project, with the development of land for agriculture, industry, and satellite cities as its purpose, basically has an economic goal. The development method involves K-water or KRC, developing and then parceling or managing the land. As a result, commercialization is at its base despite its public sector nature. As the executor of the project, K-water has a profit-cost structure to make up the costs of developing the land and improving the quality of Lake Sihwa by selling the land and operating the tidal power plant. This sub-section looks into the market-oriented institutions relating to the Sihwa District Development Project

2-2-1. Market-oriented Laws and Administration

Property Rights and Surface Water Rights

From the perspective of property rights, the Sihwa District Development Project is clear. The Sihwa Seawall formed a massive area of reclaimed land and Lake Sihwa. This reclaimed land and Lake Sihwa use rights go to the investors of the seawall in proportion to their investments. K-water, the undertaker of the Sihwa District Development Project, parcels out the reclaimed land based on these rights and is selling the electricity generated by the tidal power plant. In this way, it is recovering the invested costs.

From the perspective of water rights, the Sihwa District Development Project is complicated. MOAF planned to supply the annually occurring 18 million tons of freshwater resulting from the construction of the seawall, as irrigation water for a massive scale mechanized farming zone (Korea Water Resources Corporation, 2005, p.64). However, upon the rapid deterioration of water quality following the completion of the seawall in 1994, water was circulated in from the sea and lake water was allowed to circulate out to improve the water quality in the lake. In 2001, plans for a freshwater Lake Sihwa were abandoned and the lake was maintained as a saltwater lake. Consequently, supplying water for agriculture became a challenge. The need to institute water rights in Lake Sihwa disappeared, as obviously did any potential water right holder.

Nevertheless, K-water (in 2011) installed the Sihwa Tidal Power Plant in the seawall, to take advantage of the difference in tides circulating between the lake and the sea and to earn revenue from generating electricity from the tidal plant. In operating the tidal plant, K-water is paying the Incheon Regional Maritime Affairs and Port Administration as an occupied area fee and a seawater use fee. This is based on the amount of electricity generated in exchange for license to use the public waters, in accordance with the Permission of Reclamation and Occupation of the Common Surface of Water.

Scope of Private Participation in the Water Sector

In the management of Korea's water resources and the provision of water and sanitation services, there is no law restricting the private sector participation. In fact, in sewerage services, private participation is active with 69.6% (MOE, 2012) of terminal sewage disposal plants being private operations. BTL operations in sewage pipes and BTO operations in wastewater disposal plants is becoming more active for the private sector. On the other hand, private participation has been excluded from water services due to opposition by local governments, labor, and civil society organizations.

The Sihwa District Development Project does not resemble general water resources management. Rather, this project, through the construction of the seawall, is closer to a land development project. Applicable laws and regulations include, rather than the River Act or the law relating to multi-purpose dams, the Industrial Sites and Development Act. For land development projects, private participation is encouraged, drawing large companies that seek to satisfy their demand for land building seawalls and reclaiming land. Hyundai Engineering and Construction, in the 1980s, constructed the seawalls of Lake Ganweol and Lake Bunam near Seosan and created the Seosan reclaimed area. The Seosan reclaimed land (the first large-scale private sector reclamation project) was 104 million m^2 and first used for farming and raising livestock. However, in 2006 part of the land was designated and approved for the building of a commercial area, which is in progress until today (K-water, 2012). Of course, much of other reclaimed lands also are being used for developing commercial and residential districts.

In the case of the Sihwa District Development Project, the central government and the public sector became the lead actors through the government's Five-Year Plan and the territorial plan. As such, the public corporations, K-water and KRC, led the project's implementation. In order to recuperate investment in the project, the land is being sold in parcels and commercialized. The Industrial Sites and Development Act also stipulates that the project have commercialization as its base. To speed up the completion of the project, compensation for land and special status with regard to authorization and licensing are given to those undertaking the project.

2-2-2. Market-oriented

Cost Recovery

The costs involved in the Sihwa District Development Project, which includes the improvement of Lake Sihwa's water quality, are structured to be covered 100% through the parceling and selling of the reclaimed land and operation of the Sihwa Tidal Power Plant. Even so, a part of the costs shouldered by the local and central governments are met through tax sources. The costs of building wastewater treatment facilities that local governments are responsible for, are recovered through sewerage fees. River management costs, however, cannot be recovered through fees.

The entire cost of constructing the Sihwa Seawall (623.0 billion won) was covered by K-water. Afterwards, K-water began to recover costs through site development and through payments from local governments and organizations receiving benefits from the seawall's construction. It recovered 96.7%, or 602.5 billion won, of the costs by transferring them to sales of land in the Sihwa MTV, Songsan Green City, and other project areas (Korea Industrial Development, 2001, p.212). The remaining 20.5 billion won was paid to K-water proportionally by Ansan, the Ministry of Justice, the Road Traffic Authority (KoROAD), the Korea Electric Power Corporation (KEPCO), and KRC according to the benefits they received from the seawall's construction (Korea Industrial Development, 2001, p.212).

The Lake Sihwa Water Quality Improvement Project from Stage 1 to Stage 2 of the Shihwa Comprehensive Management Plan (April 1996-December 2011) cost a total of 1.349 trillion won including the cost of building the tidal power plant (Lake Shihwa Management Committee, 2012, p.28). Stage 3 of the plan (October 2012-December 2016) is expected to cost 652.5 billion won (Lake Shihwa Management Committee, 2012, p.28). The cost of improving Lake Sihwa's water quality is being covered by the MOLIT, ME, K-water, KRC, the cities of Ansan, Siheung, Hwaseong, and Gunpo, and Gyeonggi Province. Among the costs, installing wastewater treatment plants, maintaining sewage pipes, and building basic environmental facilities take up a large share. K-water's share of the investments for Stages 1 and 2 of the comprehensive plan was 715.7 billion won, among which 646.6 billion was spent. However, the costs of construction and operation of the tidal power plant is being recovered through profits from power generation.[13)] The remainder has mostly been recovered through land sales in the development project areas as explained below. In January 2001, MOCT requested changes in the method of procuring funds for the water quality improvement measures to K-water and MOE. Subsequently, the investment funds of the water quality improvement measures were taken care of through land sales in the Sihwa Stage 1 site enlargement project. That is, because according to the Restitution of Development Gains Act, environmental improvement costs are stipulated to be reflected in the original project costs. The costs of improving the environment are being reflected accordingly. The unrecovered cost amounts

13) K-water. 2012. Status and Progress of the Lake Sihwa Comprehensive Management Plan. K-water Internal Document.

to 92 billion won, and the reason is that the area whose environment was improved using these funds was not a newly constructed industrial site but an existing one in a nearby area. Thus, the expenses could not be transferred to the land sales in the site enlargement project, as a review by the government considered that to violate the polluter pays principle. Stage 3 of the Lake Shihwa Comprehensive Management Plan, which began in 2012, is also planned to have its initial investment funds recovered through land sales at original project cost. The water improvement costs invested by the local governments and MOLIT, do not have a dedicated recovery plan as they are being met by taxes.

Private Sector Promotion Policy

There was no particular private sector promotion policy in the Sihwa District Development Project. On the contrary, the project incurred massive water quality improvement costs during its course. Splitting these costs appropriately among the project undertakers required public management.

In the first half of the 1980s—the early period of the project—however, there was an industrial need to support the private construction sector. This was because Korean construction companies were withdrawing from large civil engineering projects in the Middle East. To solve this sectoral and economic problem, the EPB and other economic agencies made efforts to start the Sihwa District Development Project early.

Project Selection Criteria

While the Sihwa District Development Project began and progressed based on the central government's plan, it appropriately recovered part of the investments. The project executor, through an internal control process, evaluates projects from economic and financial angles and decides whether or not to invest. K-water decides on investments through its internal decision-making tools of an investment screening committee, business strategy committee, and the Board of Directors. In this process, it analyzes future economic conditions, the possibility of parceling, and expected rate of return. Then, it decides the timing and method of its investment. In the case of the Sihwa District Development Project when the lake water quality issue arose, K-water decided take on the burden of the water quality improvement. In return, it secured its Stage 2 project seawall management, and tidal power plant construction concessions.

2-3. Community-centered Institutions

2-3-1. Community-centered Laws and Administration

During the economy-focused first stage of Lake Sihwa's development, no rules or management structures related to Lake Sihwa's development allowing the participation of various stakeholders existed. As policies changed to water quality improvement and environmentally friendly development, an institutional arrangement that guaranteed the participation of the regional community in the establishment and implementation of policies relating to Lake Sihwa's water quality improvement was created. At the background of this change was the increase in environmental awareness in the 1990s, with the appearance of national-level environmental organizations and community-centered and civil society organizations. In the course of demanding Lake Sihwa's water quality improvement and eco-friendly development, they grew in solidarity with one another and due the environmental cause at large.

The Lake Shihwa Management Committee formed in 2002 and the Sihwa District Sustainable Development Council formed in 2004 are the fruits of those trends. The Lake Shihwa Management Committee is a joint public-private organization made to unify decision making related to Lake Sihwa and to comprehensively and systematically manage the lake. The committee's formation was led by MOMAF, and its membership comprises the Vice-Minister of MOMAF as the committee chairperson, seven other members from the central government, six from local governments, three from related organizations, and four from civil society organizations. The committee deliberates on key matters related to the lake's water quality improvement and environmental preservation and on the details of implementing the Comprehensive Management Plan. The committee was formed under the Prime Minister's directive in 2002.

In similar fashion, the Sihwa District Sustainable Development Council was formed under MOCT's directive in January 2004. The council is jointly managed by the central government with MOCT's successor MOLIT and community-centered organizations. its co-chairs are elected from both sides. The council has 53 members who represent the central government, local authorities, related organizations, community residents, and experts. With the participation of many community members and experts on environmental improvement and development planning of the Sihwa District, conflicts that were formerly incurred by the government's top-down approach are now under control.

Effectiveness of Accountability Provisions and Arrangement

When the Lake Sihwa pollution problem was televised and became a national issue in January 1996, the President directly ordered the Board of Audit and Inspection to investigate the cause and MOE to prepare water quality improvement measures. Subsequently, there was finger pointing among bodies of the central government. From its special audit, the Board of Audit and Inspection concluded that the cause of the Lake Sihwa pollution problem was an overall lack of environmental awareness among the central government, local governing authorities, businesses, and society as a whole. The conflicts between government agencies and between central and local government was resolved up, and the financial responsibility shares for raising Lake Sihwa's water quality and environmentally friendly development were decided. K-water, as the executor of the project, was apportioned the greatest financial burden.

Adequacy and Relevance of Information

The information that was made publicly available began with merely the results of confirmed government policies in the early part of Lake Sihwa's development. In the water quality improvement and environmentally friendly development sub-periods, the information released expanded to include information on the process of deciding policies. This change occurred naturally as participation in policy making was extended beyond central government to local government and community-centered organizations as well.

Until Lake Sihwa's water quality problem became a national issue in 1996, the government held the reigns of Lake Sihwa's development. There was hardly the notion of public information disclosure. The Sihwa District residents did not receive any information on the development project except when the government made formal announcements through the media.

It was not until before the 1998 when law requiring public corporations to disclose information to the public to guarantee the public's right to know had been introduced. Therefore, the central government merely conveyed policy results to local governments at the time. In the case of the Lake Sihwa Water Quality Improvement Comprehensive Measures announced by MOE in 1996, many stakeholders participated in the drafting of the plan. However, the community and civil society were left out and uninformed during the course of preparing the measures, specifically in the deliberations and policy deciding processes. In contrast, the Sihwa District Sustainable Development Council made every meeting public and accessible to private citizens. Also, their results were disclosed, making policy making and execution transparent.

Integrated Treatment of Water Planning and Development

A comprehensive approach to water resources planning and development is very important. In the early stage of Lake Sihwa's development, a piecemeal approach was taken in building the seawall and reclaiming the land with the purpose of enlarging agricultural land and securing agricultural water for that land. While both water quantity and quality needed to be considered together, only the water quantity necessary for the land's development was considered. In contrast, during the sub-period of Lake Sihwa's water quality improvement, the water quality that was included in the goal of securing useable water in land development improved the environment. During the sub-period of environmentally friendly development, the water ecology was considered to integrated tidal power generation, tourism, and social elements into an inclusive, comprehensive approach that is now being reflected in the project-related policy.

The case of Lake Sihwa's development and water quality improvement illustrates how centralized government power underwent a decentralization process. Through the 1995 Stage 1 development process, development planning thoroughly came about under the government's direction. Many conflicts arose, in the process, especially among government ministries, and these interministerial conflicts were often handled by the Office for Government Policy Coordination.

As the project entered the period when Lake Sihwa's water quality improvement became an issue and then the period of environmentally friendly development, the local municipal governments of Ansan, Siheung, and Hwaseong transitioned from being fragmented and held in check to actively participating in policy making. Moreover, many other local governing authorities attempted to launch their own development plans.

In addition, environmental civil society organizations, voiced their objections to the Sihwa Seawall since before its completion. This prepared the way for the lake's pollution to become a societal issue. Under the trends of organization and solidarity, it came to have active participation in policy making and was able to present their views on policy.

During the time of government monopoly on Sihwa District development planning, sidelined district residents, believing only the positive reports by the press, expressed their views through various channels. However, these views did not get reflected in policy decisions. In this period, policy planning and execution were done in parts under the general, overarching plan of the central government.

By contrast, in the switch from the water quality improvement period to the environmentally friendly development period, the Sihwa District Sustainable Development Council faithfully played a mediative role to control conflicts and differences in opinions between the central government and the regional community.

<Table 13> Change in Stakeholder Participation Level

	Early development period	Water quality improvement period	Eco-friendly development period
Level of stakeholders' participation	Central government-centered policy making [Non-participation]	Central government-led, Local government and NGOs suggest opinion [Tokenism]	Government and civil society, joint policy making [Empowerment]
Information release	Announcement of governmental policy	Release finalized policy	Entire procedure of decision-making is open

Source: Authors' tabulation based on Min (2011)

2-3-2. Community-centered Policies

Seen from an institutional perspective, the main actors during Lake Sihwa's development were the central government (MOLIT and MOE), local governments (Ansan, Siheung, and Hwaseong), environmental civil society organizations, and the media. This section examines how the structure of governance with respect to Lake Sihwa's development changed and also how the level of stakeholder participation and information disclosure changed. Finally, the section also examines the organization and operation of the Sihwa District Sustainable Development Council, which greatly affected the above-mentioned governance structure.

Impact of the Policy for Promoting Stakeholders' Participation (Education, Communication, Raising Public Awareness

One result of the case of Sihwa District's development was the participation of the many stakeholders in the various policies related to the district's development. Among the causes, the Sihwa District Sustainable Development Council's deliberation and decision process and disclosure of information are examined. When holding its meetings, the council invites an expert to lead a seminar in cases where the subject at hand requires expert knowledge. To raise the seminar's effectiveness, stakeholder participation has been promoted, and the consultation process and results are being made available to the public to increase public awareness.

The council's discussion structure consists of development planning, atmosphere, and water quality and ecology subcommittees. With regard to each subcommittee's discussion process and debated issues, they are first discussed in the subcommittees and then enter a final discussion in the plenary council (Park and Hong, 2007, p.30). This consultation and deliberation process has resulted in increased trust among stakeholders (Hong and Lee, 2009, p.38). Seminars led by experts have promoted better understanding of the issues and mutual learning. They have contributed to drawing out settlements amid the differing interests of issue among participants. For example, an agreement regarding the Sihwa MTV project was reached through a long discussion among participants. The development of the Sihwa MTV site, which was originally planned for 10.48 million m^2, was reduced to 9.26 million m^2 via consultation (K-water, n.d.).

Level of Stakeholders' Participation

A brief overview of categorizations of participation can be found in Min (2011). Paraphrasing Brett (2003, p.2), he notes that "'bottom-up systems' based on participation have often been stressed in economic development" (p.21) and notes that Arnstein (1969, p.217) has suggested an eight-category breakdown of participation based on levels of empowerment (p.21). A more recent categorization by Pretty (1995, p.1252) uses seven distinctions from "manipulative participation" to "self-mobilization" (p.22). Min prefers Pretty's typology for its greater clarity of definition but simplifies it following Arnstein (1969, p.217) into non-participation, tokenism, and empowerment, explaining the terms as follows:

> *Non-participation includes manipulative participation and passive participation. Tokenism embraces participation by consultation, participation for material incentives and functional incentives. Empowerment contains interactive participation and self-mobilisation. (p.23)*

Following Min's simplified typology, stakeholder participation continuously increased during the periods of Lake Sihwa's development and water quality improvement. From the beginning, the government played the role of primary stakeholder. The government, especially the central government, from the early part of the development plan, led the entire development process including in the water quality improvement and environmentally friendly development periods. Accordingly, at the beginning stage of the project, the focus was set on communication between and managing the interests of government ministries. Concerning the local governments, the central government recognized their status as lower level organizations and permitted their participation in presenting their perspectives. During the water quality improvement period after 1996 and in the course of establishing an environmentally friendly development plan, the participation of local governments was a given and the views of civil society organizations were communicated and collected from both sides. In the end, the Sihwa District Sustainable Development Council became a consensus-based decision-making body.

Examining the organization and governance structure of the Sihwa District Sustainable Development Council may provide insights into the change in level of stakeholder participation and its effects

The growth of community-centered organizations and the media played a large role in changing the dynamic of stakeholders' participation. Community-centered organizations had little cohesion or solidarity before Lake Sihwa's pollution became a societal issue in 1996 and failed to grow as an association or network. However, the community-centered organizations organized themselves and became more structured following the development of Lake Sihwa. Being the recipients of the proiect's economic, social, and environmental effects, it had impacts on the change. In the background of this change was the birth of the environmental movement in Korea in the late 1970s; its progression to a citizens' or civil society-based environmental movement in the mid-1980s; the rise of environmental awareness at the national level in 1990s; and the emergence of sustainable development discourse throughout society thereafter.

The media played a decisive role in raising Lake Sihwa's water quality degradation problem as a society-wide agenda and in raising community and national interest in the matter. Across the sociocultural dimension, with the growth of Internet culture from the second half of the 1990s, the water quality problem and other issues quickly spread through the Internet and other media.

Effectiveness of Conflict Resolution Mechanism

Conflict is not wholly negative. Iustead, it has positive elements in that the process of its resolution allows the mistakes and failures of the past to be discarded through experience and institutional change.

At the beginning of Lake Sihwa's development, conflicts between government ministries were handled by formal government bodies such as the EPB and the Office of Government Policy Coordination. During the water quality improvement and environmentally friendly development periods, informal consultative groups such as the Sihwa District Sustainable Development Council (at the time), in addition to formal government bodies, played the conflict resolving role.

The Sihwa District Sustainable Development Council consisted the diverse stakeholder participation the central government, local governments, local assemblies, experts, community-centered NGOs, and others. Moreover, the joint efforts to solve the pressing issues through relatively long open discussions among these stakeholders can be seen as a new alternative to the conflict-ridden government-monopolized development project.

The particular consultation and decision-making process of the Sihwa District Sustainable Development Council offer some lessons. The results of council discussions are made available to those outside the council. According to the council bylaws, "when preparing to hold a council meeting, the time, date, location, and subject must be communicated at least three days in advance to each council member and announced on the council homepage."[14] Moreover, anyone may observe the meeting, and the meeting results must be uploaded on the council web page. This opening to the public increases the credibility of the discussion (Hong and Lee, 2009).

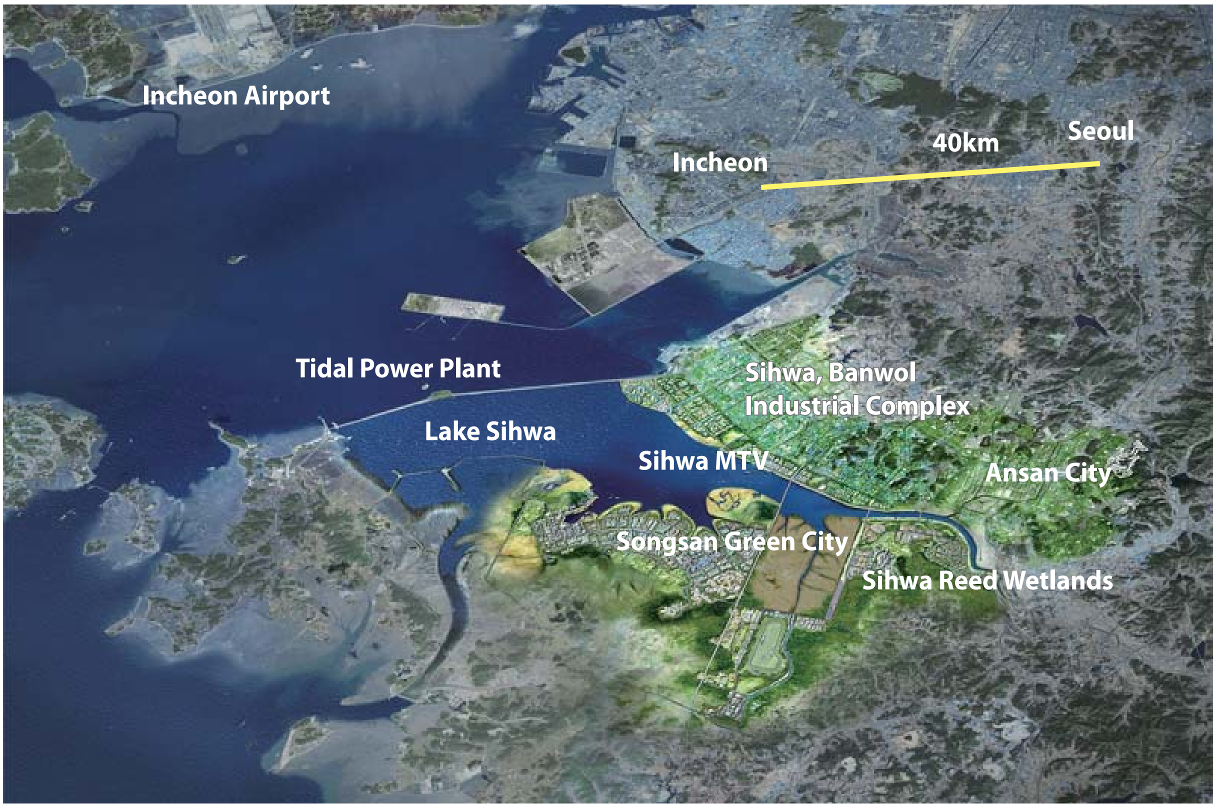
Before each council meeting, relevant and necessary information for the issue to be discussed is shared. This resolves information asymmetry. When expert knowledge is required, an expert is invited to lead a seminar. Through this cooperative learning, trust is built among all those involved, and many conflicts and differences in opinion between civil society and the government can be resolved and policies satisfactorily made.

2-4. Concluding Remarks

The Sihwa District Development Project shows how the state-centered institutional structure shifted to a community-inclusive institutional structure due to the political, economic, social, environmental, and technical exogenous factors. In the first period of the Sihwa District Development Project, the central government, and in particular the EPB, MOC/MOCT, and MOAF, led the project while managing its internal conflicting interests. The EPB's Five-Year Economic (and Social) Development Plans, MOAF's West and South Sea Coastal Reclamation and Development Plan, and MOCT's Sihwa District Development Priority Launch Plan particularly played important roles. As indicative plans, the Five-Year Plans set the direction of economic, social, and land policy. Based on plans, MOAF and MOCT established development plans each reflecting their own interests. These were adjusted following the EPB's decisions. After the Lake Sihwa water pollution issue of 1996 and the launch of the local autonomy system in 1995, MOE, environmental organizations, and local governments became important players in policy decision-making. These actors, who had been merely bystanders in the first part of the development project, became members of the Lake Shihwa Management Committee launched in 2001 and the Sihwa District Policy Council that existed from 2000 to 2003. More importantly, they played key decision-making roles in the consultative body of the Sihwa District Sutainable Development Council formed in 2004.

Despite the change in the decision-making structure, MOLIT and other ministries have maintained influence and leadership in the Sihwa District Development Project. Central government subsidies in the Sihwa District Development and Lake Sihwa Water Quality Improvement Projects are insignificant. Nevertheless, MOLIT has retained the right to authorize and license projects. This is mainly because its affiliated organization K-water, the project undertaker, shoulders most of the costs associated with improving the water quality of the lake. MOE holds the authority to regulate Lake Sihwa and the basin area and has been increasing its influence through the total pollutant load regulation based on the 2007 Water Quality and Ecosystem Preservation Law and the Total Pollutant Load Management System, adopted by the Lake Shihwa Management Committee's decision in 2010.

14) http://www.sihwa-sd.com/



Source: K-water

<Picture 4> The Sihwa District

From a market perspective, the Sihwa District Development Project and the Lake Sihwa Water Quality Improvement Project depends heavily on the division of the input cost burden and on the project cost recovery. The cost recovery is basically structured on parceling and selling reclaimed land and operating the Sihwa Tidal Power Plant. The project undertakers such as K-water undertook the costs of building the seawall and improving the water quality and are recovering the costs, having acquired the right to develop and parcel out land and build and operate the tidal power plant.

The costs of managing rivers and other costs shouldered by the central and local governments are covered by general tax sources. The installation of wastewater treatment plants and sewers and costs associated with their operation and maintenance are being collected through residents fees by the local governments. Like other regions, the Sihwa District determines cost recovery shortfalls and makes up for them with general finances.

From the community-centered perspective, the participation in decision-making of community-centered organizations, local governments, and local residents has markedly advanced during the course of the Sihwa District Development Project. In the project's first stage, the central government decided policies, announced them, and went no further. Between 1996 and 2004, the central government listened to the opinions of the local governments, civil society organizations, and district residents and allowed their feedbacks in project-related policies. After the consensus-based decision-making body the Sihwa District Sustainable Development Council was formed in 2004, community-centered stakeholders began to participate as major decision makers.

IV. Performance of the Project

1. Generic Performance

1-1. Attainment of Project Objectives

The objectives of the Sihwa District Development Project, to remove the factories and relocate some of the population in Seoul to other areas, appear to have been attained. As shown in Table 14, the population in the Lake Sihwa basin has increased by 249% from 389,612 in 1985 to 1,359,946 in 2005. On the other hand, the population in Seoul increased by just 1.88% compared to the increase in percentage of urban population by 16.4% over the same period (Table 14).[15] While the population of Seoul did not decrease in absolute terms over the 20-year period, it grew at a far slower rate compared to the national rate of urbanization and decreased in absolute terms in the latter half of the period. The Sihwa Basin's development likely contributed to this outflow.

<Table 14> Population Movement in Seoul and Sihwa District

Administrative district	1985	1995	2005
Seoul	9,639,110	10,231,217	9,820,171
Rate of increase (%)		6.1	-4.0
Ansan ①		510,314	681,590
Siheung ②	163,671	133,443	389,638
Hwaseong ③	225,941	158,590	288,718
Total(①+②+③)	389,612	802,347	1,359,946
Rate of increase (%)		105.9	69.5

Source: Statistics Korea

Secondly, the objective to remove factories from the Seoul area into other areas also appears to have been achieved. The number of businesses in Ansan, Siheung and Hwaseong has increased greatly from 3,729 in 1994 to 6,312 in 2009, or by 160%, which is higher than the growth in the number of businesses in Gyeonggi Province as a whole.[16] Thus, the development project has brought many factories, businesses, and people and has contributed to establishing the basis for the local development.

In addition to those two initial goals, the objectives of the Lake Sihwa Water Quality Improvement Measures have been met. Due to severe water pollution, the COD level of the Lake Sihwa reached 17.4 ppm in 1997. After multiple short- and long-term measures were implemented, the COD level decreased to 3.1ppm in 2012.[17] This is a successful result in that it is lower than the 1994 level (5.9ppm) when the Sihwa Seawall was completed.[18]

1-2. Timeliness of the Project

The construction of basic environmental facilities incorporated in the Lake Sihwa Water Quality Improvement Measures were supposed to be completed before the construction of the cofferdam was completed in 1994, but this did not happen. In fact, the construction of the Sihwa treatment plant was finished in 1995. However, the Lake Sihwa Water Quality Improvement Measures for water quality have been carried out for planned.[19]

15) Statistics Korea. MOSPA Data on Resident Registration Population of Cities. http://kosis.kr/gen_etl/start.jsp?orgId=101&tblId=DT_1B040A3&conn_path=I3&path (Accessed 15 July 2013)

16) Statistics Korea. Gyeonggi Province Basic Statistics on mining and Manufacturing Industry. http://kosis.kr/gen_etl/start.jsp?orgId=210&tblId=DT_1F00001&conn_path=I3&path (Accessed 15 July 2013)

17) Water quality data from the national marine environmental monitoring system.

18) Ibid.

19) Interview with Wonho Kim of K-water Sihwa Regional Division and survey of other stakeholders.

Oxidation ponds, one of the short-term measures, were installed in Ansan Stream, Sihwa runway water and main waterway 3 in October 1996, right after the measures were confirmed. Temporary intercepting pipes were also installed from October 1996 to February 1997. After the test spraying in September and October 1996, chemicals were sprayed on the lake according to circumstances starting 1997 to alleviate water quality degradation. 100 units of submersible aerators were installed in November 1996. Sediment dredging was planned for the second half of 1997, but it was stopped due to the risk of elution of heavy metals and low economic feasibility. Since July 1997, seawater has been circulated into the lake through the seawall sluicegate.

The capacity of the Ansan sewage treatment plant, one of the long-term measures, was supposed to be expanded to 534,000 m^3/day by 2001, but the capacity was expanded to 385,000 m^3/day by 2000 (Korea Water Resources Corporation, 2005. p. 110).

1-3. Appropriateness of Investment

The heavy expenses spent on the water quality improvement could have been saved to some extent, if the development project's environmental impact was carefully considered from the planning stage of the project. As a matter of fact, the environmental impact assessment conducted in 1988 required the wastewater to be treated in the Sihwa sewage treatment plant before being discharged into the open sea.[20] However, due to the lack of investment sources from relevant agents, basic environmental facilities were not ready before the seawall's completion. Thus, the wastewater flowing from nearby industrial complexes worsened the water quality.

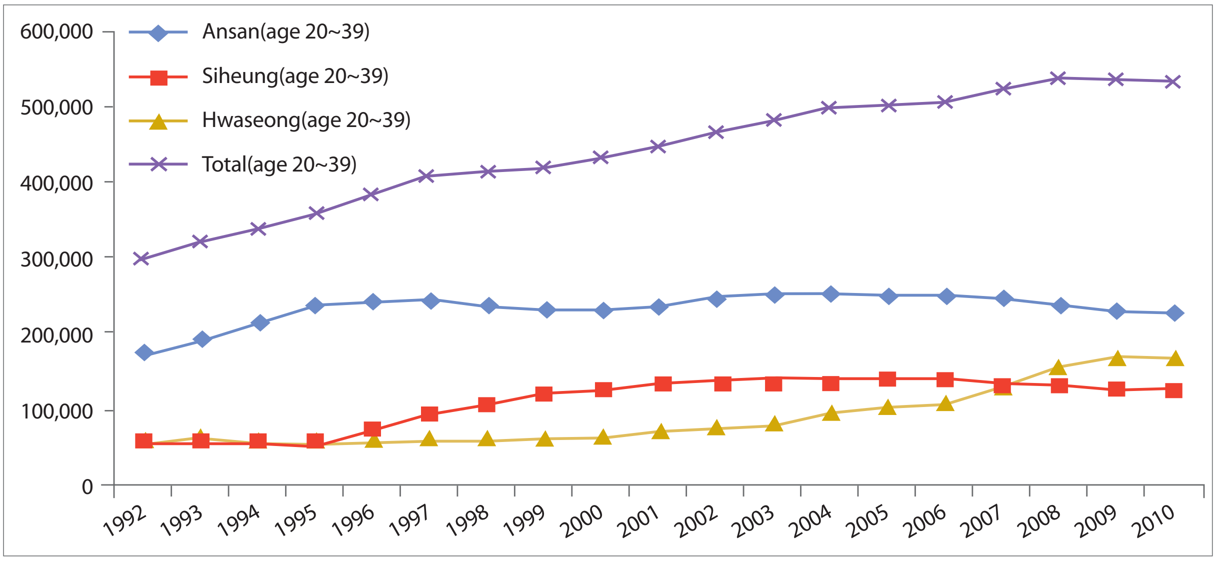
The budget invested in the implementation of Stages 1 and 2 (1996-2011) of the Lake Sihwa Water Quality Improvement Measures (i.e. not including the tidal power plant), including the installment and operation of wastewater treatment plants and other basic environmental facilities and stream maintenance, adds up to 893.2 billion won (Lake Shihwa Management Committee, 2012). Although the budget spent is considerable, the large investment in the water quality improvement measures was effective and appropriate as the COD level of Lake Sihwa in 2012 has become lower than the COD level of 1994. Particularly, the construction of the tidal plant to improve the water quality as well as to secure eco-friendly energy was highly necessary.

2. Economic Performance

The Banweol and Sihwa industrial complexes were established as an integrated complex in order to ease the dense agglomeration of people and factories in Seoul since the 1970s. It is the biggest integrated complex for small and medium businesses and is the so-called “waist” of the national industrial production system, producing parts and materials for key industries such as IT, semiconductors, and automobiles. This huge complex accounts for 46.2% of the total industrial complex area in Gyeonggi Province and 87% of industrial complex employment in Gyeonggi Province.[21]

20) Interview with Wonho Kim of K-water Sihwa Regional Division (23 July 2013).

21) Statistics Korea. Gyeonggi Province Basic Statistics on mining and Manufacturing Industry. http://kosis.kr/gen_etl/start.jsp?orgId=210&tblId=DT_1F00001&conn_path=I3&path (Accessed 15 July 2013)



Source: Ministry of Security and Public Administration, Republic of Korea

<Figure 13> Population Trends in the Sihwa Area

2-1. Contribution to Regional Production

2-1-1. Population of Ansan, Siheung, and Hwaseong

Although the population of Korea from 1992 to 2010 has increased annually by an average of 0.7%, youth population (between 20 and 40 years old) has decreased annually by 0.7% in the same period.[22] The total population and youth population of Ansan, Siheung, and Hwaseong in the same period have increased annually by 5.7% and 3.2% respectively. [23]

In the circumstances where the youth population is decreasing due to aging population and low birth rate, the population growth in the area is important to local development projects such as to the development of industrial complexes.

As mentioned earlier, the number of businesses in Ansan, Siheung, and Hwaseong has dramatically increased from 3,729 in 1994 to 6,312 in 2009. This represents a higher growth rate in the number of businesses than for Gyeonggi Province.[24] These results

<Table 15> Economic Concentration Effect of Industrial Complexes

	1994		2000		2005		2009			
	Gyeonggi Province (B)	Ansan, Siheung, Hwaseong (D)	Gyeonggi Province	Ansan, Siheung, Hwaseong	Gyeonggi Province	Ansan, Siheung, Hwaseong	Gyeonggi Province (A)	Ansan, Siheung, Hwaseong (C)	(A/B) *100	(C/D) *100
No. of Businesses	24,207	3,729	29,022	6,993	37,903	10,612	20,112	6,312	83.1%	169.3%
No. of Employees (Monthly Avg.)	761,168	183,053	748,864	215,714	887,750	277,313	726,109	246,134	95.4%	134.5%
Output	75,398	19,077	147,611	42,100	200,826	70,311	235,753	78,941	312.7%	413.8%
Value Added	35,188	7,927	63,700	15,643	85,847	29,592	96,161	29,518	273.3%	372.4%

(Units: Businesses, Employees, billion KRW)
Source: Gyeonggi Province

22) Statistics Korea. MOSPA Data on Resident Registration Population of Cities. http://kosis.kr/gen_etl/start.jsp?orgId=101&tblId=DT_1B040A3&conn_path=I3&path (Accessed 15 July 2013)

23) Ibid.

can be attributed to the economic concentration and centralization effect owing to the industrial complexes.

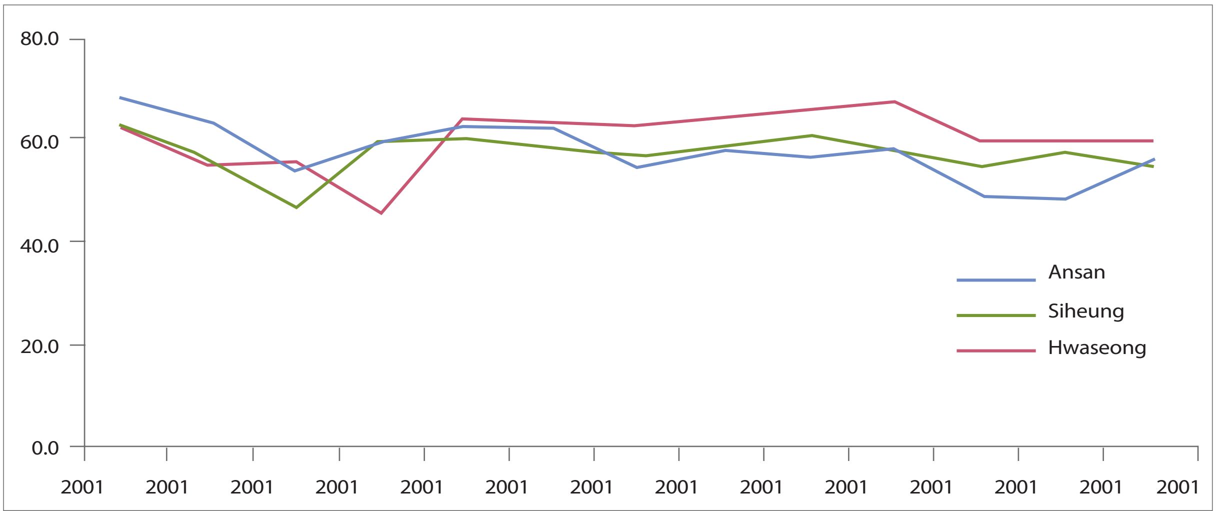
2-1-2. Employment Effect

The number of employees in Ansan, Siheung, and Hwaseong has increased 1.3 times from 183,053 in 1994 to 246,134 in 2009, surpassing the figure of Gyeonggi Province in the same period.[25] As explained above, the Sihwa District Development Project seems to have increased the regional employment rate.

Value added and production per employee of Ansan, Siheung, and Hwaseong in 1994 were larger than those of Gyeonggi Province but became smaller in 2009. [26]

2-1-3. Alleviation of Regional Imbalances

Korea's average fiscal self-reliance ratio from 2000 to 2010 was 54.2, and the ratio for Ansan, Siheung, and Hwaseong for the same period is higher than the national average.[27] The average fiscal self-reliance ratio of Seoul for the past 10 years is 92.5%, which is high above the national average.[28] Compared to the national level, except for Seoul, the fiscal self-reliance ratio of Ansan, Siheung, and Hwaseong is higher. This indicates that the Sihwa District Development Project has contributed to alleviation of the dense population of and economic centralization in Seoul. However, other areas such as North Gyeongsang Province (27.6%), Gangwon Province (26.8%), North Jeolla Province (23.4%) and South Jeolla Province (18.7%) show far lower (by 30%) fiscal self-reliance ratios than the national average.[29] Since the gap between the metropolitan area and other provinces is large, the Sihwa District Development Project has resulted in intensified regional imbalances although it alleviated the dense population problem and income disparity in the Seoul Metropolitan Area.



Source: Statistics Korea
Note: Rate of Fiscal Independence = 100 * (local tax + non-tax revenue) / local gov. budget

<Figure 14> Rate of Fiscal Independence

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24) Statistics Korea. Gyeonggi Province Basic Statistics on mining and Manufacturing Industry. http://kosis.kr/gen_etl/start.jsp?orgId=210&tblId=DT_1F00001&conn_path=I3&path (Accessed 15 July 2013)

25) Ibid.

26) Ibid.

27) Statistics Korea. Fiscal Self-reliance Ratio of Cities. http://kosis.kr/gen_etl/start.jsp?orgId=101&tblId=DT_1YL7903&conn_path=I3&path=NSI (Accessed 15 July 2013)

28) Ibid.

29) Ibid.

2-1-4. Adoption of Innovative Technology

For the water quality improvement of Lake Sihwa, various technological measures were tried. Among them, the constructed wetlands and the tidal power plant, both the first of their kinds in Korea, are significant in terms of the adoption and deployment of innovative technologies. As expansive constructed wetlands, the Sihwa reed wetlands, to treat the polluted stream waters from the upstream part of the lake and provide habitats for the wildlife, were adopted as part of the Lake Sihwa Water Quality Improvement Measures in 1996 and opened six years later in 2002. In addition to creating a natural water quality improvement effect and preserving biodiversity through constructed wetlands, the Sihwa Wetlands also host a center for research into the value of preserving wetland ecosystems and an environment education center. After its opening, number of visitors (from 116,000 in 2003 to 393,000 in 2012) increased steadily, which is helping to stimulate the local economy. The Sihwa Tidal Power Plant is the first in Korea, and it is also the largest capacity tidal power plant (252MW) in the world (as of September 2013). The tidal plant was built in 2002 to be the largest in the world and to increase the water quality improvement effect of seawater circulation into the lake. As it was the first in the country entailing appreciable risk, the plant's installation and operation shows Korea's strong will to adopt high and innovative technologies. The Sihwa Tidal Power Plant, as it was installed in the existing seawall, caused no additional harm to the environment or controversy, and far from merely helping achieve the primary objective of seawater circulation-facilitated water quality improvement reduced atmospheric pollution (by 152 tons per year of CO_2) through ecofriendly energy production and is helping to ease Korea's recent close-to-capacity electricity usage. Moreover, just like the Sihwa reed wetlands, the power plant is attracting tourists and contributing to the stimulation of the local economy.

Source: K-water

<Picture 5> The Sihwa Tidal Power Plant

3. Social Performance

3-1. Advancement of Stakeholder Participation

The Sihwa District Sustainable Development Council has a consensus-based decision-making system. This system prevents the dominance of decision-making by the government, which controls the budget, or by the environmental NGO majority. Thanks to this system, optimal agreements that satisfy both sides could be made, sometimes after an 18-hour-long discussion (Moon and Lee, 2012, p.76). If the decision-making system were by majority vote, the decision could have leaned toward one side, precluding a fair, unbiased agreement.

This council announces all the results and conclusions from official meetings and discussions through its website so that anybody including the local residents and the general public can access the information regarding the project. This system minimizes the possibility of participants making irresponsible or groundless remarks. Thus, this system has enhanced objectiveness, transparency, and rationality of participants' opinions and results (Hong and Lee, 2009).

The common learning mechanism of the council, which was intended to enhance understanding of points at issue, has largely contributed to mutual understanding among stakeholders and reaching agreements. The common learning mechanism consists fact-finding activities (including eco-network basic surveys, clinical tests of local residents, surface investigations for cultural assets, etc.) and seminar-type common learning (forecasting demographic or thematic demand, notion of population density and estimate method, examples of resource circulation types, ecological polis, etc.). As an example, participants invite experts with contrasting views so that the participants could gain a more objective view and better understanding of the issue. Since the participants have discussions or meetings after studying the issues from both perspectives, they are able to reduce the information and knowledge gap, and eventually they can reach honest agreements (Moon and Lee, 2012, p.79).

Thanks to the successful operation of the council from 2004 to 2008, the broken trust between the stakeholders was restored. One year after the council's establishment, the single-chair system changed to a co-chair system, with one co-chair from government and another from outside the government. The co-chair system is difficult to establish if the two sides do not recognize each other as equal partners. The council has maintained and developed mutual trust through 255 meetings since the council's establishment in 2004 to 2010.[30] Plus, when the council was established, a provision was created stating that all plans of the development project including water quality improvement measures would be reviewed from the beginning. This provision shows the sincere willingness of the central government to listen to various voices and has become the basis for mutual trust building (Moon and Lee, 2012, p.74).

Moreover, the governmental side has shared detailed information regarding the project almost unconditionally with all involved participants, maximizing the effect of stakeholders' participation. An NGO representative on the council has confirmed this, stating "there was active cooperation when there was a request for information" (Hong and Lee 2009, p.37). During the development planning subcommittee meeting on March 12, 2004, the government side actively complied a NGO request for the Sihwa Long-term Comprehensive Plan Research Report (Hong and Lee, 2009, p.37). The information sharing helped to maximize the effect of stakeholder participation and contributed to transparent agreements.

30) Sihwa District Sustainable Development Council http://www.sihwa-sd.com/

3-2. Improvement in Quality of Life

It is estimated that the quality of life of local residents has improved since the Lake Sihwa Water Quality Improvement Measures were implemented in 1996. First of all, the bad odor has disappeared, the water quality has significantly improved, and the lake has become a leisure area for local residents. This can be supported by a survey result verifying "the number of civil complaints for bad odor has been significantly reduced" (Moon and Lee, 2012, p.73). Plus, artificial reed wetlands (1,037,500m^2) were established in the Lake Sihwa basin in 2002 as an amenity along with an eco-friendly learning center, and more than 300,000 people are visiting the wetlands each year.[31] Siheung began hosting a yacht tournament since 2003, providing recreational activities to the local people. Moreover, the Sihwa Seawall Road is considered one of the most beautiful roads, providing more leisure space for local residents (Kyeong, 2012).

3-3. Equity between Regions and Social Groups

As a result of the Sihwa District Development Project, the GRDP of Ansan, Siheung, and Hwaseong has increased by more than four times from 1994 to 2004, exceeding the GRDP growth rate of Gyeonggi Province in the same period.[32] While the development project has contributed to the growth of GRDP of Ansan, Siheung, and Hwaseong, it also has increased regional imbalances around the Seoul Metropolitan Area.

The improved ecological environment of Lake Sihwa, as a public good, provides recreational space for the local residents regardless of gender and income level. Especially, among the annual visitors of Sihwa Reed Wetland Park, 37.6% consists of students, which shows a high utilization rate by a socially and economically vulnerable group (K-water, 2013).

4. Environmental Performance

4-1. Water Quality Improvement

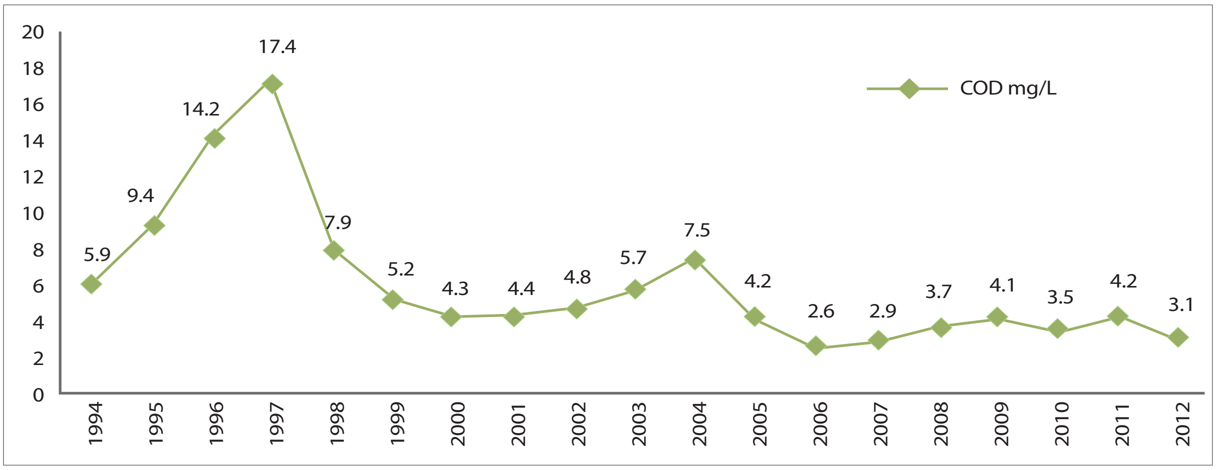
In 2001, thanks to the water quality improvement measures, Lake Sihwa's water quality drastically improved until Lake Sihwa was converted into a saltwater lake. Before the completion of the Sihwa Seawall, the water quality of the entire Banweol Bay stayed at a COD of 3-4ppm. As shown in Figure 15, in January 1994, with the seawall's construction completed, the water quality quickly began to deteriorate, reaching a COD of 17.4ppm in 1997. From the COD peak in

Source: K-water

<Picture 6> Sihwa Artificial Reed Wetlands

31) Ansan Reed Wetland Park http://wetland.iansan.net/

32) Statistics of Gyeonggi Province KOSIS Webpage



Source: Water Quality Data from National Marine Environmental Monitoring System

<Figure 15> Change in COD Concentration of Lake Sihwa

1997, when the Lake Sihwa Water Quality Improvement Measures began full-scale, the lake's water quality quickly improved. From 1999, the water quality stayed at a COD of 4-5ppm, and the biggest reason for the improvement has been judged to be the circulation of seawater into and out of the lake.

Alongside the intake and release of seawater, the maintenance of sewers in the lake basin and the prevention of polluted stream entering the lake (through intercepting sewers) were also important measures. Thus, the water quality problem, owing to leaks of sewage and wastewater from pipe misconnections made over the course of construction and management and non-permitted discharge of wastewater from firms within the industrial sites, was markedly improved.

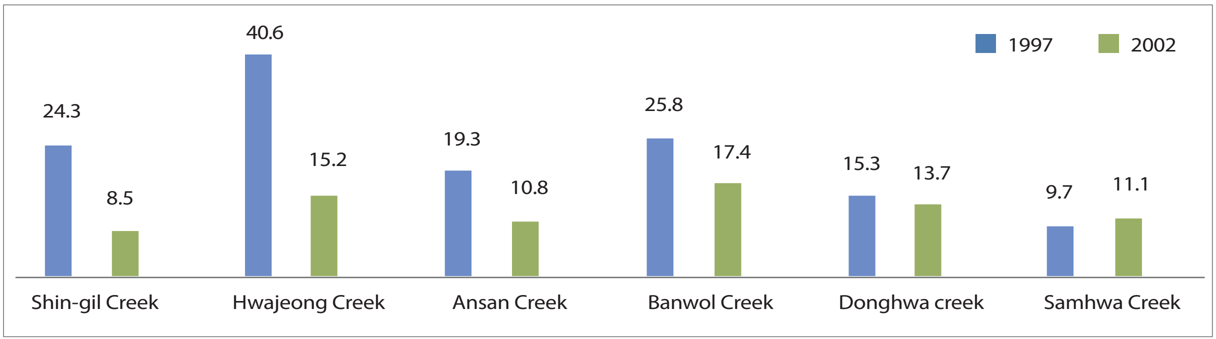
The water quality of the Shin-gil, Hwajeong, and Ansan Creeks in 2002 where misconnected wastewater pipes have been fixed has improved compared to that of 1997. Despite the reconnection of the pipes, the extent of water quality improvement in Shin-gil Creek, which is flowing through the Sihwa and Banweol industrial complex, is smaller than that of other creeks. This is because many factories have discharged wastewater illegally in spite of monitoring and reconnection of wastewater pipes (Korea Water Resources Corporation, 2005, p.144). Unlike Shin-gil Creek, the Donghwa and Samhwa Creeks flowing through farmland and where pipes are not well maintained, show small improvements in water quality. Thus, K-water installed and is operating artificial wetlands downstream for those creeks to purify the water flowing into the lake.

Lake Siwha (1996)

Lake Siwha (2012)

Source: K-water

<Picture 7> Lake Sihwa Before and After Water Quality Improvement



Source: Korea Water Resources Corporation (2005)

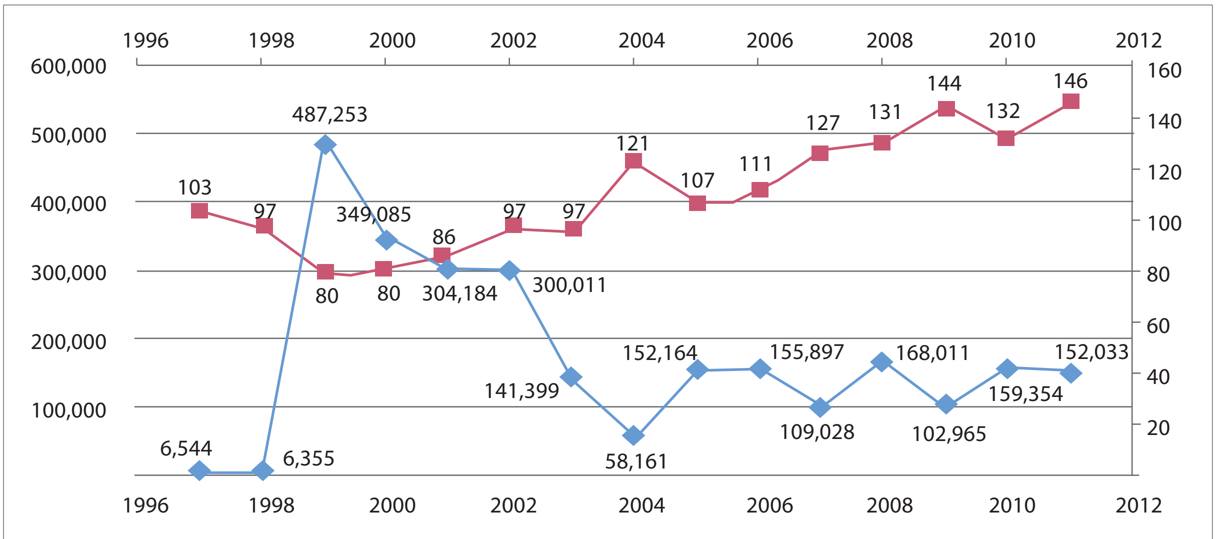
<Figure 16> Change in COD Concentrations of Local Rivers and Streams

4-2. Increase in Biodiversity

Once the Lake Sihwa Water Quality Improvement Measures were implemented, not only did the water quality improve but so did the ecosystem. According to a study on birds in the region by Professor Mubu Yoon of Kyunghee University (Korea Water Resources Corporation, 2005, p.133), after the water quality improvement measures started, the number of birds steadily increased since 1998. The 97 species present in 1998 increased to 132 species by 2010 (see Figure 17). Only adaptive species inhabited the area in appreciable numbers until, but the diversity has increased according to the study in recent uears. The decrease in the actual number of birds may be attributed to urban and industrial development.

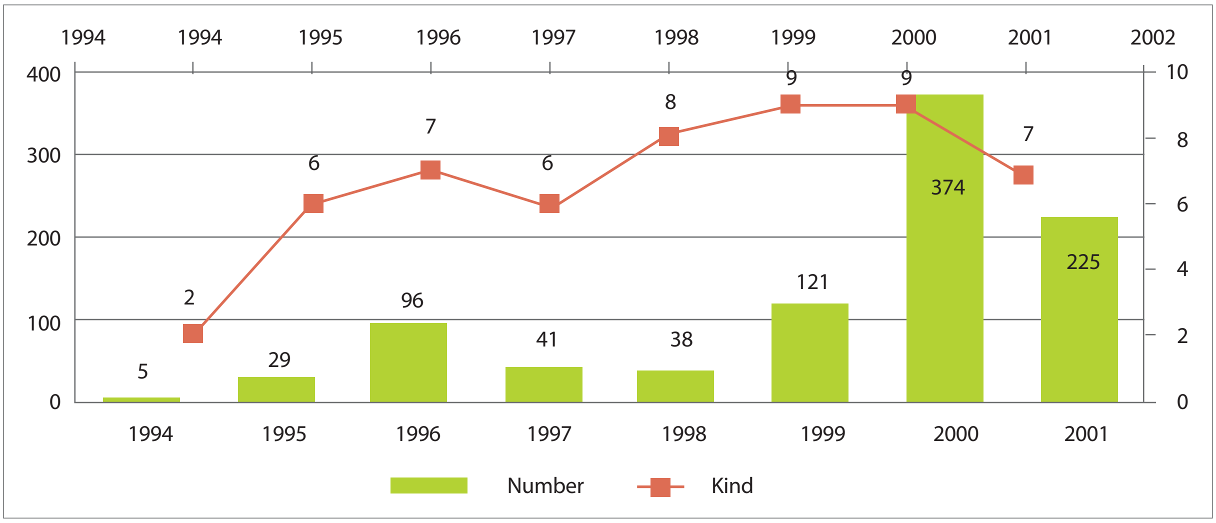
In the case of fish biodiversity, the difference before and after the water quality improvement measures is more prominent. While only 2 species of fish could be found in the lake in 1994 when the seawall was completed, umber to increased becoming 9 in 2000. The number of fish increased in the same period from 5 to 374 (see Figure 18).

After the segmentation of the seawall, the benthic organisms that had died off or disappeared as a result of the water quality degradation—lugworms, starfish, clams, shrimp, and crabs—rapidly increased after the water quality improvement measures. This shows that Lake Sihwa's water quality and lakebed had significantly improved. Those aquatic species that had left the lake due to the pollution following the construction of the seawall,



Source: K-water (2013)

<Figure 17> Number of Bird Species and Population of Lake Sihwa



Source: Korea Water Resources Corporation (2005, p. 133)

<Figure 18> Number of Fish Species and Population of Lake Sihwa

returned to the lake after the implementation of the water quality improvement measures, rapidly restoring the lake's ecological environment for diverse lifeforms.

5. Overall Performance

First of all, the objectives of the water quality improvement measures have been mostly achieved. The implementation and the invested cost of the policy instruments for improving the water quality were timely and appropriate. Since the environmental impact of the development project was not carefully considered, considerable funds were spent on the water quality improvement measures. However, the switch to a seawater lake resulting in significant water quality improvement and the installation of a tidal power plant for water quality improvement and security of eco-friendly energy, were highly appropriate as an investment and effective.

Since the Sihwa District Development Project has brought in many people and factories into Ansan, Siheung, and Hwaseong, the objectives of the project have been attained. Although the national youth population is decreasing, the fact that the youth population and employment in Sihwa District have increased can be attributed to the economic concentration effect of the industrial complex. Furthermore, with high fiscal self-reliance ratios of the three cities, the Sihwa District Development Project has likely contributed to the economic growth of the Lake Sihwa Basin. However, it intensified regional imbalances between the Seoul Metropolitan Area and other provinces.

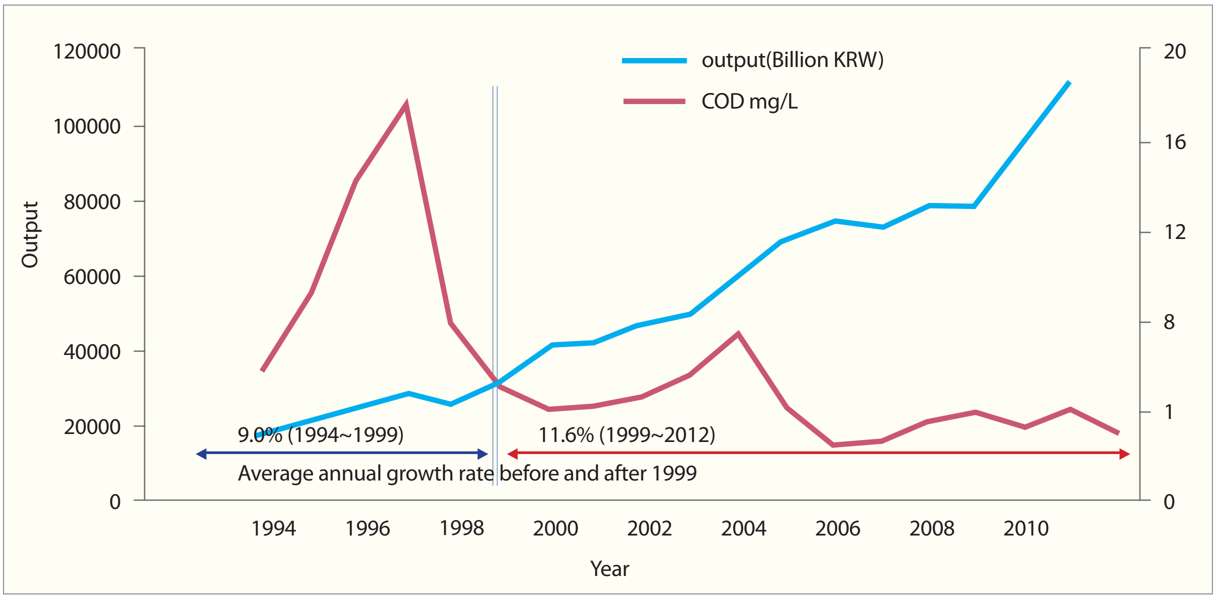
The Lake Sihwa Water Quality Improvement Measures has yielded socially significant performance. Firstly, it involved many project stakeholders in the decision-making process facilitating consensus-making. Through the improvement of Lake Sihwa's water quality, the measures have enhanced local residents' quality of life. As a public good, restored Lake Sihwa provides a place of leisure and ecological learning for the local residents regardless of gender, social status, and income.

Due to the water quality improvement measures such as seawater circulation and installation and expansion of sewage treatment plants, the COD level of Lake Sihwa has decreased below the 1994 level when the seawall was completed. Accordingly, biodiversity has increased and the number and kinds of fish and birds in the basin have also increased.

On the whole, the Lake Sihwa Water Quality Improvement Project has achieved its objectives across both the economic and environmental aspects evolving to become socially inclusive in the process. Despite setbacks in the deepening of regional imbalances and the untimeliness of environmental preparations with regard to the seawall and the industrial sites, the final result has been positive. The Lake Sihwa Basin has developed economically as shown by the GRDP and employment data. The lake's water quality has been restored to pre-1994, pre-seawall levels, and biodiversity has returned to the region. Moreover, district residents, experts, and civil society organizations have been brought into the decision-making process through the Sihwa District Sustainable Development Council, mitigating conflicts between government and community interests and building trust and cooperation. Given the decrease in air and water pollution and the provision of amenities and leisure space, as well as the environmentally friendly tidal power generation, Sihwa District appears to be on track for environmentally friendly and socially inclusive development according to Stage 3 of the Lake Shihwa Comprehensive Management Plan.

Furthermore, this case presents an example of clear decoupling between economic growth and environmental degradation. After 1999, as the output of the Sihwa district has increased at a faster pace than previous years, the water quality simultaneously improved. Interestingly, the average annual growth rate after 1999 (11.6%), which is eco-friendly development period, is higher than the average annual growth rate before 1999 (9.0%) (Figure 19). This shows that green growth strategy is actually feasible and is not hindering high rate of economic growth.

This was possible because of the well-organized development plan which is in harmony with national development plans and water quality improvement measures, which were supported by strong political commitment. In addition, of the Lake Sihwa water quality improvement measures and the enhanced awareness of importance of environmental preservation among the public have established basis for the environment-friendly growth. Furthermore, the cooperation in the Sihwa District Sustainable Development Council between the government and the civil society was a socially satisfactory development. It reflected the needs of local residents including environmental concerns.



Source: Statistics Korea & Water Quality Data from National Marine Environmental Monitoring System

<Figure 19> Evidence of WGG (Decoupling)

V. Lessons Learned and Conclusion

The Lake Sihwa Water Quality Improvement Project dramatically illustrates the success of water and green growth addressing the grave danger to the environment brought about by economic growth-focused development. This chapter presents the lessons learned from the perspectives of the possibility of attaining the principal argument of this research, namely water and green growth, and of the changes in and effects of state-driven, market-oriented, and community-centered institutions and policies.

Social and environmental expenses can be reduced through the pursuit of green growth.

The water pollution of Lake Sihwa is Korea's representative case of environmental pollution brought about by its economic development-centered growth. Progressed from the state of inadequate environmental investment, the development of the industrial zones and satellite cities degraded Lake Sihwa's water quality to a COD as high as 17.4ppm in 1997. It also resulted in the area's low biodiversity with 103 kinds of birds in 1997 compared with 146 in 2011. This environmental pollution damage has not been expressed in terms of monetary value, but Lake Sihwa's ecosystem was seriously harmed. The Sihwa District Development Plan initially aimed for a freshwater lake in order to supply irrigation water. However, with the lake's conversion to a saltwater lake, additional costs for expanding new useable water sources were incurred. The effects of Sihwa District Development Project Stage 1 on local residents' health have not been weighed, but it is presumed that these effects have been considerable. Especially, polluting industries from the Seoul region moved in large numbers to the Sihwa Industrial Zone. Losses due to the smell and public resentment arising in response to the release of fumes, wastewater, and other toxic substances continued. Alongside this, the direct input costs in Lake Sihwa's water quality improvement from 1996 to 2011 were a staggering 893.2 billion KRW. The costs of social conflicts are also not likely to be small. During the time of greatest tensions among stakeholders, meetings and other group activities were frequent. Additionally, the costs of dealing with the many civil appeals are expected to be large. The project also, in the course of accommodating stakeholders' demands, was frequently changed or interrupted. Moreover, this led to the participation of the Board of Audit and Inspection and other regulatory agencies. These expenses could have been avoided for the most part had the project pursued both Sihwa District's industrial and economic development together with environmental value simultaneously from its start.

Despite changes in the state's role, the state remains vitally important.

Since the Sihwa District Development Project was drafted until the end of the 1980s "growth first, environment later" was the mainstream in Korea when a large portion of it had been progressed. The state gradually gave up some control to the market and the community, but it retained and exercised key influence. From the point of view of the administration and the organization, the presidency displayed strong leadership and gave to the economic agencies, starting the EPB, considerable controlling power and resources. As the body responsible for setting and controlling the economic policy agenda, the EPB set up the Five-Year Economic (and Social) Development Plans and managed conflicts among departments and ministries concerned with economic and social development. In order to support the industrialization policy from the legal dimension, there were infant industry laws such as the Steel Industry Promotion Law, the Shipbuilding Industry Promotion Law, and the Electronics Industry Promotion Law; and the Foreign Capital Induction Law designed to attract foreign capital; and the National Development Comprehensive Plan Law for the systemic enlargement of social overhead capital. From the policy dimension, to nurture and promote exports of specific industries, expert loans, tax reductions, and infrastructure provisions were implemented. Indicative plans were used to systematically utilize these policy instruments.

In the Sihwa District Development and Lake Sihwa Water Quality Improvement Project, the government, despite the change and decrease in its influence, demonstrated considerable leadership. In the Sihwa District Development Project, the two policy ideas of making arable land for self-sufficiency in food production and preparing a site for both factories located in or near Seoul to relocate to and small and medium enterprises, were in competition. This competition of policy ideas, based on the EPB's decision, was settled with the use of the land aimed primarily as an industrial site and a satellite city and only secondarily as land for agriculture. This project is based on the National Development Comprehensive Plan Law and the Industrial Location Law. From a policy perspective, the Five-Year Economic Development Plans, National Comprehensive Development Plan, Sihwa District Development Priority Launch Plan, and Sihwa District Development Master Plan were used. In short, the planning of the Sihwa District Development Project was decided and implemented through the government's leadership.

Throughout the periods of Lake Sihwa's water quality improvement and green growth, the roles of government agencies underwent significant change. Following the rise in the need for water quality improvement, MOE's influence grew. Owing to the conversion of Lake Sihwa to a saltwater lake and the discovery of a dinosaur habitat, MOMAF and MCT, respectively, gained influence. MOE led the Lake Sihwa Water Quality Improvement Measures in 1996, and through the pollution load assignment and regulation in 2007 and the implementation of the Total Pollutant Load Management System, the Ministry's water quality-related role greatly increased. From 2001 on, the water quality improvement aiming Lake Sihwa Comprehensive Management Plan and the Sihwa District Development Plan through their reciprocal control process are being set and implemented.

The state's influence is decreasing with the increasing influence of community-centered governance approaches. In Stage 1 of Lake Sihwa's development, the state, especially in the EPB, MOCT, and economic agencies, monopolized the decision making structure. In Stage 2, the decision making structure slowly transitioned into a joint structure with community-centered actors. However, the state was ever important in the advancement and success of the Sihwa development project. In spite of the change in the influence of the state, market, and community-centered actors and approaches, the state is playing a large role in the allocation of resources, the generation and distribution of information, the formation of the legal system, and the establishment of plans. Without the state, it is difficult to suppose that the project could have been successful or even implemented.

The market's role becomes emphasized in cost sharing and the configuration of rights.

While the government played an important role in Korea's economic growth and environmental preservation, the country's operation is based on capitalism. Private property is recognized and thoroughly protected; commerce takes place based on market principles; and the economy's and society's growth is based on the pursuit of self-interest by market participants. This basic theme also applies to Korea's water resources management. The government, through the River Act and the law relating to multi-purpose dams, recognizes water rights increased through private and public investment in rivers as dam usage rights. Based on water rights, dam usage rights holders are able to recover their investment by collecting water fees from users. Rights for water use that has not been accompanied by investment according to the River Act require government permission. In addition, those rights are limited to designated water withdrawal stations and times, thereby contributing to the efficient allocation and use of the scarce water resources.

This basic theme applies to the Sihwa District Development Project. In Sihwa District's development and the Lake Sihwa Water Quality Improvement Project, especially in the latter, leadership in and publicly announcing cost sharing are important elements in the project's operation and success. In this project, K-water, as the confirmed project undertaker from the stance of ownership rights, is increasing its ownership rights in the developed land and parceling out the land to general, based on those rights. Under this arrangement, K-water as the project executor is responsible for the entire development costs of Sihwa District and most of the costs of improving the water quality. It is recovering these costs through the parceling of the land and the operation of the tidal power plant. State subsidies and support funds tied to the project are insignificant. Central government subsidies are bestowed on the local governments, but these do not represent any special benefits as they are provided based on the same standards by which funds are provided to other districts in accordance with the water and sanitation, local finance, and other established regulations.

From the perspective of "getting the price right" too, it is appropriate for the development project undertaker to shoulder the costs of environmental effects arising from the development and recover those costs. However, there is a need following a systematic analysis of the causes of Lake Sihwa's water pollution to establish a cost-bearing principle relating to the effects of developing the Sihwa District, to pollution from other development in the basin, and to the opportunistic behavior of polluters.

Community participation is necessary for reflecting the community's interests and for "greening."

Until the end of the 1980s, the government's basic policy theme was "growth first, conservation later." The assumption behind this policy was that citizens' needs were homogeneous towards the economic growth. However, this assumption was repeatedly challenged. In the first place, groups benefitting from the economic sector and groups having to shoulder the burden of environmental and social costs of the development could be different, and there were many instances where the benefits and burdens were not evenly distributed. Moreover, stakeholder needs were not necessarily homogeneous. Many citizens sought environmental value, community value, social value, and various kinds of values. The pursuit of this diversity of values became the background of the enlargement of the environmental movement and the introduction of the local autonomy system and community-centered politics in the first half of the 1990s.

In Sihwa District's development and the Lake Sihwa Water Quality Improvement Project, the diversity of community and its desires, and their importance, are evident. It goes without saying that Sihwa District experienced faster economic growth than other regions in Korea, and the income level is also higher. In spite of this, "the growth first policy" of the first stage of Sihwa District's development was seriously challenged by the pollution of Lake Sihwa. A reexamination of the environmental value of Lake Sihwa began, and the discovery a dinosaur fossil site established the lake area's cultural value. Through this course of events, the influence of MOE, MCT, and other ministries and departments grew. Notwithstanding this change in the decision making structure of the government, there is a need to pay attention to the community in the Sihwa project.

The Sihwa District Sustainable Development Council, the consensus-based decision making body inclusive of community participation in joint decision making, is exerting much influence not only in water quality improvement but also in the setting the direction of the Sihwa District Development Project. For example, in

2007 it helped reduce the Sihwa MTV development project area from 10.48 million m^2 to 9.26 million m^2, and it negotiated the Sihwa tidal power project. Simply put, the council goes beyond reflecting residents' opinions on improving the environmental problem to making an appropriate green growth model for the district.

Policy mixes aimed at green growth can be applied to each country and project based on the particular factors of the exogenous environment, legal system, and institutional factors of the case.

A country's government, market, and community are formed according to a nation's particular factors including history, culture, traditions, economy, society, natural environment, and technology. In Korea's case, the 1960s was characterized by state-led economic growth and "the growth first" ideology and institution. An unbalanced economic policy of pursuing selective industrial and regional policies was adopted. The government, through various regulations and incentives, controlled the market. However, the role of the state and the market changed markedly from the 1990s. From "the government leads, market follows" structure, the situation changed to where "the market leads and the government playing a supplementing role". The implementation of the local autonomy system in the mid-1990s greatly improved the political influence of the community and exerted a large influence on the realization of harmony among the district's economic growth and environmental and social value. However, unlike the claims of Lipset (1959) and some modernization theorists, this change in roles is not a natural consequence of economic growth. That is, despite comparable economic levels among a number of countries, each country expresses a different form of government, market, and community. Even within a country, different institutional structures and frameworks may form across regions, and a project undertaken in different regions can have differing outcomes. For instance, in the western United States, water rights are based on prior occupation of the land including or adjacent to the water source, whereas in the eastern part a system of littoral rights is the mainstream. This difference in institutional characteristics will require a difference in policy mix to suit each situation. Likewise, the same policy instrument in such two different circumstances is likely to show different results.

The development of Sihwa District and the Lake Sihwa Water Quality Improvement Project together are a successful case in which following changes in the state, market, and community-related institutional framework and policy mix, and development, environment, and social participation are being harmonized and positive results achieved. The state has retained leadership and is participating throughout the water quality improvement and green growth sub-periods. Community-centered actors are participating in decision-making at practically an equal footing with the government. Institutionally, the market is maintaining a structure of economic incentives. This institutional policy mix is slowly but constantly changing following changes in the exogenous environment and institutional factors.

Even within Korea, there are failure cases in which development and the value of the environment collide rather than complement each other such as in the Youngweol Dam Construction "whitewashing" in 2000. For the integrated basin management of Korea's main rivers, many problems, including the failure of community participation to progress beyond mere tokenism, must be solved. This means that diverse forms of institutions and policies need to be made according to the diverse environmental and institutional factors of different basins.

<Table 16> Policies Implemented in the Sihwa Water Quality Improvement Project

	Framework	Policies implemented
State-led policy	Well-organized hierarchical plans (national, regional, local, and project levels)	Harmonization between national, regional and local plans • The 3rd Five-Year Economic Development Plan (1972-1976) →West and South Sea Coastal Reclamation Development Plan (1975) →Territorial Enlargement Project Launch Plan (1984) →Sihwa District Development Master Plan (1986) (Growth led by industrial complex)
	Financial support for the project	Although no special subsidies for water quality improvement has been provided, the government granted executors rights to selling reclaimed land.
	Taxes and levies	Water quality tax (1992) Pollution quota excess tax (2007)
	Regulations	Water Quality and Ecosystem Conservation Act (2007) Total Pollutant Load Management System (2010)
Market-driven policy	Cost-recovery status	Costs were structured to be 100% recovered through selling reclaimed land and operation of tidal plants
	Private sector promotion policy	There was no particular private sector promotion policy since the executors were state-owned companies. However, the project aimed to boost economy by nurturing construction companies and creating job opportunities.
	Project selection criteria	Mainly based on central government's decision (Executor's analysis criteria: future economic conditions, possibility of parceling, rate of return, etc.)
Community-centered policy	Impact of the policy for promoting stakeholders' participation	The Sihwa District Sustainable Development Council established (2004)
	Level of stakeholders' participation	Various stakeholders' participation enhanced due to the 1st local government head election (1995) and the Sihwa District Sustainable Development Council (2004)
	Conflict resolution mechanism	The Sihwa District Sustainable Development Council established (2004)

Conclusion

Throughout the Sihwa case, it is shown that pursuit of green growth actually could have reduced social and environmental expenses. In Korea's way towards green growth, adequate policy mix consisting of state-driven, market-oriented, and community-centered policies have paved the way for water quality improvement as well as eco-friendly development. State's strong leadership in propelling the development project and immediate response to the water quality degradation incident was one of the key success factors. Alongside the well-organized development plans, the government introduced adequate taxes and levies as well as regulations to prevent further environmental degradation. It has made the project executors actively participate in the water quality improvement project by offering incentives to them such as rights to parcel and sell the reclaimed land. Plus, it put innovative efforts into restoring the water quality and generating renewable energy by installing Korea's first artificial wetland and constructing a tidal plant with the world-largest capacity. Above all, it maximizes stakeholders' satisfaction about the policy by creating a council where all the stakeholders participate in the decision making process and reflect their environmental and economic interests.

As stated above, these policies cannot be applied intact to other country's cases as the circumstances vary from country to county. However, the policies can serve as a guidance for policy makers in other countries who are attempting to make a voyage of greener growth, not only for current generation but for the future generations.

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Australia

Murray-Darling River Basin: Water Trading and Water Use Efficiency

About the Report

This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

Disclaimer

The findings, interpretations, arguments, and conclusions expressed in this report areresponsibility of the authors and do not necessarily reflect the views of K-water and World Water Council.

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Abbreviations and Acronyms

APEC Asia-Pacific Economic Cooperation

ASEAN Association of Southeast Asian Nations

BCC Basin Community Committee

COAG Commonwealth Government and Council of Australian Governments

CAC Community Advisory Committee

GDP Gross Domestic Product

MDB Murray-Darling Basin

MDBA Murray Darling River Basin Authority

MDBC Murray Darling River Basin Commission

MDBMC Murray Darling Basin Ministerial Council

NSSD National Strategy on Sustainable Development

NSW New South Wales

NWI National Water Initiative

PPP Purchasing power parity

RTB Restoring the Balance Program

WTO World Trade Organization

Executive Summary

In this report, we focus on Murray-Darling Basin to investigate the potential positive influence of water trading on Australia's green growth, through improved water use efficiency and affected environmental water flows. We follow Saleth and Dinar's (2004) institutional framework to analyze the interaction between institutions and water sector performance. For the purposes of the analysis, we investigate not only the economic, social, political, environmental, and technological levels in which water trading in the Murray-Darling Basin took place, but also the policies and institutions that mark project's course from its planning phase in the 1990s until today and the changes in those policies and institutions over the course of time.

One of the main lessons learned by this analysis is that, despite the potential problems of federalism – the autonomy of states hindering the attainment of federal policy goals – water reforms have proceeded apace with the so-called spirit of "cooperative federalism". An agreement has been achieved in the Murray – Darling Basin among federal states despite the presence of different water policies and objectives. The main purposes that have facilitated the achievement of the agreement include clear institutional structure at the river basin level, well-defined state level water laws and national policies, and strong enforcement of National Water Initiative (NWI). It appears that a balance has been attained between economic benefits and allocative efficiency, and sustainable water resource management. However, further research is required to assess the impact of other important socio-economic aspects such as technological change and employment levels.

I. Introduction

1. Purpose of the Case Study

In this case study, we investigate how water trading in the Murray-Darling Basin contributed to improved water use efficiency and affected environmental water flows and hence contributed to green growth in Australia. We examine the institutional and policy changes, the inter- and intra-state trades and the overall socio-economic impact of the management of water in the Murray Darling basin. This case reveals how important the "green concept"—the consideration of the environmental and social aspects in addition to the economic one—is in the efficient management of water resources for green growth. It also highlights the importance of institutional strength in achieving green growth.

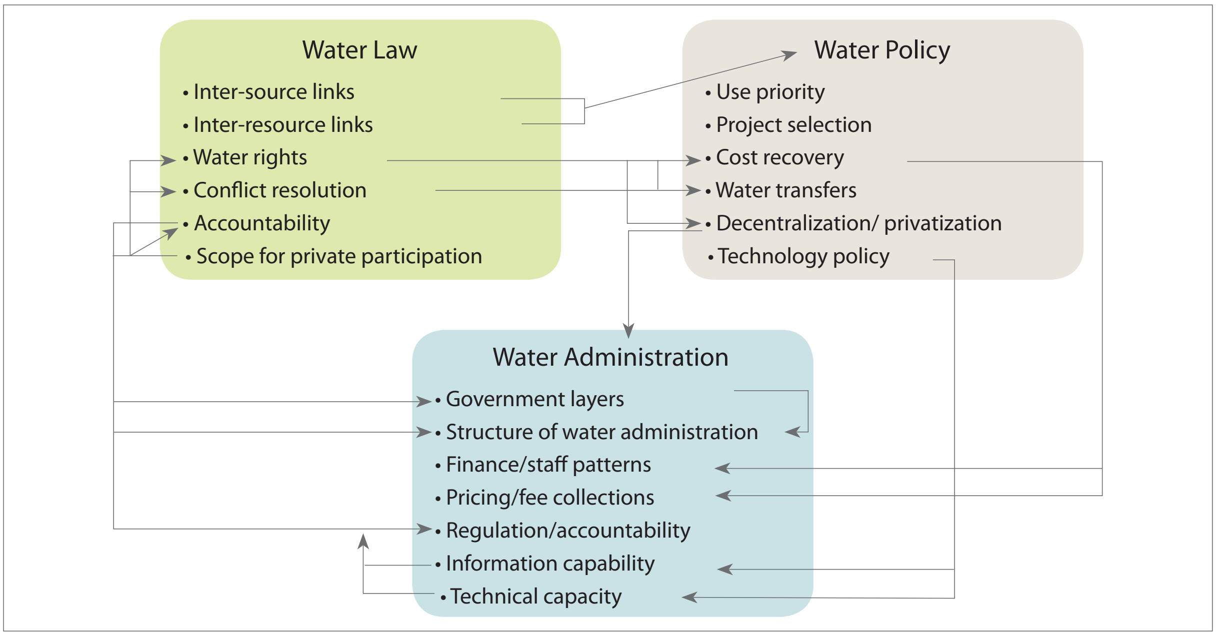
2. Case Study Methodology

New Institutionalist Approach

In this report we use a New Institutionalist Approach to analyze how water trading in the Murray-Darling Basin contributed to Australia's green growth from an institutional perspective. The question of institutions became an important research topic in Economics, leading to the development of the theory of ownership and transaction cost theory that comprise what it is known as New Institutionalism. Institutions could be defined as behavioral rules that establish what is permitted and prohibited. Thus, the analysis of the construction and change of institutions can be used to understand social change (North, 2005). The Institutionalist approach is used to investigate how Australia's water-trading scheme project attained what outcomes under which institutions and which policies. This report explores how the economic, social, political, environmental, and technical exogenous factors together with the Australia's water-related institutional framework and relevant policy mix led to the success or failure of the water-related green growth project.

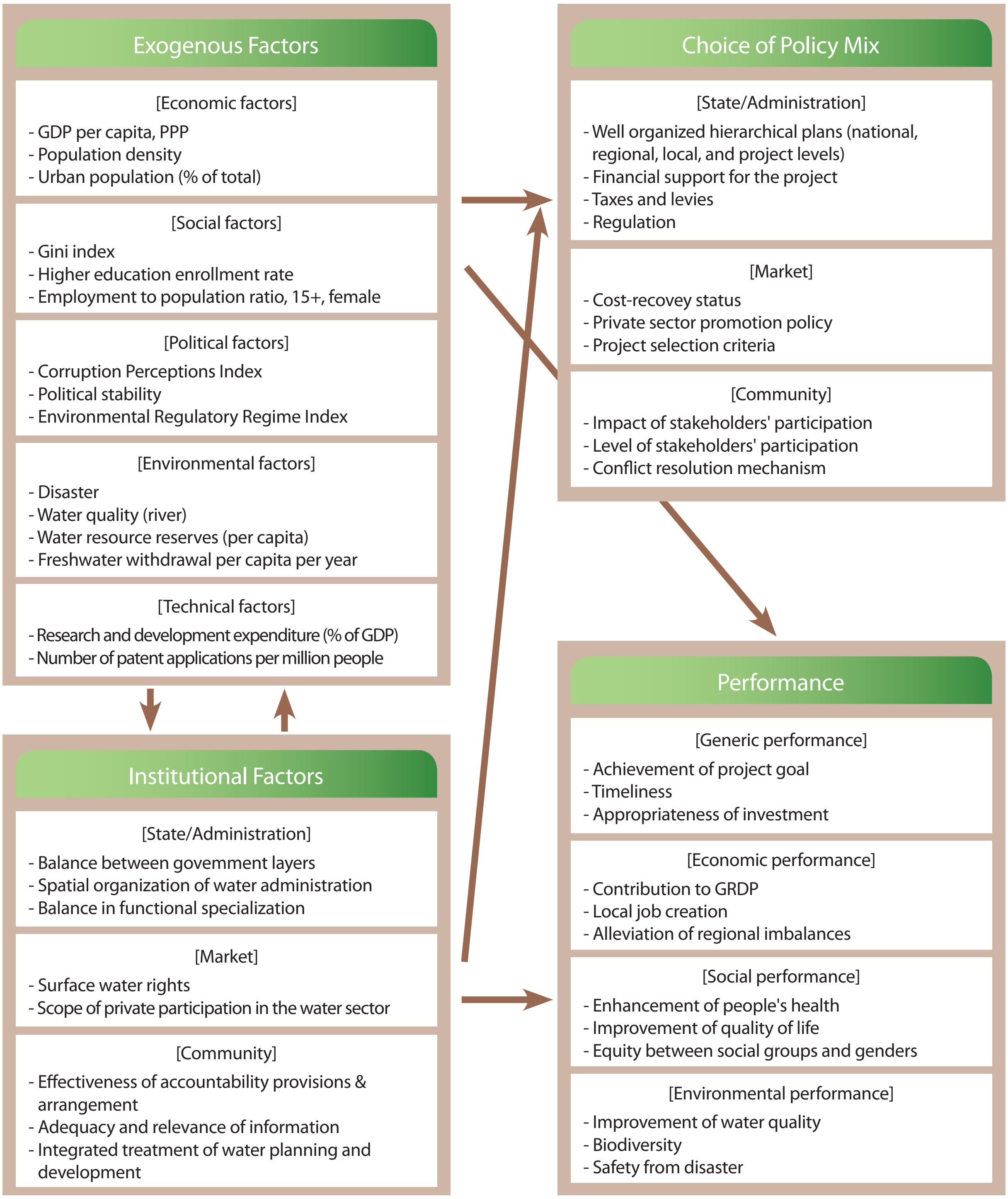
Analytical Framework

The report follows the analytical framework developed by Saleth and Dinar (2004) *The Institutional Economics of Water* (see Figure 1). In order to analyze the interaction between institutions and water sector performance endogenous and exogenous factors of



<Figure 1> Saleth and Dinar's (2004) Analytical Framework

change are identified and assessed. Exogenous factors refer to national or regional political systems, legal systems, populations, economic factors, and natural and environmental factors. The water sector comprises all water sources and uses (both consumptive and non consumptive), and all major water issues ranging from quantity-quality conflicts to drought-flood conditions. Water institutions are defined as "an entity defined interactively by three main components: water law, water policy, and water administration" (Saleth and Dinar, 2004, p. 95) and include the legal framework, policy regime, and administrative or organizational arrangements.



Source: Modified from Saleth and Dinar (2004)

<Figure 2> Institutional Framework Modified from Saleth and Dinar (2004)

Saleth and Dinar's institutional framework is re-categorized into state, market, and community (see Figure 2) to take into account the arguments about the drivers and instruments of economic and social development and environmental conservation based on the state, the market, and the community. Clearly, the outcomes of a water-related project will differ if its institutional framework was predominantly state-driven, market-oriented, or community-centered.

3. Organization of the Report

The purpose of this report is to investigate the economic, social, political, environmental, and technological levels in which water trading in the Murray-Darling Basin took place; the policies and institutions that mark the project's course from its planning stage in the 1990's until the present; and the changes in those policies and institutions over that time. The project's performance is analyzed and lessons drawn. Exogenous factors are examined first, then institutional factors and the policy mix considered together, and performance analyzed last.

II. An Overview: Water Trading in the Murray-Darling Basin

1. Geography, Water Resources, and Economic Activity

The Murray-Darling Basin (MDB) in Australia is synonymous with the successful introduction of cutting edge market based economic instruments (MBIs) for the management of water quantity and quality. The success of MBIs in the MDB could not have been easily predicted as there are several features of the MDB that do not necessarily lend themselves well to such policy interventions. Firstly, there is the sheer scale of the MDB, covering an area equivalent in size to Tibet, or eight times the size of the UK, of around 1 million squared km. The river itself is 3780 km long, making it the 4th longest river in the world, and it flows from the Great Dividing mountain range to the Southern Ocean (see Figure 3).

Secondly, the MDB contains different water users. For instance, 45% of all irrigated land in Australia, 43% of all farms, and over 70% of the total irrigated area of Australia. The combined value of agriculture is said to be US $7.5bn. The MDB is also important in terms of urban supply: residential and industrial, as well as containing numerous important wetlands areas.[1] For instance, the city of Adelaide (population 1 million) obtains 40% of its water from the river. The climate across the MDB is predominantly arid, with rainfall varying from 1,400 mm in the East to 300 mm in the Northwest. Although the largest water user in most cases is the agricultural sector, urban water users in various regions (including Adelaide, Ballarat, and Bendigo) have benefited from the purchase of entitlements and allocations by urban water authorities. On the other hand, government purchases of water entitlements for the environment have increased recently (NWC, 2010).

Thirdly, the natural flow of the river varies considerably by season with ratios of low to high flow often in the region of 1:1000. Annual variations are also large. As a consequence a great deal of investment in storage capacity has taken place to smooth supply to all users. In sum, the total storage in the MDB is in the order of 35000 million litres, and many of these storage sites are connected by canals.

1) Many of these sites are designated RAMSAR sites.

Source: Murray-Darling Basin Authority (http://www.mdba.gov.au/)

<Figure 3> The Murray Darling Basin

Lastly, the MDB is a trans-jurisdictional water resource. Australia is a commonwealth of states and territories, and the MDB crosses the borders of 4 federal states and 1 territory.[2)] It covers 75% of the area of New South Wales, 56% of Victoria, 15% of Queensland, 8% of South Australia and all of the Australian Capital Territory.

So, the MDB is large, is associated with great uncertainty with regard to the water resources themselves, and has multifarious dependent sectors across several jurisdictions. For these reasons, an important coordination problem among others related to water resource management may result.

2) The states of Australia are New South Wales, Queensland, Victoria, South Australia, Tasmania, and Western Australia. The territories of Australia are: Australian Capital Territory, Jervis Bay Territory and the Northern Territory.

Furthermore, in the 1990s water demands and threats to general water quality increased. It was increasing scarcity and these general threats to quality that lead to the institutional and policy reforms that we see today.

The main issues addressed by the institutional and policy reforms can be listed as follows (Dixon et al., 2011):

- the environmental health of the basin;
- doubts concerning the sustainability of irrigation; and
- the desire to move water to higher-value uses.

The chief innovation was the establishment of well-defined water rights, their separation from land rights and the ability to trade water rights. With the total quantity of water rights capped across the entire basin, the objective was the efficient allocation of water rights within a sustainably managed river basin. Trades have taken place within and between states. The management of the MDB however, required more than water rights to be defined and rights to be tradable. The basin is sustained by a complicated arrangement of horizontal and vertical institutions which bring together and represent stakeholders across different federal states, across sectors, and across different ministerial departments. The successes of the management of the MDB are rooted in these institutional arrangements, as well as in the ability to trade well defined water rights. Central to these institutional arrangements is the Murray Darling River Basin Commission (MDBC), the associated Community Advisory Committee (CAC) and above this at the Federal ministerial level, the Murray Darling Basin Ministerial Council (MDBMC). The complexity of the institutional arrangements has allowed the system of management to evolve, and emerging problems and crises to be dealt with in a manner that has allowed most stakeholders to be accounted for in the decision making process. In this way third party effects of water trades, increasing frequency of drought, and other such problems have been accommodated in more recent adjustments to, for example, the trading rules. We now discuss these institutional arrangements in more detail.

2. Murray Darling Basin Institutions

As described above, the institutional framework surrounding the MDB is complex and reflects the scale and variability of the basin on the resource side and the multi-sectoral and trans-jurisdictional nature of the river basin on the demand side. Figure 4 provides a diagram of the institutional arrangements. We now describe the key institutions that determine water resource management and allocation in the MDB.

2-1. The Commonwealth Government and Council of Australian Governments

The Commonwealth Government and Council of Australian Governments (COAG) is a national body which coordinates between states on matters of national interest: economy, transport, environment, water etc. It contains members from the national, state and local government. In relation to water, coordination was formerly facilitated in relation to the 1994 COAG Water Reform Framework. This framework was extended by the National Water Initiative of 2004 (NWI), the principles of which are discussed in detail below, but which include:

- full cost pricing of water consumption;
- water resource management at the catchment level;
- clear water entitlements and;
- separation of water rights from land ownership.

The reforms are directed by a High Level Steering Group consisting of members of the COAG. The overarching objective of the reforms is to ensure economic development which is ecologically sustainable. In order to assist in the finance of the reform process, the Commonwealth government has supplied central funding via the COAG to individual states (MacDonald and Young, 2001).

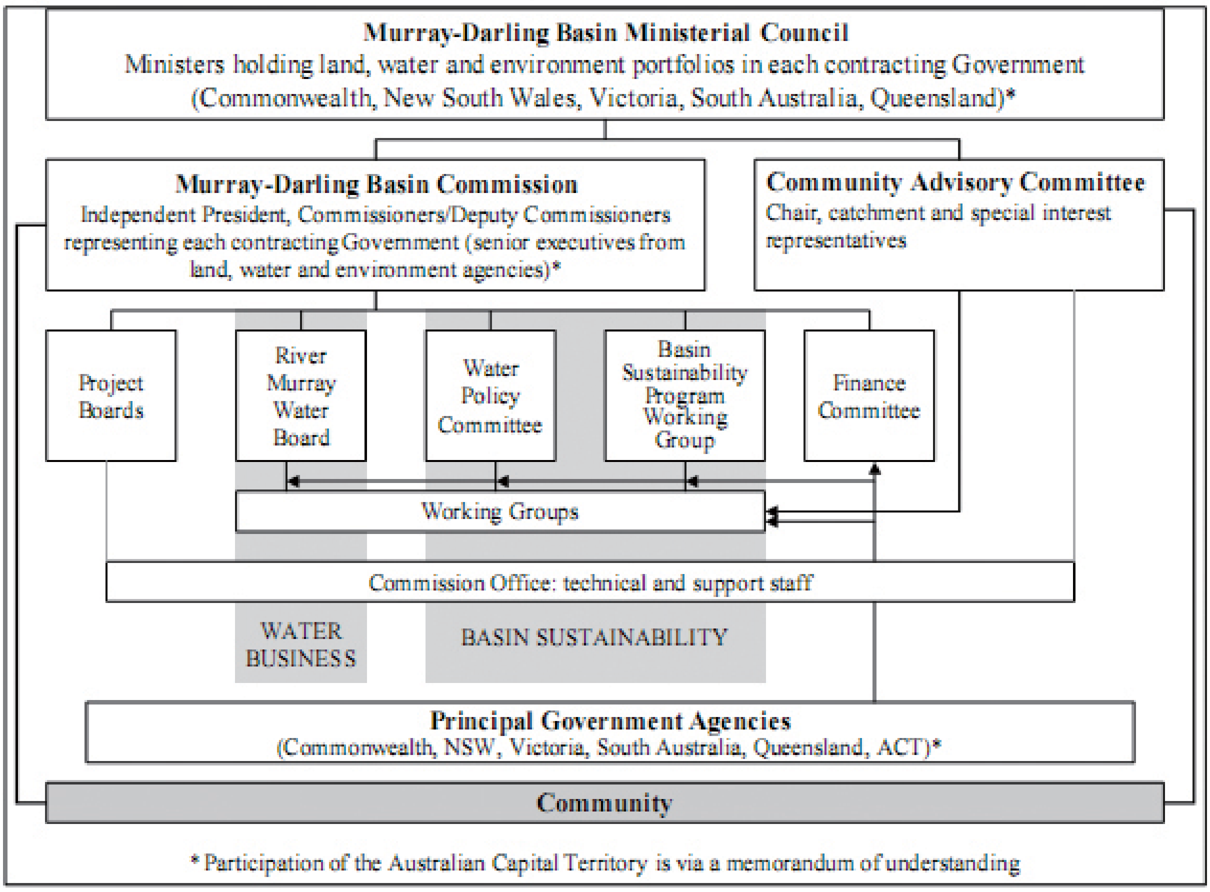
2-2. Murray-Darling Basin Ministerial Council (MDBMC)

The MDBMC was created in 1985. It acts as a conduit between the Murray Darling Basin Commission (see below) and the COAG in matters relating to the implementation of the NWI. The MDBMC contains ministers of land, water and environment for each of the signatory states of the Murray Darling Agreement (MDA). The MDBMC's objectives are to consider all matters of common interest to the members in relation to water and environment, and to develop, consider and authorise measures to ensure economic, sustainable and equitable use of water, land and other environmental resources (MacDonald and Young, 2001). The MDBMC can make decisions at the basin level, but this requires unanimity among the basin states/territory. Implementation of agreed measures is the responsibility of the state/territory governments however.

2-3. Murray-Darling Basin Commission (MDBC)

The MDBC is the executive arm of the MDBMC. It is an autonomous organisation responsible in equal measure to the MDBMC as to the state and local governments represented there (MacDonald and Young, 2001). The key functions of the MDBC are:

- Advising the MDBMC on planning, development and management of the MDB;
- Assisting the council in developing measures to ensure equitable, efficient, and sustainable use of resources;
- Coordinating the implementation of, or actually implementing these measures; and
- Giving effect to any policy decision of the MDBMC



Source: Macdonald and Young (2001)

<Figure 4> The Institutional Arrangement for the Murray-Darling River Basin

In sum, the MDBC facilitates cooperation between states and between the states and their stakeholders, and oversees various working groups on basin sustainability and water supply. This reflects the goals of the NWI and the weight placed upon community participation in the MDBC.

Under the 2007 Water Act, the MDBC essentially became the Murray Darling River Basin Authority (MDBA).

2-4. Basin Community Committee (BCC) (was Community Advisory Committee (CAC))

The CAC, reestablished as the BCC under the Water Act of 2007, is a body which represents community interests in the overall institutional structure surrounding the MDB. It acts as a voice for the community, as well as a conduit for information from the MDBMC. It provides a community perspective on water resource management, environment, culture, and socio-economic issues. This mechanism for public participation is a common feature of resource management bodies in Australia (MacDonald and Young, 2001). Community participation is a pre-condition for water and green growth since it is by definition “inclusive and concerned with social equity” (UNESCAP, 2012; UNEP, 2009). Australia has a long history of community organisation reflected in the current shape of its institutions.

The BCC embodies representation from the catchment committees and other organisations within the MDB and reflects community concerns in relation to the implementation of the Basin Plan. Members are selected on the basis of expertise or interest in the community or environmental issues. The BCC must form sub-committees for specialist areas such as irrigation, environmental water, and the like.[3)]

2-5. Summary

Water management arrangements in the Murray-Darling Basin have evolved from a focus on managing rivers for water quantity and security of supply for rural development, to integrated catchment management. Policy statements developed by the Murray-Darling Basin Ministerial Council, such as the Natural Resource Management Strategy, adopted in 1990, explicitly embrace integrated catchment management for the MDB. The MDBMC and CAC have adopted the policy ‘Integrated Catchment Management in the Murray-Darling Basin 2001-2010’ in order to harmonise all Council strategies and actions. In turn, the basin states now have decentralized catchment management bodies, represented in the CAC, which have the task of advising on all aspects of natural resource management.

With the advent of the NWI, the institutional arrangements in the MDB began to change again. State governments and the Murray-Darling Basin organizations are now supplemented at the sub-basin level by catchment management bodies responsible for water, land and environmental management. The NWI means that the COAG and the Commonwealth government now consolidate the basin level approach of the MDBC in developing water policy, and that reforms are pushed at the national level to encourage water trading and environmental sustainability.There are numerous other sub-bodies that feed into the decision making-apparatus embodied in the MDB institutions, but the aforementioned are the main bodies.

3) http://www.mdba.gov.au/about-mdba/governance/committees/bcc

3. Water Laws and Policy

3-1. Water Laws and Initiatives

Australia faces severe difficulties on balancing supply and demand for water. In the literature, climate change, an increasing population and an increasing awareness of environmental costs of water withdrawals are identified as the reasons of this problem (Grafton and Peterson, 2007; Young et al., 2006). In consequence, each state has a separate water law stipulating regulations concerning environmental demands, water for consumption and so on. In 1994, with the signing of the COAG Framework for Water Reform, Australia and its States and Territories embarked on a process of reform in the water sector since "there is a number of issues and deficiencies involving water and the wider natural resource base that require the attention of governments." The oldest water act is from 1997, while some of the more recent amendments are from 2006. The National Water Initiative (NWI) of 2004 has guided reform in recent years.

The NWI embodies commitment from state and federal governments to reform water law and policy in recognition of: the continuing national imperative to increase the productivity and efficiency of Australia's water use; the need to service rural and urban communities; to ensure the health of river and groundwater systems; and the need to return all systems to environmentally sustainable levels of extraction. The NWI also signifies, inter alia, a commitment to identifying over-allocated water systems, restoring those systems to sustainable levels, expanding the trade in water resulting in more profitable use of water, more cost-effective and flexible recovery of water to achieve environmental outcomes, better monitoring, reporting and accounting of water use, and improved public access to information. In short the NWI aims to move towards a unified, more sophisticated, transparent, and comprehensive system of water planning in the face of obvious issues of scarcity and pollution. The precise objectives of the NWI are described in Box 1. The NWI makes specific reference to the MDB to ensure that: a) relevant Parties agree to review the 1992 Murray-Darling Basin Agreement, where necessary, to ensure that it is consistent with the NWI; and b) a separate agreement to address the over-allocation of water and achievement of environmental objectives in the MDB will operate between the Commonwealth Government and the States of the MDB. The ensuing MDB Intergovernmental Agreement will be consistent with the objectives, principles, and actions identified in the NWI (NWI, 2004, para 14).

In recent years water law has been guided by the Commonwealth Water Act (2007) and the Water Amendment Act (2008) which specify the need for a River Basin Plan in the Murray Darling River Basin, and specify more clearly the roles of the MDBA.

Key features of the act in relation to the MDB are:[4)]

- The Act establishes the Murray-Darling Basin Authority (MDBA) with the functions and powers, including enforcement powers, needed to ensure that Basin water resources are managed in an integrated and sustainable way.
- The Act requires the MDBA to prepare the Basin Plan - A strategic plan for the integrated and sustainable management of water resources in the Murray-Darling Basin. The River Basin Plan became law in 2012.
- The Act establishes a Commonwealth Environmental Water Holder to manage the Commonwealth's environmental water to protect and restore the environmental assets of the Murray-Darling Basin,

4) http://www.environment.gov.au/topics/water/australian-government-water-leadership/water-legislation#water-act

and outside the Basin where the Commonwealth owns water.

<Box 1> The Aims of the NWI[5)]

The National Water Initiative aims to achieve:

- Clear and nationally-compatible characteristics for secure water access entitlements;
- Transparent, statutory-based water planning;
- Statutory provision for environmental and other public benefit outcomes, and improved environmental management practices;
- Complete the return of all currently over-allocated or overused systems to environmentally-sustainable levels of extraction;
- Progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be in place;
- Clarity around the assignment of risk arising from future changes in the availability of water for the consumptive pool;
- Water accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management;
- Policy settings which facilitate water use efficiency and innovation in urban and rural areas;
- Addressing future adjustment issues that may impact on water users and communities; and
- Recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource.

3-2. Property Rights to Water

The NWI as states explicitly in its objectives the need for facilitating trade in water rights to ensure the efficient use of water. Such trade is only to be tempered by the need to achieve certain environmental goals such as sustainable use and ecological integrity. This emphasis is reflected in the various state laws. For this reason, it is worthwhile discussing the property rights to water in greater detail.

One of the main goals of the NWI is to facilitate trade in water between sectors to achieve an efficient allocation of water. Rights have been defined in terms of "entitlements" and "allocations".

- Permanent water access "entitlement": A right to a part, or share, of the water available within a water system (e.g. a river).
- Water Allocation: During the year, water is distributed or 'allocated' against an entitlement by State governments. This creates a water allocation: the level of water available for use.

In order to facilitate trade in water property rights to water have for the most part been separated from land rights. This is a movement away from the riparian/ad hoc legal doctrine of the past. Successful trade (in any commodity) requires well defined property rights to water. The NWI specifies that water entitlements should have the following properties (NWI, 2004):

i) Water access entitlements are separate from land;
ii) A water access entitlement will specify the essential characteristics of the water product,
iii) Be exclusive, tradable; mortgageable
iv) Have the ability to be subdivided or amalgamated;
v) Be enforceable and enforced;
vi) Be recorded in a publicly-accessible reliable water register; and
vii) The allocation of water to a water access entitlement is to be consistent with a water plan.

The process of property rights reform evolved at different rates in each of the states of the MDB, and hence so did the structure of property rights/entitlements to water. Due to variability of surface water flows both seasonally and annually, water rights in the MDB have tended to be defined as a proportion to the seasons flow. There are also several classes of security for water rights/entitlements within the MDB: e.g. 'high security', such that the quantities are guaranteed except under extreme drought, or 'low/general security', which is a license to available water only (MacDonald and Young, 2001). In accordance with the definition of entitlments and

5) NWI 2004. Paragraph 23. http://www.nwc.gov.au/nwi/index.cfm.

allocations, trades can be either permanent or temporary.

- Allocation Trade: A person may choose to sell their water allocation for a single year, but retain their water access entitlement.
- Entitlement Trade: A person may also choose to sell their water access entitlement. This is known as an entitlement trade and is potentially permanent.

While for many years the nature of water rights differed across states, efforts have been made to harmonise water rights and their conditions and terms. One major problem that has been highlighted is the potential for third party costs, or externalities as water use is transferred from one party to another. Formal rights for environmental flows are gradually being defined in law, partly as a response to this, but mainly inline with the objectives of the NWI. Rights are often allocated to groups rather than individuals: e.g. irrigation districts. Some have argued that this has hindered trade (World Bank, 2005). One problem with the allocations of water rights in the past is that in many basin states the rightsare greater than the available resources. Attempts to reduce the allocation have met with resistance from irrigation and farmers groups (World Bank, 2005), but this has been addressed in the 2007 Water Act.

3-3. Water Policy

Historically, water policy in Australia has prioritised water consumption in the following order: domestic, livestock, irrigation, and industry. Water policy has changed radically in Australia and in the MDB since the 1994 COAG agreement, and this process if of reform remains a feature of the NWI. In recent years, environmental demands for water have started to be prioritised in the state level water laws (See Table A1 in the Appendix for instance). For instance, areas such as the Barmah-Millewa Forest have a specific environmental allocation, partly due to the Ramsar status of the Barmah wetland. In New South Wales, a 10% reduction in irrigation licenses has been enacted to ensure environmental flow.

It is in relation to water quantity and allocation that water policy has seen the most radical changes however. In the MDB, water use exploded in the 1950s, as a result of state funded irrigation projects built with the intention to furthering rural development. The growth in water use continued throughout the 70s and 80s until in the 90s, the increased incidence of water drought combined with various environmental episodes: algal blooms, low water quality due to salt concentrations and turbidity, lead the MDBC to recognise that something had to be done. Numerous policy changes have occurred since then. The overall ethos of water law and policy has shifted away from the need to develop water resources at government expense, towards and ethos of conservation of water resources, control of pollution and full cost recovery of water supply. The government uses taxpayers' money to protect the environment. It is a prioritisation of the environment and intervening in a market on the demand side to reallocate rather than planning and supply side interventions. It is redistributive also (willing buyer/ willing seller) and politically easier.

The current ethos is expressed well by the objectives of the NWI as well as in its principles (NWI, 2004, para 5).

In 1992/93, the MDBC members agreed to undertake a thorough audit of the users. In 1994, this lead to agreement by the MDBC that additional water extraction should cease, and total extraction within the MDB should be capped at 1993 levels. These varied by each state, as shown by Table 1.

<Table 1> The MDB Water Extraction Cap by State

State	Cap (million litres)	Comment
New South Wales	6000	1993 levels, or in proportion
Queensland	-	1993 levels, or in proportion
South Australia	50 (rural towns), 650 (metropolitan), 524 (agriculture)	With certainty
Victoria	4000	1993 levels, or in proportion

3-4. The Commonwealth Buyback Scheme

More recently, with the advent of the 2007 Water Act and the requirement for the River Basin Plan to be put in place by the MDBA, the Commonwealth Buyback scheme has been implemented under the "Restoring the Balance" (RTB) program. In competitive situations of water allocation (i.e. when water demand exceeds the supply), the necessity to assess the value of in-stream flow uses is a very important policy issue. Since excess water supply is unusual, a compensation principle could be applied and an economically efficient solution (Pareto Optimal) could be expected if those benefiting from an action could hypothetically compensate the losers and still be better off (Platt, 2001). Efficient allocation of water requires that the marginal value of water be equal across all uses. There is a range of mechanisms for determining these marginal values in a number of areas through, for example, the use of water markets (e.g. the MDB water trade scheme). The RTB program is a part of the Sustainable Rural Water Supply and Infrastructure progam. The buyback scheme has seen the Australian Government committing AUS $3.1 billion to purchase water for the environment. The aim was to return 2,750 gigalitres of water to the river basin from irrigation users.

3-5. Tradable Water Rights

One of the central tenets of the NWI was the promotion of trade in water rights. In order to ensure efficient administration of water trading and address some of the shortcomings of tradable permit schemes, such as the impact on third parties and environmental degradation, the NWI has set out certain generic rules for trading. Box 2 documents these rules (NWI, 2004).

<Box 2> General Water Trading Rules (NWI, 2004)

- Water access entitlements may be traded either permanently, through lease arrangements or through other trading options;
- All trades should be recorded on a water register;
- Restrictions on extraction, diversion or use of water resulting from a trade can only be used to manage:
  - Environmental impacts;
  - Hydrological, water quality and hydro-geological impacts;
  - Delivery constraints;
  - Impacts on geographical features (such as river and aquifer integrity); and
  - Features on major indigenous, cultural heritage or spiritual significance;
- Trade may be refused on the basis that it is inconsistent with the relevant water plan;
- Trades must not generally result in the sustainable yield being exceeded; and
- Where necessary, water authorities will facilitate trade by specifying trading zones and providing related information such as exchange rates to be applied on trades.

Trades can be permanent or temporary leases. Furthermore, with water rights separated from land, water rights can be held by individuals without land. To date, trading has taken place both within states, and to a lesser extent, between states. The introduction of the Cap by state in the MDB has focused attention on the efficiency of water use and the trading of water rights to the most valuable user, and hence over the past decade trading volumes have increased.

In addition to these general rules, there are state specific rules stemming from the state water laws. For instance, in Victoria, trading is generally only allowed where Water Resource Plans have been completed for the agents in question. The extent to which landowners can engage in water trade also differs by state, as do the rules governing trades external to irrigation districts.[6] Lastly, in order to administer the trading system, fees are levied by state and local governments ranging from US $50 - US $500, with fees for permanent transfers being higher than for temporary.

6) This is where the main differences lie (PWC, 2005).

4. History of Water Trades in the MDB

4-1. Intra-state Trading

Trades in water rights have occurred both within and between the states of the MDB. Trading within Victoria and New South Wales (NSW) is well developed, with trades easily facilitated on the internet.[7)] In NSW between 1997-98, total sales of water rights amounted to 11% of the total entitlements to consumptive users. Most trades at that time were temporary 'leases' of water, rather than permanent trades, and involved low security rights. Permanent trades are generally subject to environmental impact assessment and require the consent of the relevant water allocation authority (MacDonald and Young, 2001).

Since that time, the volume of temporarily traded water has increased by 8.8%, while permanent trades increased by 7.9% (PWC, 2005). Overall trade has remained stable as a percentage of the total allocated entitlements, at 12.6% in 2003/04, and temporary trades make up around 90% of all trades. Table 2 shows the volumes traded by state in 2003/04. The trades recorded here are not only intra state but also intra-catchment trades. Inter-catchment trades represent a minor component of trading activity (PWC, 2005). As explain, "water trade requires connected (natural or built) infrastructure to facilitate the movement of water from the seller to the buyer." However, many catchments are not hydrologically connected, so trade is restricted to schemes within a catchment and this result in less inter-catchment trade.

<Table 2> Interstate Water Trades in 2003-04

State	Permanent		Temporary		Total (Ml)
	Million litres	% of Trades	Million litres	% of Trades	
New South Wales	20077	15.9	604059	84.1	624136
Victoria	52212	3.2	275446	96.8	327658
South Australia	23818	21.4	87522	78.6	111340
Queensland	-	-	15585	100	15858
Total Basin	96107		982612		1078719

4-2. Inter-state Trading

In recent years, there have been a number of initiatives to stimulate inter-state trading of water rights. Between 1998 and 2006, the MDBMC commenced with a pilot interstate water trading project under which limited inter-state trades of permanent water rights was allowed. The pilot project allowed water users in South Australia (River Murray) and Victoria and New South Wales (Mallee Regions) to trade, with water to be transferred via existing infrastructure.[8)] Where rights of differing security are traded, an exchange rate is arranged to reflect the relative risk. With the advent of the NWI in 2004, the areas engaging in interstate trade were expanded. Table 3 shows the volumes traded in the pilot project. Interestingly, these consisted of over 160 trades of small volumes (PWC, 2005).

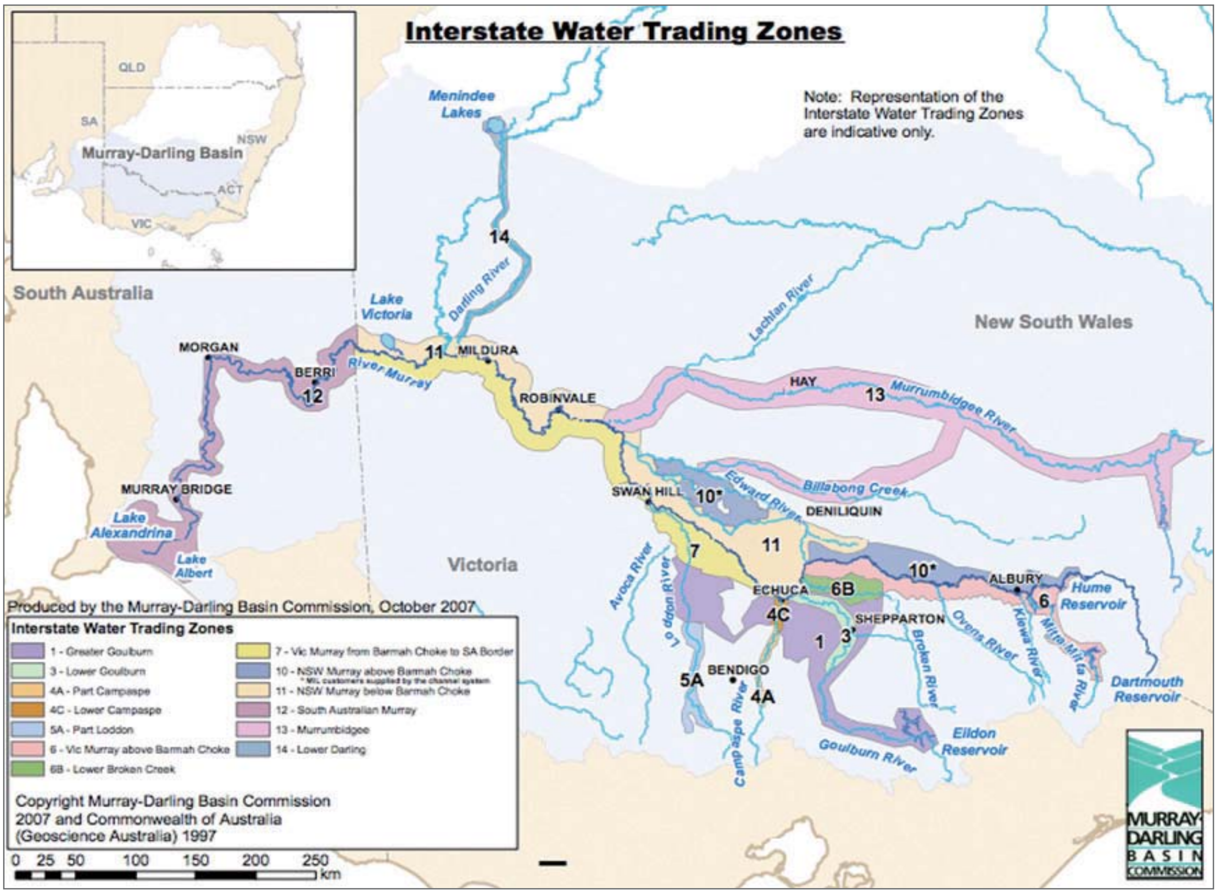
The methods of trading differ between the participating states. In South Australia there are two methods: i) exchange rate trade: an entitlement is converted from the selling state to the buying, and then reissued to the buyer; and ii) tagged trade: the entitlement remains issued by the selling state but the water is delivered to the buying state. In New South Wales, only tagged trade is possible. Trades are administered and approved by the state governments and the MDBC. Figure 5 shows the inter-state trading zones

<Table 3> Inter-state Water Trading, 2003 (PWC, 2007)

Origin	Destination (million litres)			
	NSW	SA	Victoria	Total
New South Wales	-	7310	345	7655
Southern Australia	100	-	2074	2174
Victoria	3040	9936	-	12976
Total	3140	17246	2419	22805

7) See e.g. www.watertrading.com.au and www.waterexchange.com.au.

8) These regions were selected due to the homogeneity of water rights therein (secure) as well as the homogeneity of agricultural activities and water prices (MacDonald and Young, 2001).



<Figure 5> Map of Interstate Trading Zones

5. Impact of Water Trading

According to NWC (2010), water trading in the MDB has proven to be an extremely useful tool in helping water users, particularly irrigators, to respond to changes over the past decade. The flexibility that tradable water rights impart has enabled users to respond better to drought and unprecedented variability in water allocations. All the available evidence suggests that there were net benefits from participation in the trading scheme. Some estimate that the net benefit to agriculture alone was a $220 million increase in GDP in 2008–09.

While it remains difficult to establish clear causality, it seems that water trading may have had the effect of moving water out of rice-growing areas in NSW and some milk-producing areas in northern Victoria towards other areas of agriculture. So, the instrument appears to be encouraging structural change in the agricultural sector. Water trade has allowed long-term industry investment, reduction or exit of companies or individuals because it improves the management of variations in seasonal water availability. It has also provided flexibility in water use, production and farm management (risk and debt management) that would not be otherwise possible. Trading has not always come without some cost to certain parts of society. Yet, although from an environmental perspective the trading scheme has had isolated adverse effects, overall it appears to have had a negligible negative effect on the environment compared to the impacts of other factors (water resource development and drought). In some cases the introduction of a “buy back” scheme appears to have increased in-stream flows and improved environmental outcomes. So it can be argued that the MDB trading management regime and trading scheme has increased net economic benefits without an adverse effect on the environment (NWC, 2010). Further information about the impacts of the project is provided in Section III of this report.

III. The Case Study

1. Exogenous Factors

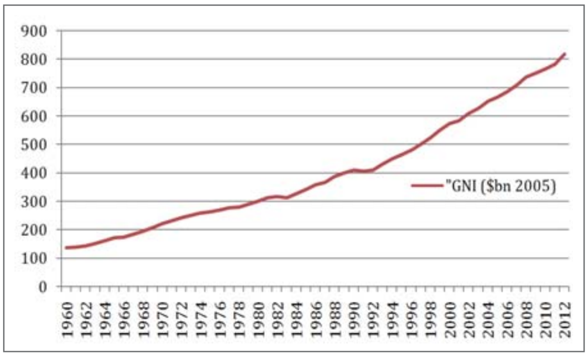
1-1. Economic Factors

The exogenous factors present a picture of the general context in which a project is carried out. This section presents the general national level of the Australian context in which water trading in the Murray-Darling Basin occurred across the economic, social, political, environmental, and technological dimensions.

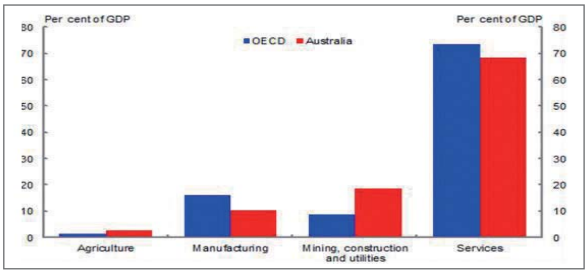
1-1-1. Economic Growth and Structural Change

The economy of Australia is one of the largest capitalist economies in the world with a GDP of US $1.57 trillion. Australia's total wealth is 6.4 trillion dollars. In 2011, it was the 13th largest national economy by nominal GDP and the 17th-largest measured by PPP-adjusted GDP, about 1.7% of the world economy.

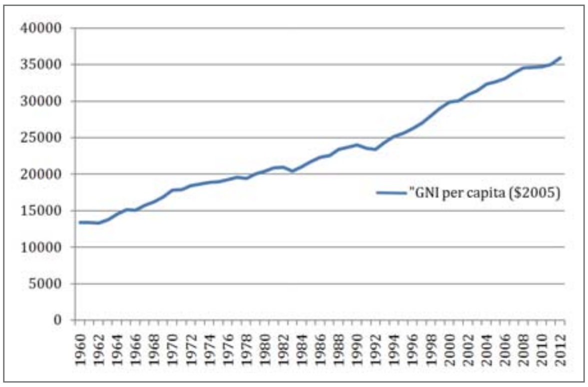
The Australian economy is dominated by its service sector, comprising 68% of GDP. The mining sector represents 10% of GDP; the "mining-related economy" represents 9% of GDP – the total mining sector is 19% of GDP (see Figure 7). Economic growth is largely dependent on the mining sector and agricultural sector with the products to be exported mainly to the East Asian market. Australia is a member of the APEC, G20, OECD ,and WTO. The country has also entered into free trade agreements with ASEAN, Chile, New Zealand, and the United States. Australia is also the world's leading coal exporter.



<Figure 6> Australia's GNI 2005 (US $tr).



<Figure 7> GDP per Sector (%)

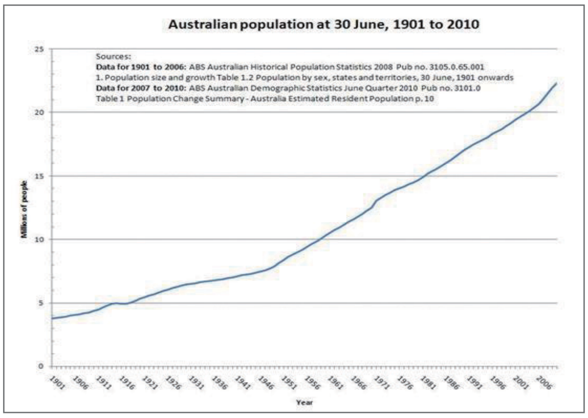


<Figure 8> GNI per capita (US $, 2005)

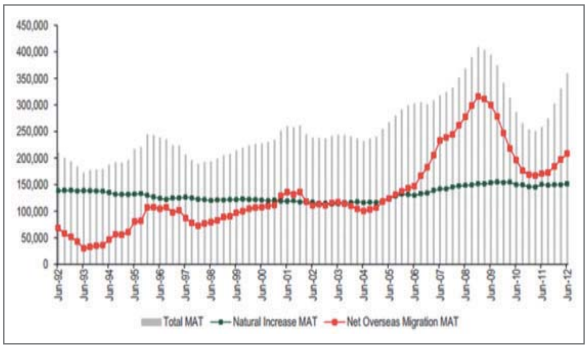
1-1-2. Population Movement and Urbanization

Today, Australia's population is 23,381,742 as of 15 February 2014 and its population density is 2.91 /km^2 (7.5 /sq mi). The density was 2.8 /km^2 (7.3 /sq mi) in 2008 and 2.86 /km^2 (7.4 /sq mi) in 2009. That made Australia the 3rd least densely populated country in the world, after Namibia and Mongolia.

Australia has scarcely more than two persons per square kilometer of total land area. With 89% of its population living in urban areas, Australia is one of the world's most urbanized countries.



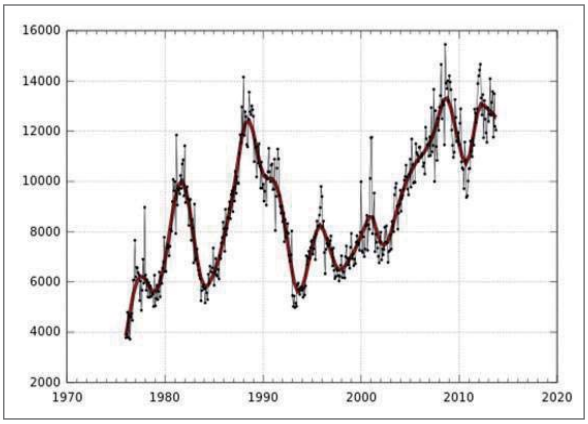
<Figure 9> Estimated Resident Population in Australia since 2008



Source: Australian Bureau of Statistics

<Figure 10> Australia's Population Growth by Component-Moving Annual Total

According to the Australian Bureau of Statistics, in mid-2006 there were 4,956,863 residents who were born outside Australia, representing 24% of the total population.



Source: Australian Bureau of Statistics

<Figure 11> Monthly Arrivals of Permanent Settlers since 1976

1-1-3. Effect of Socio-Economic Factors

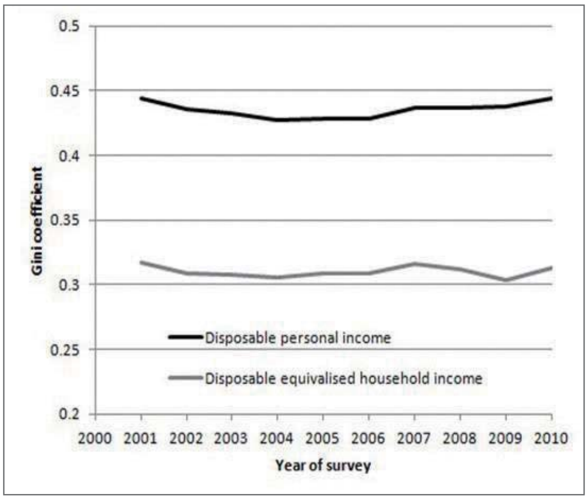
The chief economic factors that have affected the development of water resource management institutions and policy in the MDB has been the growth of agricultural and urban demands for water in the MDB combined with increased uncertainty in rainfall. These in turn have lead to environmental concerns. The low level of contribution of agriculture to overall GDP, coupled with its typically water resource intensive nature also raised concerns throughout the 80s and 90s about the efficiency of agricultural water use. Coupled with a general ideological shift towards free-market economic principles, opening up to international trade and so on, these were the main "exogenous" economic factors behind the MDB institutional reforms (MacDonald and Young, 2001).

1-2. Social Factors

1-2-1. Income Inequality

The first thing to note about the changes in income inequality in Australia over recent decades is that they are less dramatic and, unfortunately, less consistent across data sources than they are in the US. It would appear from an analysis of the Melbourne Institute that measured inequality using the Australian Bureau of Statistics' income surveys that the Gini coefficient in Australia rose from a little over 0.30 in 1993/94 to a little under 0.34 in 2008/09.

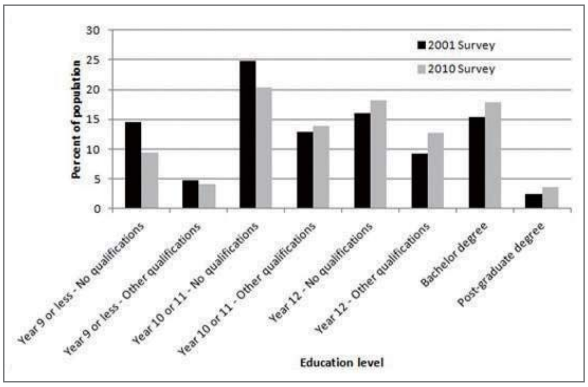
Using a more consistent set of income measures (albeit over a shorter time period) in the Household Income and Labor Dynamics in Australia (HILDA) survey, income inequality seems much more stable. This is presented in Figure 12, which gives the Gini coefficient for personal disposable, income (that is, after taking into account taxes and benefits) as well as household equaled disposable income (after also taking into account household pooling of income).



<Figure 12> Gini Coefficient (2000-2010)

1-2-2. Education Level and Equality of Opportunity

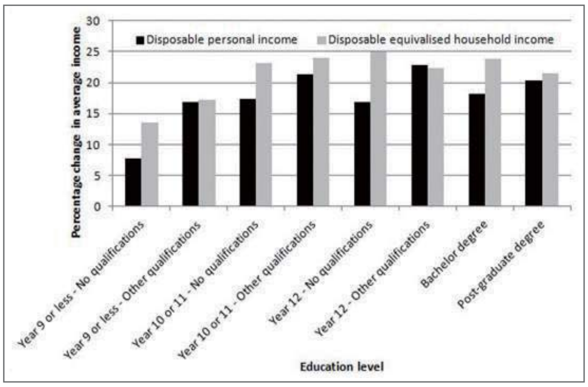
According to the HILDA survey (and all other datasets), education levels in Australia increased substantially between 2001 and 2010. Figure 13 shows the weighted percent of the 2001 HILDA sample by their education level (in black) alongside the 2010 HILDA sample.



<Figure 13> Education Level (2001 and 2010)

The percentage of the (weighted) sample that had completed Year 9 or less fell over the 9 years between Wave 1 and Wave 10 of the survey. This fall was greatest amongst those who also did not have any qualifications. There was also a fall amongst those who had completed Year 10 or 11 but did not have any qualifications. At the other end of the distribution, there were large increases in those who had completed Year 12, as well as those with a bachelor or post-graduate degree.

Between 2001 and 2010, all education types experienced an increase in average income. This is demonstrated in the following figure which gives the percentage change in average disposable personal income over the period (in black) as well as the percentage change in average disposable household equaled income (in grey).



<Figure 14> Disposable Income (2001 and 2010)

Between 2001 and 2010, average personal disposable income for those in the HILDA who had completed Year 9 or less increased by only a small amount (7.7%). Increases were greater for all other education groups, particularly for those with Year 12 and a non-degree (other) qualification (22.8%), those with Year 10 or 11 and a non-degree qualification (21.3%) and those with a post-graduate degree (20.3%). One way to look at the net effect of such changes is through a decomposable measure of income inequality (the Theil index), which apportions income inequality into the amount of inequality within education levels, and income inequality between education levels.

In the case of education, the within component is each education group's inequality level, weighted by their contribution to total income and summed across the population. When inequality is decomposed within and between education groups in HILDA, a very stable within component is found. In 2001, it was 0.297 for disposable personal income and 0.155 for disposable equaled household income. In 2010, the figures were

0.301 and 0.152 respectively. Despite rapid income growth between 2001 and 2010, variation in income within a particular level of education does not seem to have changed too much.

There was, however, a slight increase in inequality between groups. Here, the between component can be thought of as what the overall inequality level would be if there was no variation in income within each education grouping. In 2001, it was 0.053 for disposable personal income and 0.020 for disposable equaled household income. In 2010, the figures were 0.057 and 0.021 respectively. The increase in between-group income inequality over the decade suggests a small but important widening of education-based income inequality. It may not be as large as what has occurred in the US and documented in Human Capitalism, but it is noticeable in the HILDA survey.

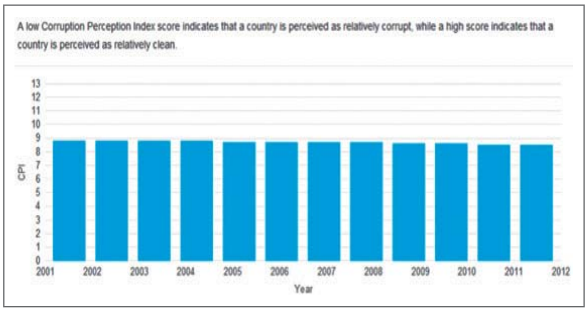
1-2-3. Effect of Social Factors

It is extremely difficult to evaluate the effect of these social factors on the MDB institutional and policy environment. Distributional issues were a motivating factor in the institutional reform process to the extent that environmental degradation and inefficient water resource use have spatial effects and lower the economic benefits from limited water resources. But concern for inequality of income, educational policy, and equal opportunities were not obviously the major determinants.

1-3. Political Factors

1-3-1. Bureaucratic Integrity

In Transparency International's Corruption Perceptions Index (CPI), Australia was listed among the 20 top countries that were ranked as having the lowest perceived levels of corruption. In 8th place Australia along with Switzerland scored 88 in 2011.



<Figure 15> Australia Corruption Perception

1-3-2. Political Stability

In a recent report by The Economist Intelligence Unit - 'Manning the Barricades' - Australia achieved one of the highest rankings of any country in the world for political stability. Australia came in equal ninth in country rankings for political stability, with the Scandinavian countries and Canada heading the list. The Economist's Political Instability Index is based on 15 social, political, and economic indicators. The Index measures a country's underlying vulnerability to political instability by indicators such as inequality, state strength and governance, levels of social provision, public trust in political institutions, and history of unrest. Economic stress is also looked at, and takes into account levels of development, growth in GDP per head and unemployment. Of the 165 countries covered by The Economist for these rankings, 95 are in the high to very high risk group for political instability; 53 countries are rated as moderate, and only 17, almost all highly developed states, are rated as low risk.

1-3-3. Effect of Political Factors

Effective water resource management relies upon functioning institutions such as enforceable and enforced property rights, well organized markets, suitable conflict resolution strategies, representative and accountable decision making. It would be easy to underestimate the need for stable, transparent and corruption free governance in realizing the success of the MDB water management strategy. The relationships between institution building and corruption are complex however, so it would be difficult to assert anything more than correlation between good governance scores and the success of the MDB water management institutions. In other words, if water management essentially is “about the relationship between water users and the government, it presupposes good governance. Yet, the fact that in many places people are still without adequate water and sanitation facilities highlights the political nature of water decisions” (Van der Zaag, 2005).

1-4. Environmental Factors

1-4-1. Water Resources

Australia is the driest inhabited continent on Earth, and among the world’s highest consumers of water. Amongst OECD nations Australia is ranked fourth-highest in water use per capita. Total water runoff in 2004–05 was estimated at 243 billion cubic meters (BCM) and total groundwater recharge was estimated at 49 BCM, giving a total inflow to Australia’s water resources of 292 BCM. Over 60 percent of runoff occurred in northern Australia. Only 6 percent of Australia’s runoff was in the Murray-Darling Basin, where 50 percent of Australia’s water use occurs. Australia’s total large dam storage capacity was 84 BCM. While surface water is well known, groundwater resources are not well known. In 2004–05, the National Water Commission undertook water balance assessments for 51 priority geographic areas across Australia.

1-4-2. Water Disasters

Australia has experienced two significant '100-year droughts' in the last 100 or so years as well as others not described here. These major droughts have resulted in financial losses, personal hardship, and environmental damage. In Western New South Wales and west Darling areas, the 1895 Federation Drought was exacerbated by heavy overstocking, and the arrival of rabbits which crossed the Murray River into western New South Wales in 1881 and reached plague proportions. Overstocking caused widespread severe erosion and increased the effects of the drought. This establishes the long history of extreme weather events in the MDB. In more recent years however, there have been several such events.

- 1982-83: large areas of central and eastern - particularly south-eastern - Australia experienced unprecedented low rainfall levels. This was the culmination of the four-year drought that had begun in 1979. It is estimated that the total cost to the economy was around A$ 7 billion. Agricultural losses, such as the death of livestock, resulted in massive job losses in rural areas. The effects of the drought contributed to the 1983 Ash Wednesday bushfires across Victoria and South Australia.
- 1991-95: This drought in north-eastern New South Wales and much of Queensland, was the result of the lowest rainfall levels on record. A number of major water reservoirs went dry and many others fell to critically low levels. Average rural production fell by over 10 percent and rural unemployment rose. Loss to the economy is estimated at around A$ 5 billion.
- 2002-06: Eastern and southern Australia once again experienced widespread drought, with agricultural income in 2006-07 at the lowest level since 1994-95.

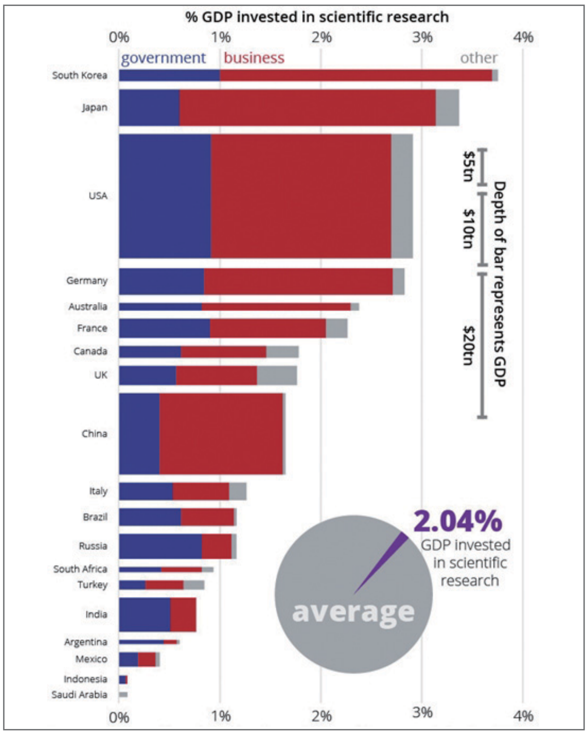
1-4-3. Effect of Environmental Factors

It is well documented that the movement towards market based/property rights based institutions for water, and the use of innovative allocation mechanisms such as tradable water rights, were a direct response to weather and environmental damages associated with both drought and inefficient use of water resources (MacDonald and Young, 2001; NWC, 2010). These environmental factors the River Murray system included salinity of watercourses and soil and its effect on productive uses for water as well as river health resulting from excess irrigation water. Third-party effects of trade on water quality depend on the source and the destination of the water traded (i.e., they can either improve or reduce water quality depending on the location of water use after trade, thus having either positive or negative effects on users not directly engaged in the trade) (Heaney et al., 2006). In short, environmental factors, as well as the demand economic factors described in the previous sections, were influential factors in the reform process.

1-5. Technical Factors

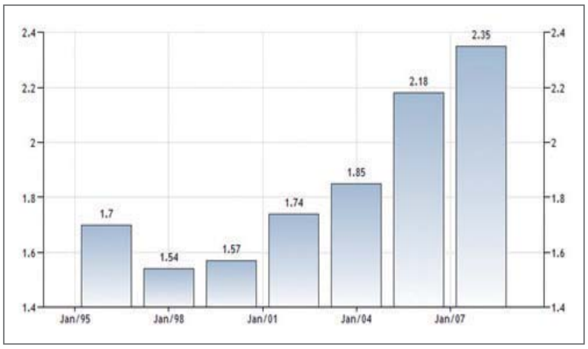
1-5-1. Research & Development (R&D)

In 2011, Australia's research and development (R&D) expenditure as a share of GDP, at 1.7%, was 18th in the world. Figure 17 shows that R&D investment has been increasing as a proportion of GDP for the past decade in Australia, in line with many OECD countries.



Source: Data from UNESCO "Gross Expenditure on R&D by source of funds (PPP)

<Figure 16> Government and Business Funding of Scientific Research in the G20



<Figure 17> Research and Development Expenditure (% of GDP) in Australia

1-5-2. Effect of R&D

The real innovation associated with the management of water resources in the MDB is institutional and policy related, rather than technical. For this reason it is difficult to ascertain whether or not the technology research environment, rather than the policy research environment, was an important determining factor.

One area in which technology has been important is in relation to irrigation technology, which, it has been argued, has improved in its water efficiency as a consequence of the introduction of the MDB water trading scheme. Another area of importance is information technology. For instance, to facilitate efficient water trades, the MDBA provides information inline to farmers about the price at which water is trading in different areas of the MDB, and at different times in the past.[9] Coupled with an extensive network of brokers, water traders are able to make clear decisions based on this information.

1-6. Concluding Remarks

The economic, social, political, environmental, and technological contexts influence the formation, change, and performance of institutions, and likewise it influences the choice policies taken and their performance. The relationships between these

9) http://www.environment.gov.au/topics/water/rural-water/restoring-balance-murray-darling-basin/market-price-information

country wide aggregate statistics and the specific institutional arrangements of the MDB are difficult to establish in anything but the vaguest terms, but it seems clear that the environment of increasing and competing water demands, inefficient allocations of water, increased uncertainty and drought, coupled with general movements in ideology towards market based instruments and the role of private water rights, were all pivotal in shaping the institutional framework of the MDB and the market based approach to water allocation. In the other direction though, the MDB institutional and policy framework may have influenced some of the factors described above, such as technology use in some sectors, rather than vice versa.

In terms of economic aspects, growth in agricultural production and demands for water caused the pressures that lead to the need for reforms in the MDB. Increased competition in agricultural production from overseas, in part due to new competition policies, also fuelled the need for a more efficient allocation mechanism for water.

2. Water Governance and Institutions

In the previous section the influence that exogenous factors have on the institutional causes and performance of water trading in the Murray-Darling Basin were presented. This section examines the direct and indirect influences that institutional factors have on the project. These institutional factors can be divided into legal, administrative, and policy elements (Saleth and Dinar, 2004). In this section, the influence of these institutional factors on state-driven, market-oriented, and community-centered projects' planning, execution, and results is explored. For this purpose, legal, administrative, and policy factors are re-categorized and analyzed as government, market, and community-centered factors. Particularly, in order to investigate, among the institutional factors, the effect of policies with greater mutability and elasticity, the section is divided into sub-sections. For convenience we reproduce the schematic representation of the key institutions associated with the MDB.

2-1. State-driven Institutions

As discussed in the "Background" section above, the institutions associated with the water management in the MDB vary in terms of their jurisdiction and geographical coverage.

2-1-1. Laws and Administration

Balance between Government Layers (Structure and Power)

The balance between the government layers, both vertical and horizontal dimension, is achieved by balancing decentralised autonomy at the State level with State level obligations both at the level of the River Basin and National level, with the fact that each State is reliant on the Federal Government for funds by and large. Federal funds can be withheld from the States if they fail to implement their water management plans (MacDonald and Young, 2001). This overcomes some of the potential problems of federalism.

Furthermore, horizontally, the MDB ministerial council represents different elements (Agriculture, Environment, Transport, etc.) of the government across the Basin states, while the Murray Darling River Basin Authority represents the water industry, consumers as well as the needs to ensure sustainability within the basin. In this way demand, supply and environmental issues are internalized at the basin level.

Spatial Organization of Water Administration

The Murray Darling Basin Agreement (which appears as Schedule 1 of the 2007 Water Act) provides the basis for the MDB Authority to:

- coordinate trade of water entitlements and allocations between states and valleys within the Murray–Darling Basin;
- set out principles to be applied to trades of water entitlements and allocations between states and valleys within the Murray–Darling Basin; and
- develop and amend protocols as required to support the implementation of interstate trade.

The MDBA is at the appropriate geographical scale for this task. It crosses State jurisdictions and can thereby coordinate between these competing interests. At the lower level, catchment level organisations have been established to represent and coordinate local catchment allocation issues.

2-1-2. State-driven Policies and Laws

The Coalition of Australian Governments (COAG) was the main driving force behind the following policies and initiatives:

- The National Water Initiative (NWI, 2004) (see above);
- The National Strategy on Sustainable Development (NSSD) which emphasized the importance of environmental flows of water in rivers;
- The State level “Caps” on water extractions in the MDB;
- The Commonwealth Water Act (2007) and Water Act Amendment (2008); and
- National Competition Policy which speaks to the role of tradable water rights.

The general reform process in the water sector was driven by the Federal Government through the COAG.

At the “State” level (Victoria, New South Wales, etc), there are individual water laws. Table A1 in the appendix documents these laws and their roles. In short there is:

- New South Wales: Water Management Act (2000),
- Victoria: Water Act (1989),
- South Australia: Water Resources Act (1997), and
- Queensland: Water Act (2000) and Water Amendment Act (2006).

Each specifies the priorities for water consumption between domestic, irrigation and environmental uses, as well as specifying rights to water, whether these are tradable and who has ultimate ownership. In South Australia, for instance, rights and responsibilities are devolved to the Catchment boards who must develop Water Allocation Plans.

Perhaps the most important recent change in the water Laws if the Commonwealth Water Act (2007) and the amendments in 2008.

The key issue here is that the Act provided a further push to the States to ensure that the MDB returns to a water balance: sustainable water use in which water demands, including environmental demands and equal water resources availability. The Basin Plan reflect this objective.

In addition, in December 2008 the Water Amendment Act 2008 amended the Water Act 2007. The key features of the Water Amendment Act 2008 are:

- The functions of the Murray-Darling Basin Commission were transferred to the Murray-Darling Basin Authority. There is now a single body responsible for overseeing water resource planning in the Murray-Darling Basin.
- It enabled the Basin Plan to provide arrangements for meeting critical human water needs.

Under the River Basin Plan, the policy entitled “Restore the Balance” emerged.

2-2. Market-oriented Institutions

2-2-1. Market-oriented Laws and Administration

The main laws and administration in this regard are the National Competition Policy and the Commonwealth Water Act (2007) as well as the individual State level Water Acts. The administration revolves around the MDB Authority.

The 2007 Water Act provides the Australian Competition and Consumer Commission (ACCC) with a key role in developing and enforcing water charge and water market rules along the lines agreed in the National Water Initiative. Key feature of the NWI in this regard include:

- water access entitlement and planning,
- water markets and trading,
- best practice water pricing, and
- integrated water management for the environment.

2-2-2. Property Rights and Surface Water Rights

The establishment of property rights for water has been central to the success of the management of the MDB. In particular the separation of water rights from land, and the ability to trade. The key features of property rights to water are shown in Section II. In Section II we also discussed the background of water rights in the MDB. The establishment of property rights and water trading was central to the NWI of 2004 also. Clause 58 states that the NWI aims to:

> "facilitate the operation of efficient water markets and the opportunities for trading, within and between States and Territories, where water systems are physically shared or hydrologic connections and water supply considerations will permit water trading…. and recognise and protect the needs of the environment [and] provide appropriate protection for third parties" (NWC, 2010).

One form of protection of the environment and third parties can be found in the 4% limit on inter-state trades of water. This is an arbitrary limit which has been the focus of much discussion since, while protecting certain environmental functions, it limits the inter-basin efficiency gains that can be released from trading. This is a crucial issues when considering the economics and environmental performance of the MDB.

2-2-3. Market-oriented Policies, Cost Recovery, and Water Pricing

The Water Act of (2007) provides the latest guidance on water pricing, allocation and water trading, all of which can be thought of as market based policies. It strengthened the role of the ACCC by providing for the water charge rules and the water market rules to apply to all water service providers and transactions. The current powers of the ACCC were extended to determine or accredit determination arrangements for all regulated non-urban water charges. This arrangement followed on from the undertaking committed to in the NWI of 2004 for cost recovery and economic pricing of water resources at a national level.

As discussed above, perhaps the latest addition to the market based initiatives and policies is the Commonwealth Buyback scheme. In essence, via water buybacks the Commonwealth Government of Australia obtains water for the environment from irrigators who wish to offer their water entitlement for sale. The Australian Government is acquiring a portfolio of entitlements which best meet the environment's needs. So far the buyback activities have included a variety of tenders in each State of the MDB to buyback entitlements to groundwater and surface water. This has lead to concerns about the economic and social impact of the buybacks which are investigated in more detail below. More information about the buyback tenders can be found on the MDBA website.[10)]

2-3. Community Water Govermance Structures

The National Water Initiative of 2004 specified the need for water access entitlement and planning, knowledge and capacity building and community participation in water decision making.

The institutional arrangements for the MDB included the Community Advisory Committee, which after the Water Act of (2007) became the Basin Community Committee (BCC), which represents the views and issues of the catchments within the MDB as well as water users; irrigators, environmentalists and urban consumers. Community participation is also possible within the MDBA directly.

The level of community involvement in decision making has been high and despite antipathy to the notion of water trading when the initiative was first implemented (e.g. the "zap the cap" campaign (MacDonald and Young, 2001)), public views on the role of water trading have become more positive over time (NWC, 2010).

<Box 3> Involvement of Indigenous Communities

> The MDB Authority recognises that the Traditional Owners and their Nations in the Murray–Darling Basin have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The Basin Authority works with Indigenous groups on cultural heritage projects, training and capacity building programs, and environmental works and measures projects in the southern Basin (e.g the Lake Victoria Cultural Heritage Program and The Living Murray Indigenous Partnerships Program). Also supports the Murray Lower Darling Rivers Indigenous Nations and the Northern Basin Aboriginal Nations participation in the MDB planning and programs including environmental water delivery. Finally, there is funding provision for the National Cultural Flows Planning and Research Committee. The term "cultural flows" translates the complex relationship Aboriginal peoples have with their land and water into the language of water planning and management.

Source:http://www.mdba.gov.au/what-we-do/working-with-others/aboriginal-communities

In general, there is a strong tradition of community participation in water (and other) policy in Australia. This is embodied in the institutional structure of water management in the MDB. The engagement and consultation with the community including indigenous people is a statutory requirement of the Water Act (2007). Box 3 describe the involvement of indigenous coummunities.

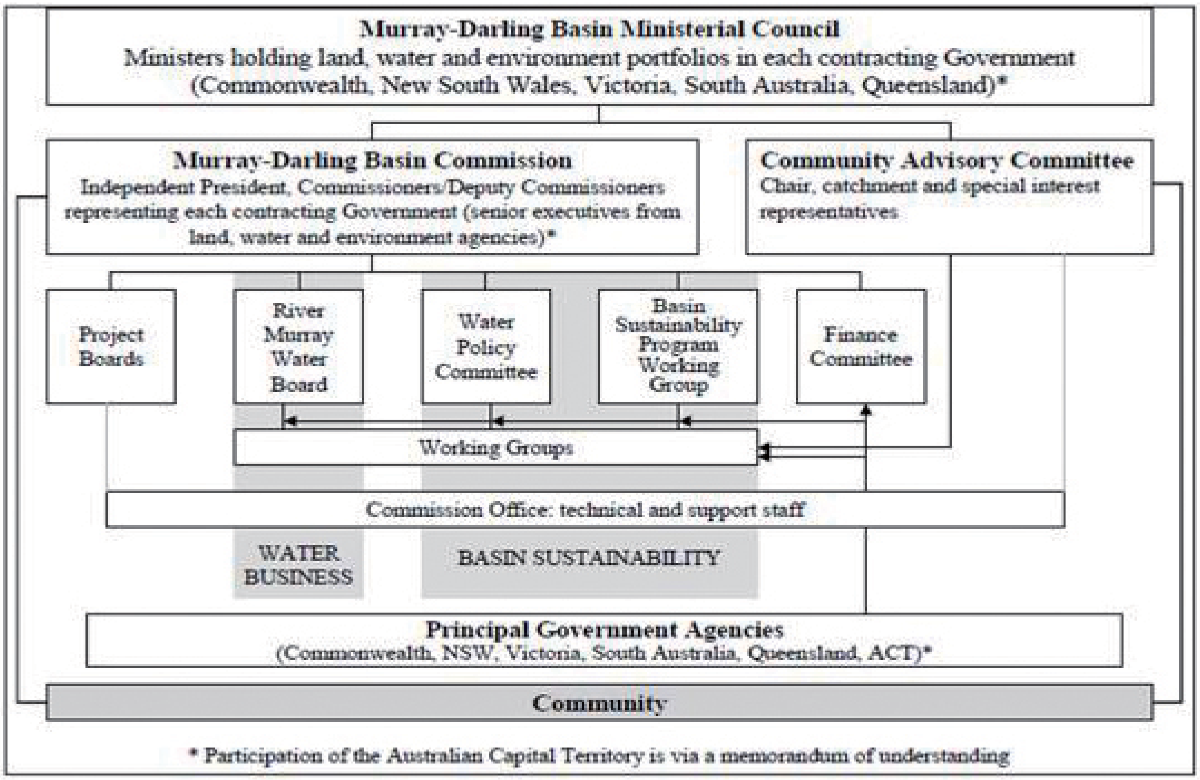
2-4. Concluding Remarks

The implementation of the MDB has only been possible as a consequence of the clear institutional framework which has represented the views of the majority stakeholders at each stage of the implementation process (see Figure 18).

The fact that a market-oriented approach to the allocation of water was implemented, rather than some other approach, is likely to have been influenced by the movement towards general market reforms which took place in the 1980s and 90s in Australia. These started with the formation of the National Competition Policy Review Committee in 1992 and culminated in the Competition Principles Agreement and the Competition Reform Act of 1995. The water reforms discussed above followed on from general economic reforms, and the two are still tied as can be seen in the role of the National Competition Policy of 2007 in recent years. The general movement towards freer international trade and the greater competition in agriculture that this lead to can also be seen as causal factors in the water reforms and the MDB in general.

The movement towards water reforms was also motivated by genuine issues of scarcity and environmental degradation. Taken together the message is that the nature of reforms are somewhat dependent on historical events and changes in political ideology. Nevertheless,

10) http://www.environment.gov.au/topics/water/rural-water/restoring-balance-murray-darling-basin



Source:Macdonald and Young (2001)

<Figure 18> The Institutional Arrangements for the MDB

the sound institutional structure, both at the federal and state level, has facilitated the change to water trading and helped in its implementation and, arguably, its success in generating growth, in consultation with stakeholders, while adhering to environmental and social constraints. That is, in generating Green Growth.

IV. Performance of Water Trading in Murray-Darling River Basin

1. Generic Performance

There is evidence that the trading scheme has been successful in reallocating water to higher value uses and reducing/managing the risks faced by water users within the MDB. According to Bjornlund (2005) for example:

> "There is strong evidence that irrigators over time will get used to water markets and use them in an elaborate way to manage the risks associated with water scarcity and drought, and to benefit from fluctuating water and commodity prices as well as supply and demand for water. During focus groups with irrigators in New South Wales in Australia it was strongly expressed that 'in most seasons the temporary market is a great help, but last season (2002–03 the worst drought year) it saved us."

Farmers have been recorded using trading to manage their responses to drought. For instance, rather than take steps each season to manage the water available to them through the allocation process, farmers can earn cash from selling water instead of applying the water to crops, or they can buy additional water at the market price. Alternatively, a farmer can choose not to buy or sell water and to simply manage the farm using the allocated volume of water.

The NWC (2010) report found the following results:

- Without temporary trade the dairy industry would have fared much worse than it did during the past 10 years of drought.

- Even with temporary trading many dairy enterprises collapsed as a result of the extraordinarily low seasonal allocations of 2002–03 and 2006–07.
- Permanent trading meant that those farmers left farming with more money than they otherwise would have had.
- Without temporary trading many existing horticultural enterprises in the Goulburn system would not have survived the extraordinarily low seasonal allocations.
- Many mixed farms survived the low seasonal allocations by selling water on the temporary market, thus making more money than they would have done by growing crops [in those years]" (NWC, 2010).

Furthermore, as the tables in the background section make clear, there have been numerous trades both inter and intra-state, indicating that willing sellers and willing buyers are exploiting gains from trade. In this sense the objectives of the "project" to increase the efficiency of water use in the MDB appear to have been achieved (more details below).

Lastly, the suite of water reforms for the MDB have been successful in part due to the clear horizontal and vertical arrangement of institutions which, crucially, have mobilized community participation in the decision making process and the evolution of reforms.

2. Economic Performance

2-1. Regional Economic Impact and Gains from Trade

The gains from trade have been estimated and shown to be positive. That is, the introduction of trading has reallocated water to higher value uses (mainly agricultural users, and mainly in the lower reaches of the river basin, but also, with the buyback scheme, to environmental users now) so that productivity has increased whilst maintaining a sustainable extraction level from the River Basin. Estimates come from a variety of sources and methods. Economic modelling exercises have been undertaken to evaluate:

1. The role of inter and intra-state trades in reducing the costs of basin-wide restrictions on water (the cap) (Petersen et al., 2005);
2. The basin wide economic costs and benefits of water trading (ABARE, cited in NWC, 2010);
3. The impact of the Commonwealth "Buyback" scheme (Dixon et al., 2009); and
4. The impact on farm management of water trading (NWC, 2010).

We now look at each in turn.

The Costs of the Water Cap With and Without Water Trading (Petersen et al., 2005)

Petersen et al. (2005) looked at the costs of implementing the cap with and without water trading. Table 5 shows the results of the a modelling exercise looking at the welfare effect of a reduction of the cap by 20% under trading regimes that vary in the ability to trade inter- or intra-state.

Table 4 shows that the economic impact of the imposition of a cap on water allocations is reduced in most cases as the opportunities for water trading are enhance expanded. For instance, in Southern MDB catchment in Southern Australia, a 20% reduction in water allowances is estimated to reduce GDP in that region by 2.55%, compared to 1.53% when intra-state trades are allowed. This means that the impact is reduced by 40%, as shown in the column headed 'scenario 1'. Note that this represents a cost saving of around AUS \$350m[11]. These theoretical results employ assumptions about the nature of agricultural technology, and hence the

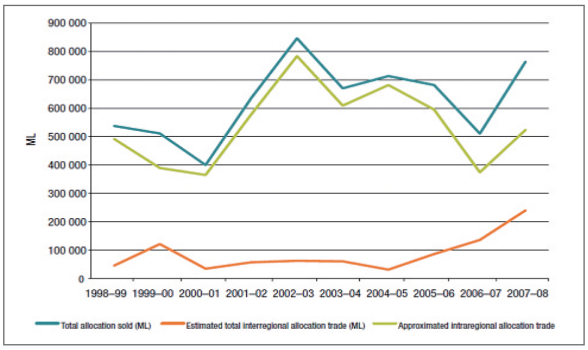
11) Using GDP in 2003 of \$35bn.

available substitution possibilities, as well as assumptions about how trading unfolds[12]. However, they can be seen as indicative of the cost savings available by allowing water trading while ensuring total water use does not exceed the cap.

<Table 4> Impact on GDP of 20% Reduction in Cap under various Trading Regimes

State/Region	% change in GDP			Proportional Change	
	No trade	Intra-regional trade	Inter and intra regional trade	Scenario 1	Scenario 2
New South Wales					
Murrumbidgee	-3.02	-1.45	-1.92	52	-32
Queensland					
Mallee	-3.67	-1.57	-0.98	57	38
Southern Australia					
Southern MDB	-2.55	-1.53	-1.17	40	24

Most of these gains (>50%) come from intra-state trading. However, a significant and increasing proportion come from inter-state trades. Peterson et al (2005) also find that fostering trade within regions (e.g. between irrigation districts) has greater potential for cost savings than fostering inter-regional or interstate trading. In recent years the rules on inter-state trades have been relaxed somewhat and the number of inter-state trades has increased. Figure 19 below shows this trend quite clearly, which increases after 2004.



Source: The impact of the Commonwealth "Buyback" scheme (Dixon et al. 2009)

<Figure 19> Impact on GDP of 20% Reduction in Cap under various Trading Regimes

As discussed above, the Commonwealth Buyback scheme is a scheme in which water entitlements are purchased by the Australian government for environmental purposes. Dixon et al., (2009) found that, despite initial fears,sales of entitlements provided benefits to regional economies due to the resources generated by the buyback purchases.

More specifically, according to a survey of water entitlement sellers under the scheme there were more than 500 irrigators whose principle reason for participating was to generate cash flow to either reduce debt, supplement income or make investments in on-farm improvements. The majority of these proceeds was spent locally. While this does not tell us much about the third party effect of entitlement sales, it does substantiate the findings of Dixon et al. (2009).[13]

The Costs and Benefits of Water Trading in General (ABARE, cited in NWC 2010)

The Australian Bureau of Agricultural and Resource Economics (ABARE) found that irrigators benefited by AUS $35m, AUS $31m of which accrued in the Southern part of the Basin. Evidence suggested that these gains came from water gravitating towards more valuable uses.

The Impact on the State and Regional Economy (NWC, 2010)

NWC (2010) estimated the benefits of water trading to agriculture at the National, State and regional level. Most of the benefits in agriculture were to be found in the Southern MDB. At the National state level they found that the benefits in 2008-09 were as depicted in Table 5. The pattern for 2008-09 broadly reflects the pattern

12) Note that in NSW, the introduction of inter-regional trading worsens the situation compared to solely intra-regional trading. This is because this region would be expected to be a net exporter of water.

13) http://www.environment.gov.au/resource/survey-water-entitlement-sellers-under-restoring-balance-murray-darling-basin-program

in other years. Put in perspective, AUS $220m reflects approximately 30% of agricultural GDP.

<Table 5> Benefits to Agricultural Production by Geographical Area

Geographical Area	AUS $m in 2008-2009
National	224
MDB	371
New South Wales	79
South Australia	16
Victoria	271

Overall, it is widely agreed that water trading has achieved some efficiency gains. Further evidence for this comes from the observation that in general there is greater cultivation of high value crops these days, and generally improved irrigation efficiency (MacDonald and Young, 2001, NWC 2010). Care is needed in interpreting such trends however since the general movement towards higher value crops and higher efficiency irrigation could have happened as a matter of course, irrespective of water trading in the MDB, nevertheless, as we discuss in the next section, there is some evidenve to suggest that water trading could have had such effects.

2-2. Water Trading and Aggregate Economic Trends

One way to look at the regional economic impact is to look at the aggregated statistics on economic and other trends that describe the economic backdrop to the MDB and its water management initiative. We could look at the trends in population, employment, household income, and so on that exist in the regions of the MDB and try and establish some relationship between these macro trends and the management of and trading in the MDB. Several studies have tried to do this already and reached the same conclusion: of all the issues that affect population growth, employment and overall income, the management of water resources in the MDB, and in particular trading is a minor component (e.g. NWC, 2010).

In order to look at the regional economic impact it is likely to be more fruitful to look at the value and nature of production in the MDB, and the regional/interstate differences that have emerged. Nevertheless, as a purely descriptive exercise we first present some of the socioeconomic trends of the MDB. The key issues of concern typically mentioned are (NWC, 2010):

- Employment in agriculture: A reduction in water use due to trading might reduce employment in agriculture. Such effects have been witnessed in other long-standing water markets in the US.
- Household income: A reduction in agricultural production due to water trading may reduce spending in the region and hence reduce incomes for people working in related industries. Alternatively, the increased income from water transactions may offset those reductions, or any induced increase in productivity
- Population change: Reduced economic activity and employment opportunities due to reductions in agricultural production may lead to outward migration of the working-age population in the region.

In relation to the last point, it has been noted that “under current and proposed water trading schemes communities are either net exporters of water or net importers of water. Communities exporting water experienced reduced populations and less local spending while communities importing water experienced increased populations but may not necessarily have the infrastructure and services to accommodate the new arrivals” (Kiem, 2013). The NWC (2010) report concludes that there are too many other factors to consider to be able to disentangle the effect of water trading.

In the literature, it is clear that further research is needed to fully understand the social implications of water trading. It is important to analyze how water trading can change the demographics of rural communities, and what are the social impacts on people in rural communities that reduce (or disappear) as a result of water trading (Kiem, 2013).

Adoption of Innovative Technology

One area where there is some empirical evidence is in relation to the characteristics of farms that buy water rights and those that sell. For instance, according to Young et al. (2000) and Alankarage (2004) (cited in NWC, 2010), buyers are more likely to:

- be efficient;
- use more advanced technology;
- use a whole- farm plan;
- have better drainage practices;
- have drainage re-use systems; and
- grow profitable crops.

There need not be anything causal in this relationship: that is, buying water did not cause these better, more efficient practices, but it seems clear that if water resources are flowing towards farms with such characteristics then the gains from trade seen in the modelling exercises are likely to come to fruition.

On the other side of water trades, there is evidence to suggest that sellers of entitlements have turned to more opportunistic irrigation practices or ceased irrigation altogether. These different characteristics have implications for the environmental and other third party effects of trade.

3. Environmental Performance

The key findings from the most recent research on the the environmental impacts of the water trading on the MDB can be summarized as follows (NWC, 2010).

- Trade impacts on hydrology vary between regions.
- Trade impacts are small compared to other factors (e.g. persistent drought).
- Trading is moving water downstream (to South Australia).
- Trading is increasing flows in many tributaries (e.g. the Loddon river).
- Trading is having minimal impact on key ecological assets (e.g. RAMSAR wetland sites).
- Trading can lead to positive and negative environmental effects because buyers and sellers have different water-use characteristics.
- Trading is not an important driver of changes in groundwater levels.
- Trading may have increased groundwater recharge.
- Trading is affecting river salinity, but the effect is being addressed through the Basin Salinity Management Strategy.

Trading is having a clear effect on the spatial allocation of water flow within the River Basin, but the evidence so far suggests that the issues associated with environmental quality are not substantially alarming, although the severity of environmental impacts varies spatially, and vary in terms of the quantity and quality dimensions.

Once again, there are reasons why this result can be expected. For instance, trading water may reduce the return flows from irrigation, hence reducing the quantity of water flowing in the MDB. However, if these return flows were of poor quality this may actually improve the quality of water in the MDB (Heaney and Beare, 2001; Young et al., 2003; Heaney et al., 2005; Van Dijk A et al., 2006; Qureshi et al., 2010).

Interestingly, as discussed above, buyers and sellers have different characteristics which pertain to the ecological effect of water trading in the basin.

On the other hand, the Murray-Darling Basin Ministerial Council published in 1995 an ‘Audit on water use in the Murray-Darling Basin’ (Murray-Darling Basin Ministerial Council, 1995). This was prepared due to the concerns of environmental deterioration of the Basin's river systems (there was evidence of the declining condition of river and flood plain health) and contained modeling that implied that increasing water diversions from the Basin would aggravate environmental problems and put at risk the security of water supply for irrigators. Thus, the cap and trade system was established in 1997 to address the decline in the health of the river system that was happening in the absence of regulation.

Given the remaining concerns about environmental impacts of water use, and in particular the reduced baseline flow in the river basin, the most recent water recovery program is the Australian Government's Restoring the Balance in the Murray-Darling Basin program. For this program the government has committed $ 3.1 billion to purchase water for the environment in the Murray-Darling Basin over 10 years (Garrick, 2009). The Australian Government is acquiring a portfolio of entitlements in order to meet the environment's needs. The Government is recovering water for environmental use through a combination of water savings derived from investments in water saving infrastructure and water purchase. There are also water recovery programs undertaken by state governments. Water buybacks obtain water for the environment from irrigators who wish to offer their water entitlement for sale (DoE, 2012). The Minister for Climate Change and Water announced on 16 June 2009 the establishment of the Water Recovery and Environmental Use Stakeholder Reference Panel. In particular, the panel will consider arrangements for the water purchase mechanisms developed under the Restoring the Balance in the Murray-Darling Basin program. This will include the socio-economic impact of water purchasing and the environmental benefits of water purchases and how best to provide information on the program to the public. It will also provide stakeholder views on the proposed arrangements for managing the water from entitlements that the Commonwealth buys for the environment.[14)]

4. Social Performance

4-1. Impact of the Policy for Promoting Stakeholders' Participation (Education, Communication, Raising Public Awareness) and Engagement

While effective participation and engagement with stakeholders has always been an important aspect of the MDB water management initiatives, as evidence by the centrality of the Community Advisory Committee and its sub committees in the institutional framework, engagement was particularly important during the preparation and implementation of the Water Act (2007) and its progams.

The Water Act itself specifies requirements for engaging stakeholders during the development of the draft Basin Plan. There is a requirement that the MDBA must consult with the Basin states, the Basin Community Committee and the Basin Officials Committee, as well as undertaking other consultation as appropriate.

The engagement process concerning the development of the draft Basin Plan had the following key features:

- Developed a process that tracked and collated over 3,000 pieces of feedback on the Guide to the proposed Basin Plan;
- Published an overview of feedback on the Guide;
- Implemented a round of community information

14) Information available at http://www.environment.gov.au/topics/water/rural-water/restoring-balance-murray-darling-basin

sessions to discuss the Guide; feedback from these sessions was published daily on MDBA's website;

- Continued to support the effective participation of Aboriginal people whose traditional lands lie within the Basin in the development of the draft Basin Plan; and
- Supported the National Cultural Flows Planning and Research Committee in developing a research project to identify and quantify cultural flows in the Basin.

These are just some of the details of the engagement that took place with stakeholders in the MDB in order to develop the River Basin Plan. Figure 19 shows the engagement process in the development of the River Basin Plan.[15)]

4-2. Stakeholder Awareness

One of the key instruments to evoke participation in the allocation of water in the MDB is the access to market information concerning the value of water. Despite initial skepticism, there is also a growing acceptance of water trading and how the market operates.

The reform process has raised awareness of the water management issues in the Murray-Darling basin (NWC, 2010). This can be evidence by the involvement of a number of non-governmental water user and conservation groups such as the Murray Darling Association. The role of the Basin Community Committee (BCC) has also been important in this regard.

4-3. Stakeholders Perceptions

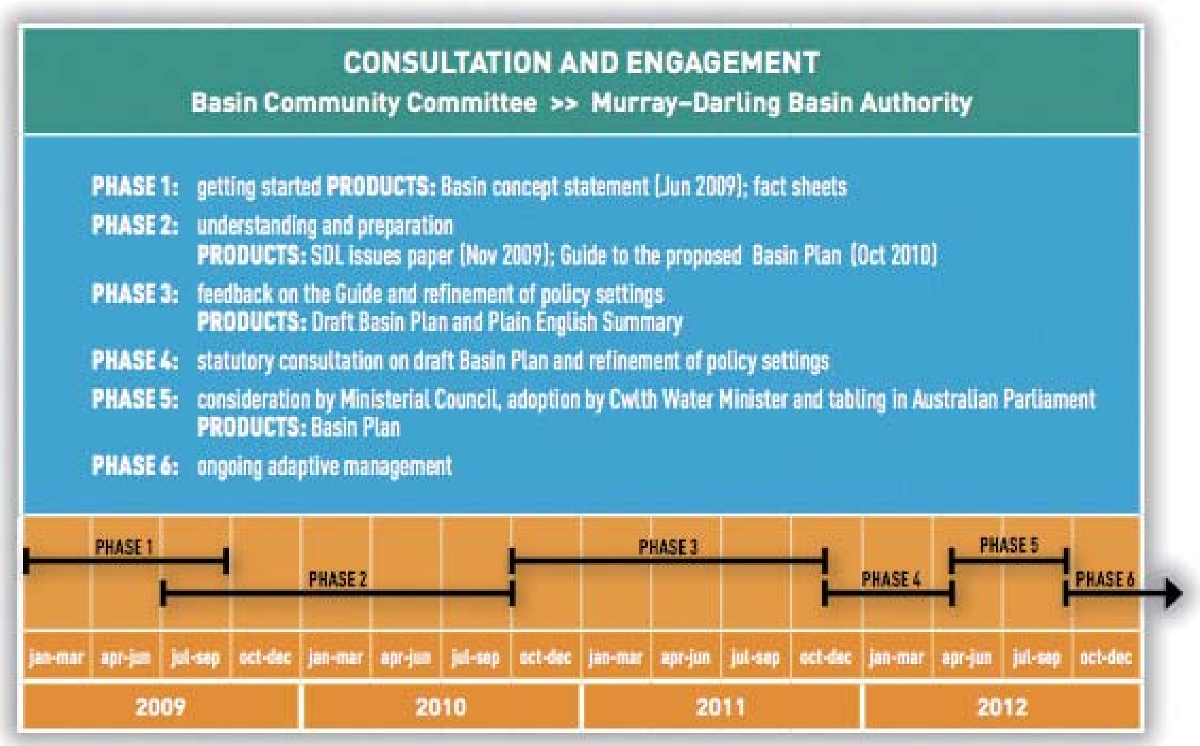
Irrigators' perceptions and experiences of water trading and related issues vary in unusual ways. The following issues have been highlighted (NWC, 2010).

- Stakeholders had difficulty in separating out the impact of drought and the impact of water trading on their activities.
- Stakeholdersunderstood the difficulty associated with assessing the social impacts of water trading while communities are being negatively affected by drought.
- Participants in the market often found it difficult to assess the costs and benefits of water trading without trading in a season of normal water availability.
- Perceptions varied depending on the level of scarcity in any given season.

These observations provide some insight into the initial antipathy to the implementation of the MDB water trading scheme, which has often coincided with a period of extended drought.

On the other hand, recent research (see Kiem, 2013; Kiem and Austin, 2013*a*; 2013*b*) has found that water trading has had negative social effects for local communities. It is explained that many people are opposed to water trading because of a strong fear of people selling their water entitlements and leaving the community. It is perceived that water trading will reduce the populations of already small rural communities affecting its services and sense of community.

15) http://www.mdba.gov.au/annualreports/2010-11/chapter_01_2.html



<Figure 20> Engagement Process on the River Basin Plan

4-4. Effectiveness of Conflict Resolution Mechanism

Although there was still some opposition within some rural communities to outward entitlement trading, attitudes appeared to be softening as people recognise the beneficial role of water trading in dealing with adjustment pressures. Previous studies of water trading in Victoria (Fenton, 2006; Frontier Economics et al., 2007) found the following.

- In some irrigation communities, there was an element of social pressure against selling water entitlements because of perceptions about the consequences. It might have reduced demand for local goods and services.
- Some farmers had been ostracised by their communities for selling their water entitlements.

What appears to have happened is that as drought pressure increased, a greater appreciation of the need for many farmers to take up trade of entitlements to alleviate crippling debt. So in this sense, the market has reduced hardship, and conflict over the instrument has dissipated as a result of its functionality in the face of drought. However, the picture is heterogeneous, with antipathy building towards the market in some drought ridden districts.

IV. Lessons Learned and Conclusion

The lessons learned for Green Growth and Water Management can be summarised as follows. Despite the potential problems of federalism, that is, the autonomy of states hindering the attainment of federal policy goals, water reforms have proceeded apace with what some authors have called a spirit of "cooperative federalism" (MacDonald and Young, 2001). Agreement has been reached in the Murray Darling basin between federal states despite their heterogeneous water policies and objectives. The main factors which have facilitated this are the following.

Clear institutional structure at the river basin level:

a. The Commonwealth Government directly acts through the COAG to the river basin institutions;
b. The Murray Darling Basin Ministerial Council is a well-defined legal entity and contains ministers from commonwealth and state governments from all relevant portfolios. This facilitates coordination;
c. The Murray Darling Basin Authority has similar representatives from each state and ministerial portfolio, again facilitating coordination; and
d. The Community Advisory Committee facilitates public participation in policy design and implementation.

National policies reflected in well-defined state water laws:

a. The impetus for water reform was driven by macro-economic policy on competition: the National Competition Policy;
b. Despite heterogeneous state water laws, water and land rights are separated in all basin states. This enables water trade;
c. The National Water Initiative has endeavoured to remove further hindrances to water trade; and
d. The Water Act of (2007) and subsequent amendments have striven for the water balance to be met within the Basin.

Strong Enforcement of NWI:

a. The Commonwealth Government can hold back funding (via the COAG) if states are slow to reform; and
b. Under the NWI, policy reforms are now consolidating the river basin approach and sub-basin catchment organisations have emerged.

In this way, the balance between economic benefits and allocative efficiency appear to have been attained alongside sustainable water resource management. Ultimately, more research is needed to evaluate the impact on other important aspects of the socio-economic impact, such as technological change, employment, and unemployment.

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Sources are indicated with each photo.

Interview 1

Respondent 1 was required to provide her expert opinion about the "Environmental Water Management in the Murray Darling Basin" project. She stated that the main purpose of the project was water resource planning and that it is mainly concerned with Ecosystem services and Ecosystem restoration. In terms of community institutional factors, she stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers, and users; and they vary in by use categories and user groups. In her opinion, those legal provisions are very effective for users, but are less effective for water suppliers and not very effective for officials. She did not provide further information about the way that legal provisions of accountability administratively are translated and how effective they are in practice. She considers that in general water data is adequately collected, managed, and publicized by Water Connect MDBA (the agency in charge of water data management). She considers that the data is very much open to the public through websites, upon request and on company reports. She stated that this data is adequate and reliable for conducting research and for performance evaluation of the project. However, this data is not very adequate and reliable for planning, implementation, coordination, and conflict resolution. Finally, she stated that the case in question represents an integrated water resources management (IWRM) approach.

In relation to the choice of policy mix, in the case of state/administration policies she mentioned that there are well-organized plans related to water management in Australia but she is not sure on how well was the case aligned with the plans. She did not answer questions related to financial support for the project, taxes and levies, and regulations. In the case of market policies, she did not answer questions related to cost recovery. In relation to private sector promotion policies, she considers that users are favorable toward private sector involvement in the case. Finally, she mentioned that financial factors, ecological factors, and community and landholder support, and potential for water savings were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation she mentioned that the central and regional government along with residents were effectively involved during the consultation and decision making stages. Local government and NGOs participated during the consultation and firms were informed only. On the other hand, she mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, she indicated that there are judicial/legislative/constitutional conflict resolution or coordination mechanisms in place regarding the case in question. She mentioned that basin organizations are the legally specified mechanisms for transboundary conflicts. In her opinion, legal provisions for conflict resolution at local level (among users) are not very effective.

When queried about the overall performance of the project, she stated that early decision making by water holders, use of ecological monitoring data, and consultation with local stakeholders were important factors that contributed to the successes of the case in question. On the other hand, she identified insufficient water and the potential for better modelling to inform real time management as factors that caused unexpected results in the case's implementation. Overall, she considers that the intended objectives of the project have been achieved 60%.

In terms of economic performance, she considers that there was a marginal positive impact in terms of job creation in the local economy as a result of the case. She declined to provide an answer about the project's impacts on the gross regional domestic product, local development to national standards and technological performance and advancement.

In terms of social performance, she reckons that the project had no impact on improving people's health, improving quality of life or increasing gender equality. However, she considers that there was a positive impact of citizen participation in decision-making through the case. In terms of environmental performance, she considers that there is no improvement in disaster safety as a result of the case. However, she stated that there have been positive impacts in water quality improvements, maintaining or restoring biodiversity and increasing environmental awareness.

Interview 2

Respondent 2 was required to provide her expert opinion about the "Environmental Water Management in the Murray Darling Basin" project. When asked about community institutional factors, she mentioned that there are explicit legal provisions for ensuring the accountability of officials, water suppliers, and users. Such provisions vary by use categories and user groups. In her opinion, those legal provisions are very effective for officials, water suppliers, and users. She declared that she is not sure about the way that legal provisions of accountability administratively are translated and how effective they are in practice. However, she mentioned that within formal water administration administrative supervision is very effective in practice. She considers that in general water data is not adequately collected, managed and publicized. She did not answer the follow-up questions related to data openness, reliability and availability. Finally, she stated that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies she mentioned that there are not well-organized plans related to water management in place. She stated that the case has not received financial support such as subsidies or Official Development Assistance (ODA) and that the case in question was not subject to taxes, levies, or tax deductions. She mentioned that there were specific regulations directly affecting the case in question but did not describe the impacts of the regulations.

In the case of market policies, she declared that there is full cost recovery in irrigation, household, industrial and commercial use. In relation to private sector promotion policies, she reckons that users are favorable toward private sector involvement in the project. Finally, she mentioned that financial and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation she mentioned that the regional government, NGOs, firms, and residents were effectively involved during the consultation and decision making stages. The local government participated during the consultation stage and the central government was informed only. On the other hand, she mentioned that there are not clear conflict-resolution mechanisms explicitly specified in the law. She did not answer questions related to the legal provisions for conflict resolution.

When queried about the overall performance of the project she stated that visionary managers unafraid to take risks and do something positive were important factors that contributed to the successes of the case in question. Overall, she considers that the intended objectives of the project have been achieved 30%.

In terms of economic performance, she considers that the project had a positive impact on the gross regional domestic product. However, she considers that there were no impacts in terms of job creation in the local economy, local development to national standards and technological performance and advancement as a result of the project. In terms of social performance, she reckons that the project had a marginal positive impact on improving people's health, improving quality of life, or increasing citizen participation in decision-making. However, she considers that there was no impact on gender equality through the case. In terms of environmental performance, she considers that there is no improvement in water quality and in disaster safety as a result of the case. However, she stated that there have been improvements in maintaining or restoring biodiversity and increasing environmental awareness.

Interview 3

Respondent 3 was required to provide his expert opinion about the "Environmental Water Management in the Murray Darling Basin" project. He stated that the main purpose of the project was water resource planning and that it is mainly concerned with ecosystem services and water resources development. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In his opinion, those legal provisions are effective for water suppliers and less effective for officials and users. About the way that legal provisions of accountability administratively are translated and how effective they are in practice he mentioned that within formal water administration there is a monitoring procedure for sectoral and regional water allocation that is effective and inter-ministerial committees that are less effective in comparison. He does not consider that water data is adequately collected, managed and publicized. He considers that the data is very much open to the public through websites, printed materials, upon request and on company reports. He stated that this data is adequate mostly for the implementation of the project. Finally, he stated that the case in question represents an integrated water resources management (IWRM) approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are not well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). However, he explained that the whole project is based on public funds and is effectively funded by taxpayers at Commonwealth and State levels. Finally, he stated that there are there specific regulations directly affecting the project. However, he mentioned that Commonwealth regulations only relate to water quantity with no scope to link with water quality or habitat to get best environmental outcome with least social or economic cost.

In the case of market policies, he stated that there is full cost recovery in irrigation, household, industrial and commercial use. In relation to private sector promotion policies, he reckons that users are favorable toward private sector involvement in the case. Finally, he mentioned that financial, equity and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that residents, firms and NGOs were involved during the consultation stage. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the National Water Council and Basin organizations could intervene in conflict resolution regarding the case in question. He mentioned that Basin organizations are the legally specified mechanisms for transboundary conflicts.

When interrogated about the overall performance of the project he stated that legislation and cash were important factors that contributed to the successes of the project. On the other hand, legislation and cash targeted at water quantity only and intent of the Murray-Darling Basin water planning was for social, economic, and environmental balanced outcomes – water quantity alone cannot achieve triple bottom line outcomes.

Overall, he considers that the intended objectives of the project have been achieved 30%.

In terms of economic performance, he considers that there was a negative impact in terms of job creation in the local economy, on the gross regional domestic product and on the local development to national standards as a result of the project. In his opinion, there was marginal positive impact on technological performance and advancement.

In terms of social performance, he reckons that the project had no impact on improving citizen participation in decision-making or increasing gender equality. However, he considers that there was a marginal negative impact on quality of life.

In terms of environmental performance, He considers that there was no impact in disaster safety, in water quality improvements, in maintaining, or restoring biodiversity or in increasing environmental awareness.

Interview 4

Respondent 4 was required to provide her expert opinion about the "Environmental Water Management in the Murray Darling Basin" project. When asked about community institutional factors, she mentioned that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In her opinion, those legal provisions are effective for water suppliers and less effective for officials and users.

About the way that legal provisions of accountability administratively are translated and how effective they are in practice she mentioned that within formal water administration there is a monitoring procedure for sectoral and regional water allocation that is effective and inter-ministerial committees that are less effective in comparison. Outside formal water administration there are NGOs but they are not effective. She considers that in general water data is not adequately collected, managed, and publicized. She considers that the data is very much open to the public through websites, printed materials, upon request, and on company reports. She declared that this data is adequate mostly for the implementation of the project. Finally, she stated that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies she mentioned that there are not well-organized plans related to water management in place. She stated that the case has not received financial support such as subsidies or Official Development Assistance (ODA) and that the case project is based on public funds so effectively funded by taxpayers at Commonwealth and State levels. She mentioned that there were specific regulations directly affecting the case in question. In particular she mentioned that commonwealth regulations only relate to water quantity with no scope to link with water quality or habitat to get best environmental outcome with least social or economic cost.

In the case of market policies, she declared that there is full cost recovery in irrigation, household, industrial and commercial use. In relation to private sector promotion policies, she reckons that users are favorable toward private sector involvement in the project. Finally, she mentioned that financial, equity, and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation she mentioned that NGOs, firms, and residents were involved during the consultation stage. On the other hand, she mentioned that there are not clear conflict-resolution mechanisms explicitly specified in the law. However, she mentioned that the National Water Council and Basin organizations could intervene in conflict resolution in the project. She also mentioned that Basin organizations are the legally specified mechanisms for transboundary conflicts.

When questioned about the overall performance of the project she stated that monetary resources and regulation were important factors that contributed to the successes of the project. Overall, she considers that the intended objectives of the project have been achieved in 30%. In terms of economic performance, she considers that the project had a negative impact on the gross regional domestic product, job creation, and local development to national standards. However, she considers that the project has had a positive impact on the technological performance and technological advancement. In terms of social performance, she reckons that the project had a marginal negative impact on the quality of life and on citizen participation in decision-making and a negative impact on people's health and on gender equality. In terms of environmental performance, she considers that there is no impact in water quality and a marginal negative impact on disaster safety, restoring biodiversity, and environmental awareness.

Interview 5

Respondent 5 was required to provide his expert opinion about the "Environmental Water Management in the Murray Darling Basin" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In his opinion, those legal provisions are effective. About the way that legal provisions of accountability administratively are translated and how effective they are in practice he mentioned that within formal water administration there is administrative supervision, financial auditing, work auditing, and a monitoring procedure for sectoral and regional water allocation. He considers that water data is adequately collected, managed and publicized. He considers that the data is very much open to the public through websites, printed materials, upon request, on company reports, external audit, and on government audits. He stated that this data is adequate for the planning, implementation, evaluation, and conflict resolution on the project. Finally, he considers that the project represents an integrated water resources management (IWRM) approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the financial support from commonwealth for drought /ecological recovery has been very good, however the impacts will probably last longer than the funds. Finally, he stated that there are not specific regulations directly affecting the project.

In the case of market policies, he stated that there is full cost recovery in household, industrial, and commercial use. However, in the case of irrigation there is partial recovery and varies between states. He did not answer the questions on relation to private sector promotion policies. Finally, he mentioned that financial, equity, and ecological factors were the criteria used in the project selection.

In the case of community policies, in terms of stakeholder participation he mentioned that all stakeholders were involved during the consultation stage but only the central and regional government participate in important decision-making. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the National Water Council and Basin organizations, judicial/legislative/constitutional and tribunals could intervene in conflict resolution regarding the case in question. He mentioned that Basin organizations, river boards and tribunals are the legally specified mechanisms for transboundary conflicts. When interrogated about the overall performance of the project he identified as important factors that contributed to the successes of the project the commonwealth government identifying need with state government and community participation, community vitally interested as whole of life issues involved in drought recovery and the government setting up good systems for public consultation throughout the program. Overall, he considers that the intended objectives of the project have been achieved 80%.

In terms of economic performance, he considers that there was no impact on local development, and a marginal negative impact on the gross regional domestic product and on the technological performance and a negative impact in terms of job creation in the local economy. In terms of social performance, he reckons that the project had no impact on improving citizen participation in decision-making or in gender equality. However, he considers that there was a negative impact on quality of life and people's health. In terms of environmental performance, he considers that there was a marginal negative impact in disaster safety, a marginal positive impact on water quality improvements and a positive impact on maintaining or restoring biodiversity or in increasing environmental awareness.

Water and Green Growth Case Study Report 3

Brazil

Integrated Water Resources Management : How National Policy and Practices Support Green Growth

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

ABCON Brazilian Association of Private Sanitation Companies

ABID Brazilian Association of Irrigation and Drainage

ABRH Brazilian Water Resources Association

AESBE Association of State-owned Water Service Companies

AIBA Association of Farmers and Irrigators of Western Bahia

ANA National Water Agency of Brazil (Agencia Nacional De Aguas)

BMP Best management practices

BOD Biochemical oxygen demand

CERH State Water Secretariats and Agencies

CESB State-owned Water and Sanitation Companies (Companhias Estaduais de Saneamento Básico)

CNRH National Council of Water Resources

Embrapa Brazilian Agricutural Research Agency

FBPDP Brazilian Federation of No-till Planting

FNDE National Fund for Educational Development

GCM General Circulation Model

HDI Human Development Index

IBGE Instituto Brasileiro de Geografia e Estatística (Statistical and Geographical Institute of Brazil)

INPA The National Institute of Amazonian Research (Instituto Nacional de Pesquisas da Amazônia)

INBO/REBOB Brazilian and International Basin Organization Network

INPE National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais)

INT National Institute of Technology (Instituto Nacional de Tecnologia)

IPCC Intergovernmental Panel on Climate Change

IWRM Integrated water resources management

MST Movement of Landless Rural Workers

NOAA National Oceanic and Atmospheric Administration

PAB Basic Care Threshold (health system)

PCJ Piracicaba, Capivari, and Jundiaí River Basins

PES Payments for Environmental Services

PLANASA National Water Supply and Sanitation Plan (1968-86)

PPP Public-Private Partnership

PRODES River Basin Restoration Program (Programa Despoluição de Bacias Hidrográficas)

PROINFO Program on Information Technology in Education

SINGREH National Water Resources Management System in Brazil

Sabesp Basic Sanitation Company of the State of São Paulo

SBPC Brazilian Society for Scientific Development

SNIRH The National System of Hydrologic Information

SNIS Sistema Nacional de Informações sobre Saneamento (urban water and sanitation information system)

SPIA Secretariat for Computer and Automation Policy (Secretaria de Política de Informática e Automação)

SRH Secretariat of Water Resources

SUDENE The Superintendency for the Development of the Northeast

SUS Unified Health System

TNC The Nature Conservancy

UNCED United Nations Conference on Environment and Development

USLE Universal Soil Loss Equation

WGG Water and Green Growth

WPP Water Provider Program (ANA)

WTO World Trade Organization

WWC World Water Council

WWF World Wildlife Fund

Executive Summary

Brazil has one of the world's most sophisticated water resources management systems, and accounts for 12% of the world's freshwater. This case study investigates the economic, social, political, environmental, and technological context in which Brazil has implemented its integrated water resources management policy and "Payment for Environmental Services" (PES) programs that support green growth in the country.

Brazil is the world's seventh largest economy, with a GDP of US $2,253 billion in 2012 in current prices. It is also the fifth largest country in area and population in the world and the largest in Latin America and the Caribbean. It had a population of just over 200 million in 2013, heavily concentrated on the Atlantic coast. The country has experienced rapid urbanization since 1980, and its Human Development Index (HDI) has registered significant improvements in the last 30 years. The greatest advance for Brazil was in the HDI for education, which rose from 0.40 to 0.67 over the period.

Despite the significant economic development of Brazil in recent decades, a series of bottlenecks still hinder the effective implementation of water and sanitation programs in the country, where a significant deficit stills remains, independent of the level of regional development. This is particularly true in remote regions of the interior, and in urban favelas.

Deforestation has been a major issue in the last 30 years, causing many concerns inside and outside Brazil, since the forest is a vital regulator of climate and water. In addition to the loss of natural biodiversity, deforestation contributes to accelerated river sedimentation and reductions in the baseflows during the dry season. The annual economic impact of off-site sedimentation in Brazil was estimated at US $3.5 billion in 2004, not considering the additional costs of water treatment and reservoir volume losses. If those were added, that figure would be much higher. In the last 25 years, the water resources management structure in Brazil has evolved from a centralized and rigid system, to a more modern, dynamic process. In the past, very organized water user sectors, such as hydropower, dominated the water management process, with the other users and society in general playing a small role.

Since the promulgation of the National Water Law in 1997, federal, state and river basin management institutions have grown exponentially in Brazil, with over 200 river basin organizations established by 2014. However, the policies and institutions that have been responsible for the initial improvements in water management and availability are still evolving, and are adapting to changing circumstances and lessons learned. The broad participation of stakeholders in consultations related to river basin planning and management has had a strong influence on this evolution.

To ensure that water has been an engine of growth and has contributed to both environmental protection and social development, the Government of Brazil has implemented the types of policies recommended in the Water and Green Growth policy framework:

· Adopt river basin management plans using integrated water resources management (IWRM) principles;
· Value ecosystem services to ensure their conservation (e.g., PRODES, Water Provider Program);
· Promote technology transfer and invest in innovative tools to improve water and energy efficiency;

· Adopt a package of economic instruments, including demand management and incentives for cleaning up waterways, recycling and reuse of water; and
· Promote access to clean drinking water supply and sanitation as a key to poverty alleviation, public health and quality of life.

Many of these programs have been very successful and have contributed to the economic success of the country over the past few decades. However, challenges in the environmental and social spheres still remain. One of the river basin institutions that has been most active in tacking these challenges is the Piracicaba-Capivari-Jundiai (PCJ) Basin Committee, and its corresponding basin agency. In order to tackle the water problems and impacts identified in the basin, several actions were started in the PCJ committee, including hydrologic monitoring and basin plans, basin conservation initiatives, water quality improvement, and protection against floods and droughts.

Brazil has also designed and implemented water-oriented PES programs, such as the Basin Pollution Control Program (PRODES) and the Water Provider Program (WPP). Developed by the National Water Agency (ANA), these programs have been implemented since 2001 on a national scale, and involve a new philosophy in water resources management, namely that communities and firms should be compensated for environmental services they provide, based on the project performance.

Since 2001, a total of 69 PRODES sewage treatment stations have been contracted in six different states of Brazil, considerably reducing pollution from sewage in the river basins receiving the project. Since its conception in 2004, the Water Provider Program allowed the implementation of 16 projects in strategic basins of 11 Brazilian states. It is estimated that more than 50% of the original basin sedimentation was abated with the program.

Some of the lessons learned and challenges still facing Brazil as it moves forward with its water management policies are listed below and described in the case study.

· Additional focus is needed to meet the deficit in sanitation services, especially in favelas in large cities and remote rural areas of the north and northeast.
· Specific programs need to be stepped up on water resources management in the north and northeast.
· Serious objections to water projects need to be addressed through consultation and dispute resolution.
· Communities need to be educated and empowered to manage water systems.
· Continuous capacity building of water users and stakeholders is required, especially in water and environmental management.
· A better connection between effective policies and green growth, including socio-economic and ecosystem improvements needs to be clearly demonstrated.
· Environmental education and showcasing PES programs could be effective in the promotion of green growth.
· Monitoring, evaluation, and follow-up would enhance PES systems.

I. Introduction

1. Purpose of the Case Study

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of United Nations Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then, the United Nations and the international community have considered water as essential to the attainment of sustainable development. Moreover, the concept of sustainable development was the cornerstone of UNCED. The Brundtland Commission defined that concept in 1987, and ever since, it has been accepted that development must include not only the economic growth, but also the environmental and social dimensions.[1)]

In addition, innumerable international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991 and the triennial World Water Forums, convened by the World Water Council every three years since 1997. The Sixth World Water Forum was held in Marseille, France in 2012, where the Water and Green Growth project was introduced to a broad audience.

Two case studies involving Brazil's water institutions were considered as good examples of Water and Green Growth, and were thus included as part of the Water and Green Growth (WGG) project, being jointly undertaken by the World Water Council (WWC) and the Government of the Republic of Korea since November 2010.[2)] The project collected case studies demonstrating water and green growth and developed a policy framework. The first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille, France in March 2012.[3)] The case studies on "Green Growth and Integrated Water Resources Management (IWRM) in Brazil" and "Payment for Environmental Services (PES): Brazil" were included in the first edition.

The green growth and IWRM case study presents an overview of national water resources management policy and structure and how it is aligned with green growth objectives. Brazil holds 12% of the world's fresh water and has one of the most sophisticated water resources management systems. The National Water Resources Management System has introduced such water management practices as decentralization, the use of economic tools for water management, and public participation in the decision-making process. The second describes Brazil's public policy on PES that provides a financial Instrument to improve water quality in the country. Two of the instruments are the River Basin Clean-Up Program and the Water Provider Program. These program are described in Chapter III of this report. The expanded case study included here elaborates on the lessons learned in the two case studies presented earlier. This case study on "Integrated Water Management and Payment for Environmental Services in Brazil" is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu, Republic

1) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced Our Common Future (Oxford University Press, 1987), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

2) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

3) *Government of the Republic of Korea and World Water Council. 2012, March. Water and Green Growth Edition 1.* Marseille. www.waterandgreengrowth.org

of Korea in 2015. The World Water Council and the Government of the Republic of Korea, the organizers of the Forum, supported preparation of the case study.

2. Case Study Context

The Brazilian case study presents an overview of national water resources management policy and institutions and highlights two individual examples: the water basin management structure in the Piracicaba, Capivari and Jundiaí river basins and the mechanism for implementing payment for environmental services. Illustrative examples of the latter are the River Basin Clean-up Program (PRODES) and the Water Provider Program. These examples are aligned with green growth objectives. Some of the water management practices being used in Brazil are decentralization to the basin and sub-basin level, the use of economic tools for water management, and public participation in the decision-making process. The National Water Agency (ANA) is responsible for implementing national policy and coordinating the National System, particularly its technical and institutional instruments. Moreover, the agency is responsible for regulating water uses in rivers under the federal jurisdiction by issuing water permits and controlling water use.

In accordance with its green-growth objectives, water resources management in Brazil promotes “reasonable use of the water resources among multiple users that supports sustainable economic growth through a socially inclusive decision-making process and appropriate governmental capacity.”

The country is divided into 12 hydrographic regions (each with one or more river basins) used for macro analysis of water resources in Brazil. The boundaries of these regions are different from the geopolitical boundaries of the Brazilian States. In order to demonstrate IWRM practices in Brazil, the cases of the Piracicaba, Capivari and Jundiaí river basins, which comprise the States of São Paulo and Minas Gerais, are presented in this case study. The water agencies in those basins have evolved a system of water use charges and collected, in 2010, over US $42 million, which is being invested under the River Basin Water Plan.

The Brazilian Water Law has established five management instruments to help with implementation of national policy: river basin plans, classification of water bodies, water permits, water use charges, and information systems. At the basin level, the Integration Pact is an agreement between the Agency and the States, together with the River Basin Committee. It establishes the obligation for parties to work together to implement the water management tools and the Water Law.

Even though Brazil is endowed with enormous water resources, the country has come to realize the importance of conserving its resources in an effort to promote real green growth. The structure of the water resources policy is complex, but it offers some very positive lessons for IWRM, including river basins. The case provides a framework for working at the basin level in a Federal system and offers guidance to other countries with many rivers that flow across different jurisdictions. The examples of how the river basin committees make decisions in line with national water policy are useful for other countries attempting to implement river basin plans.

3. Case Study Methodology

This case study examines one of the world’s most sophisticated water resources management systems for Brazil, a country that holds 12% of the world’s fresh water. It describes the integrated water resources management system that has evolved in Brazil to implement national water resources policy, establish institutions and economic and regulatory tools, and coordinate activities at the basin level based on 12 hydrographic regions. It also explores financial instruments for paying for watershed and ecosystem services in the river basin context. The case study examines exogenous factors and water institutions at the national, basin, and community levels that have had a major impact on watershed protection and environmental conservation, as well as on economic growth and social development. The present research explores the exogenous economic, social, political, environmental, and technical factors that drive water resources planning and management processes. Water management is considered of crucial importance to economic growth, social development, and environmental sustainability in Brazil. The case study was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[4] These case studies indicate how the institutional framework in the water and related sectors contribute to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in The *Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[5] The questionnaires presented to representatives of the main water-related institutions and other stakeholders in Brazil were developed to reflect that framework. Saleth and Dinar(2004) define a water institution to be an entity defined interactively by three main components: water law, water policy, and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which Brazil has implemented its integrated water resources management policy and practices that support green growth. The policies and institutions that have been responsible for the improvements in water management and availability and thus economic growth and social development along the rivers and in urban areas, are still evolving and are adapting to changing circumstances and lessons learned. The broad participation of stakeholders in consultations related to river basin planning has had a strong influence on this evolution. The case study describes the water management institutions and policies at national, basin, municipal, and community levels. Their performance is analyzed, and lessons and conclusions are drawn.

First, the external environment during the evolution of the water management system in Brazil is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Then water resources governance, policy, law and institutions in Brazil are examined, including local water governance structures. Information and statistics from international, national and basin sources, and from independent academic studies, provide an overview of the situation in the country and in selected river basins.

Finally, the impact and performance of the various elements of water management policies and practices in Brazil are analyzed. Survey results and expert interviews are used to examine the current situation and performance of specific aspects of the water management, including river basin plans and payment for environmental services.

4) *K-water Institute (Research Center for Water Policy and Economy). 2013, September. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report*. Daejeon, Republic of Korea.

5) Saleth, R.M and Dinar, A. 2004. *The Institutional Economics of Water: A Cross-Country Analysis of Institutions and Performance*. Washington, D.C., the World Bank.

II. An Overview: Water Management in Brazil

1. About Brazil

Brazil, officially the Federative Republic of Brazil (in Portuguese: República Federativa do Brasil), occupies half of South America's landmass. It is the fifth largest nation in the world in both population and area, and is the largest country in Latin America and the Caribbean. Brazil has a 7,400 km coastline along the Atlantic Ocean, and shares more than 15,700 km of inland borders with every South American nation except Chile and Ecuador (see Figure 1). Brazil stretches roughly 4,350 km from north to south and from east to west to form a vast irregular triangle that encompasses a wide range of tropical and subtropical landscapes, including wetlands, savannas, plateaus, and low mountains. Brazil contains most of the Amazon River basin, which has the world's largest river system and the world's most extensive virgin rainforest.[6]

Brazil is the world's seventh largest economy, with a GDP of US $2,253 billion in 2012 (current prices). It had a population of just over 200 million in July 2013, according to the Instituto Brasileiro de Geografia e Estatística (IBGE), which runs the Brazilian census and compiles the latest population data.[7] The population is heavily concentrated on the Atlantic coast.

Brazil is a country with extreme regional differences, especially in the social indicators such as health, infant mortality, and nutrition. The richer South and Southeast regions enjoy much better indicators than the poorer North and Northeast (see Figure 1). The North is the Amazon Basin, with lush tropical rainforest and the largest concentration of freshwater in the world (one fifth of the earth's freshwater resources are located there). The Northeast, where 30% of the country's population lives along the coast, suffers from chronic drought. The West Central is an area of savannahs and grasslands and is sparsely populated. The Federal Capital of Brasilia is located there. The Southeast is highly industrialized, where the majority of the population lives, while the South is highly developed with a good balance between rural enterprises and manufacturing industry. Itaipu dam, one of the largest hydroelectric dams in the world, is located in the South, on the Paraná River that separates Brazil and Paraguay.

Source: Felipe Menengaz, Mapa Clicável do Brasil (Brazil State Map), Wikimedia Commons

<Figure 1> Map of Brazil Showing 26 States, the Federal District and Five Regions

2. Timeline for Water Management Milestones

The Brazilian study presents an overview of national water resources management policy and institutions and analyzes how these have been instrumental in achieving green growth objectives. The National Water Agency of Brazil (ANA), together with the State Water Resources Organizations, is the institution responsible for implementing the national policy and coordinating

6) Poppino, R.. E. 2013. Brazil, *Encyclopedia Britannica*, http://www.britannica.com/EBchecked/topic/78101/Brazil

7) Brazil Population 2014, 2014. *World Population Review*, http://worldpopulationreview.com/countries/brazil-population/

the National Water Resources Management System in Brazil (SINGREH), particularly its technical and institutional instruments. ANA regulates water uses at rivers under federal jurisdiction by issuing water permits and controlling water uses.

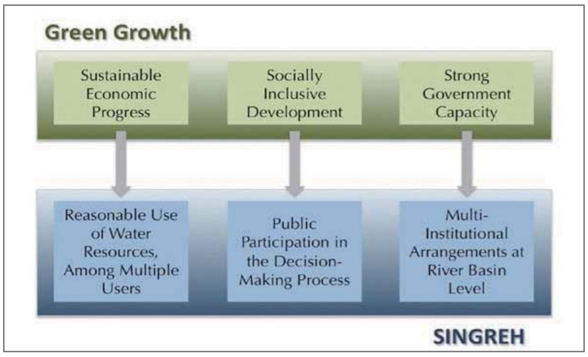
Brazil is endowed with enormous water resources (Figure 2), and the country can provide some very positive lessons for how integrated water resources and river basin management could contribute to green growth. The examples of how the river basin committees make decisions in line with the national water policy are valuable for others embarking on IWRM programs.

Source: Só Geografia (2014): http://www.sogeografia.com.br/Conteudos/GeografiaFisica/Hidrografia/

<Figure 2> Surface Water Resources of Brazil

Additionally, the philosophy of water resources management in Brazil allows for the reasonable use of the country's water resource samong multiple water users, providing the conditions for sustainable economic growth in various sectors, through a socially inclusive decision-making process and appropriate governmental capacity (see Figure 3).

Many institutions have responsibility for the water resources management in Brazil. ANA is the institution responsible for the overall management of the water resources of Brazil, a sector that is fragmented institutionally.



Source: Superintendência de Apoio à Gestão de Recursos Hídricos, ANA

<Figure 3> Green Growth Objectives Alignment with the National Water Resources Management System (SINGREH) Principles in Brazil

Policy, regulatory, and planning functions are dispersed among different agencies and administrative levels. Water Supply and Sanitation Service provision is the responsibility of 27 state-owned water and sanitation companies (Companhias Estaduais de Saneamento Básico or CESBs) and municipalities. River Basin Water Committees are responsible for solving water allocation conflicts among competing users at the basin level. Water governance and institutions will be covered in detail in Chapter III. Box 1 outlines some of the major milestones in water management in Brazil.

<Box 1> Water Management Milestones in Brazil

1934 : Brazil's Water Code established
1968 : National Water Supply and Sanitation System was created; the National Water Supply and Sanitation Plan (PLANASA) covered the period 1968 to 1986
1988: Federal Constitution provided for the organization of the National System of Water Resources Management (SINGREH)
1989 : PCJ Consortium created to act as the River Basin Water Agency
1993 : Piracicaba, Capivari and Jundiaí River Basins Committee installed
1997 : Law no. 9.433/1997, also known as the Water Law, was adopted
2000: Establishment of National Water Agency (ANA) under Law 9884
2001 : PRODES (River Basin Restoration Program) introduced
2003 : Decree 4613/03, defining the competences of the National Council of Water Resources (CNRH) established
2004 : Public Private Partnerships Law adopted (Law # 11079)
2004 : Water Provider Program introduced
2005 : PCJ River Basins Water Agency created
2007 : Federal Sanitation and Solid Waste Bill (Law 11.445/07) adopted
2013 : Federal Government approved the National Basic Sanitation Plan (Plansab)

III. The Case Study

The Federal Constitution of 1988 created the legal foundation for the National Water Resources Management System in Brazil (SINGREH, in Portuguese acronym). SINGREH has introduced such water management practices as decentralization, the use of economic tools for water management, and public participation in the decision-making process. The National Water Resources Policy, known as the Water Law, was promulgated in 1997. This provided the mandate for the establishment of the National Water Agency of Brazil (ANA in Portuguese acronym) in June 2000. The creation of ANA took only 15 months, a relatively short development period for such a complex process.[8)]

ANA was designed to fit into the political and institutional context of Brazil's water sector, a sector that has been evolving since 1934, when the nation's Water Code was established as part of the Federal Constitution. The concept of Brazil's "water domain" was substantially modified in subsequent constitutions; in the 1988 constitution, the water domain at the federal level was defined to include:

- Lakes, rivers and streams that are located in more than one State, that serve as borders with other countries, or that extend to or come from a foreign territory; and
- Ground or surface water courses and rainwater that does not belong to the Union (i.e. the federal system) belongs to the States. Thus, for instance, all rivers and all groundwater that are entirely contained within a state's boundaries belong to that State.

The Brazilian Water Law has established five management instruments to help the implementation of national policy: river basin plans, classification of water bodies, water permits, water use charges, and information systems. ANA has introduced the user pays concepts in Brazil, and continued to utilize the polluter-pays concept that was introduced with the National Environment Policy in 1981.

Because a single water basin often falls under different Federal and State jurisdictions, integration among SINGREH's various levels – national, state, and river basin – has been a challenge. The 12 hydrographic regions in Brazil have limits that are different from the geopolitical boundaries of the Brazilian States (see Figure 4). This case study presents an example of integrated water resources management practices in the Piracicaba, Capivari and Jundiaí (PCJ) River Basins, which comprise São Paulo and Minas Gerais States, and located in the Parana basin. The implementation and evolution of water use charges and the water agency in these river basins are described as part of the case study.

Source: Agencia Nacional De Aguas (ANA),(2013) Conjuntura de recursos hídricos do Brasil. Brasilia (in Portuguese)

<Figure 4> Map of Brazil Showing 12 Hydrographic Regions

8) Leomax dos Santos, J.. The establishment of the National Water Agency ANA. ECLAC. http://www.eclac.cl/samtac/noticias/documentosdetrabajo/1/23411/InBr02603.pdf

At the river basin level, ANA has created the Integration Pact framework, which is agreed between ANA and the States, together with the River Basin Committee. It establishes the obligation for parties to work together to implement the water management tools and the Water Law. The River Basin Committee includes representatives of the government, users and non-governmental organizations. These committees are responsible for approving the River Basin Plan and for proposing the amount to be charged for water use. The ANA also has a Cooperation Pact framework, which supports the States, technically and financially, to cope with the challenge of decentralized and participative management. Further, a Management Contract enables the collection of water charges by Federal or State organizations and transfer to the River Basin Water Agency. SINGREH strives to promote coordination among different user sectors, at regional, state and national levels and incorporates flexibility to accommodate regional differences. The way the system works is described in the case of the PCJ River Basin Committees in Chapter III.

So far, there is some evidence that the IWRM initiatives in Brazil, at the legal, institutional, and operational levels, are aligned with the Green Growth objectives. These are reflected in the following objectives of the National Water Law:

- The decentralization of the decision-making process in water planning and management (article 1st-IV of Law No. 9433/97);
- The assurance of good quality water, in quantities needed for present and future generations (article 2nd-I of Law No. 9433/97);
- The integration of water management with the management of soil and the environment (article 3rd-III/V);
- The utilization of economic management instruments, such as charging for bulk water (article 5th-IV of Law No. 9433/97);
- The creation of more than 200 river basin committees in the country, since 1997; and
- The establishment of PES programs aiming at water quality improvement, such as PRODES and the Water Provider Program.

Although the above initiatives are still recent, it is expected that they will lead to the significant improvements in water quality and quantity for the multiple uses and sectors, which is one of the main objectives of Green Growth.

1. Exogenous Factors

This section presents the exogenous factors that helped shape the context in which key water resources management decisions were made and implemented in Brazil and its hydrographic regions (or river basins). It describes some of the economic, social, political, environmental, and technological elements that influenced those decisions and that contributed to the achievement of green growth.

1-1. Economic Factors

Brazil is the world's seventh largest economy, with a GDP of US $2,253 billion in 2012 in current prices (US $1,136.6 billion in 2005 constant prices). It is also the fifth largest country in area and population in the world and the largest in Latin America and the Caribbean. It had a population of just over 200 million in July 2013, according to the Instituto Brasileiro de Geografia e Estatística (IBGE), which compiles the latest population data.[9] The population is heavily concentrated on the Atlantic coast.

9) *Brazil Population 2014. World Population Review*. http://worldpopulationreview.com/countries/brazil-population/

As can be seen from the GDP constant price data in Table 1, Brazil's economy was growing rapidly from 2004 to 2008. Since 2009, Brazil has struggled with slow economic growth, but still benefited from robust prices for commodity exports. After the rapid growth in 2010, the economy slowed significantly in 2011 and 2012. The GDP growth of 7.5% in 2010 decelerated to 2.7% in 2011 and to 0.9% in 2012.[10] Industrial output and investment demand were affected disproportionately. The slowdown was driven by both domestic and external factors.

Brazil had solid economic growth in per capita GDP over the period, with an annual average of 2.2% per year from 2000 to 2012 in constant prices. The most rapid growth in per capita income was from 2004 to 2008, when it averaged 3.7% per year in constant prices (calculations based on Table 1).

<Table 1> Brazil: Total GDP and Per Capita GDP and Growth Rates, 2000-2012

Year	Total GDP in billion US % (constant 2005 prices)	Growth over previous year (%)	Per capita GDP (constant 2005 US $)	Growth over previous year (%)
2000	769.0	4.31	4406	2.81
2001	779.1	1.31	4403	-0.09
2002	779.8	2.66	4458	1.27
2003	809.0	1.15	4451	-0.17
2004	855.2	5.71	4648	4.42
2005	882.2	3.16	4739	1.97
2006	917.1	3.96	4875	2.85
2007	973.0	6.10	5121	5.05
2008	1023.3	5.17	5336	4.20
2009	1019.9	-0.33	5271	-1.22
2010	1096.8	7.53	5618	6.58
2011	1126.7	2.73	5721	1.83
2012	1136.6	0.87	5721	0.00

Source: http://databank.worldbank.org/data/views/reports/tableview.aspx

The government introduced the Growth Acceleration Plan in 2007 to increase investment in infrastructure and provide tax incentives for faster and more robust economic growth. This was followed in 2012 by a range of initiatives to reduce energy costs, restructure oil royalty payments, strengthen investment in infrastructure through foreign participation, and reform the value-added tax. While the stimulus measures undertaken so far have not had a big impact on economic activity, the economy was starting to pick up in 2013, ending the year with an estimated growth rate of 2.3%.[11] Still, Brazil's strong domestic market is less vulnerable to external crises, and Brazilians are benefiting from stable economic growth, with relatively low inflation rates and improvements in social well-being.

According to the World Bank, the financial sector has weathered the slowdown well so far. The banking system has remained sound and resilient. Despite rapid credit growth, the lower interest rates have helped contain credit default. Foreign direct investment remains more than sufficient to cover the current account deficit, which has hovered around 2.2% of GDP. Investment flows showed significant fluctuations, due to changing interest rates and the imposition of financial transaction taxes.[12]

Brazil's overall macroeconomic framework is solid and sustainable in the medium term. The country has maintained high foreign reserve levels (about US $380 billion), a favourable external debt composition, a current account fully covered by foreign direct investment and a relatively low dependence on international trade.[13]

10) Brazil Overview. World Bank. http://www.worldbank.org/en/country/brazil/overview

11) *Winter, B. and Cascione, S. 2014S, 27 Feburary. Update 3 - Brazil Economy Ends 2013 on an Upbeat Note, Boosting Rousseff. Reuters*. http://www.reuters.com/article/2014/02/27/brazil-economy-gdp-idUSL1N0LW0VN20140227

12) http://www.worldbank.org/en/country/brazil/overview

13) http://www.worldbank.org/en/country/brazil/overview

1-1-1. Economy by Sector

The economic importance of agriculture in value added to the Brazilian economy has fluctuated in recent years, but it has remained relatively low, between 5 and 7% of value added in GDP from 2000 to 2012 (see Table 2). The industrial sector retained its portion of about 27% of value added in GDP over the period, while the service sector accounted for over two thirds of the value added throughout the period. The service sector had good growth rates throughout the period. Agriculture was growing at a steady rate until 2008, and then began a decline in its contribution to the economy through 2012.

1-1-2. International Trade

As can be seen from Table 3, exports of goods and services from Brazil grew very rapidly from 2000 to 2008, with an average growth rate of 8% per year in constant prices. Exports declined in 2009 with the global recession and recovered thereafter. Except for 2009, Brazil's export performance remained strong (over U$$150 billion per year in constant prices). It is interesting to note that Brazil's top exports are all raw materials: iron ore, crude oil, soybeans, raw sugar, and coffee. Brazil is the world's largest exporter of such products as raw sugar, coffee, poultry meat, fruit juice, and raw tobacco.[14] Exports fluctuated between 10% and 16% of GDP over the period. Major export markets are China, the U.S., Argentina, the Netherlands, and Germany.

From 2002 to 2007, exports exceeded imports, giving Brazil a favourable trade balance for that period. Following the recession in late 2008, imports overtook exports, and the trade balance has been negative ever since. Brazil's main imports are iron ore, poultry meat, refined petroleum, cars, and crude petroleum. Its main import partners were Argentina, U.S., China, Germany and the Republic of Korea.

1-1-3. Demographic Trends

Brazil has experienced rapid urbanization since 1980 (see Figure 5), with the urban population increasing from

<Table 2> Brazil: Value Added by Sector, 2000-2012

Year	Agriculture, value added (constant 2005 US $ billion)	Agriculture, value added (% of GDP)	Industry, value added (constant 2005 US $ billion)	Industry, value added (% of GDP)	Services, etc., value added (constant 2005 US $ billion)	Services, etc., value added (% of GDP)
2000	35.2	5.6	196	27.7	427	66.7
2001	37.3	6.0	195	26.9	435	67.1
2002	39.8	6.6	199	27.1	449	66.3
2003	42.1	7.4	201	27.8	452	64.8
2004	43.1	6.9	217	30.1	475	62.3
2005	43.2	5.7	222	29.2	492	65.0
2006	45.3	5.5	226	28.8	513	65.8
2007	47.4	5.6	238	27.8	544	66.6
2008	50.5	5.9	248	27.9	571	66.2
2009	48.9	5.6	234	26.8	583	67.5
2010	52.0	5.3	258	28.1	615	66.6
2011	54.0	5.5	262	27.5	632	67.0
2012	52.8	5.2	260	26.3	642	68.5

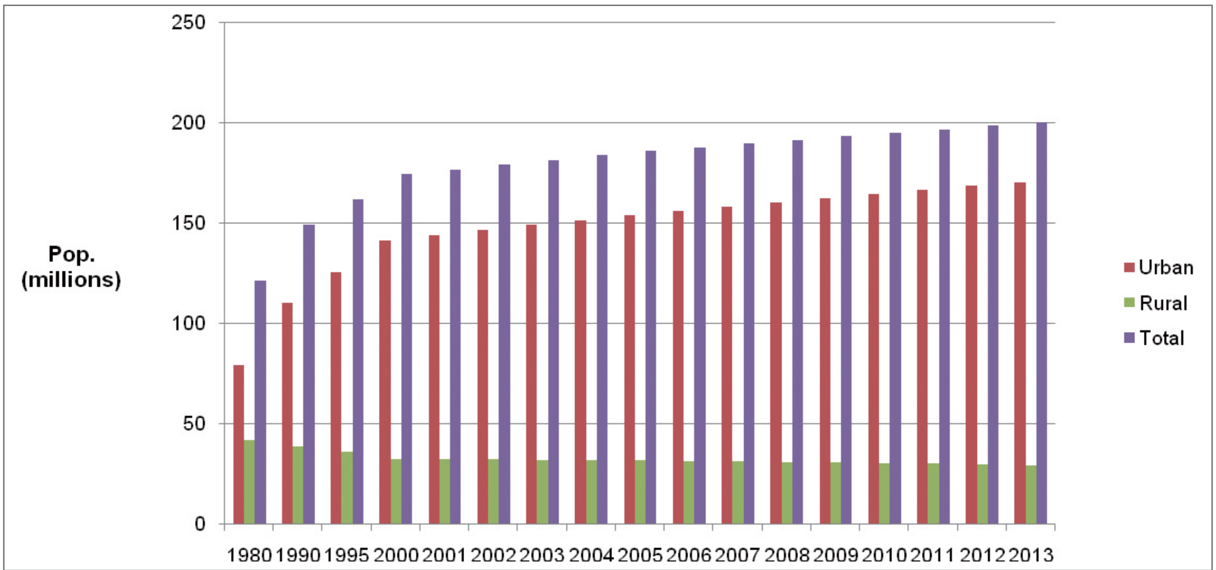
Source: World Bank Databank: http://databank.worldbank.org/data/views/reports/tableview.aspx

14) Trade in Brazil. http://atlas.media.mit.edu/profile/country/bra/

<Table 3> Brazil: Imports and Exports, Percentage of GDP and Annual Growth, 2000-2012

Year	Imports of goods and services (constant 2005 US $) in billion	Imports of goods and services (annual % growth)	Imports of goods and services (% of GDP)	Exports of goods and services (constant 2005 US $) in billion	Exports of goods and services (% of GDP)	Exports of goods and services (annual % growth)
2000	93.9	10.8	11.7	81.1	10	12.9
2001	95.3	1.5	13.5	89.3	12.2	10
2002	84.1	-11.8	12.6	95.9	14.1	7.4
2003	82.7	-1.6	12.1	106	15	10.4
2004	93.6	13.3	12.5	122	16.4	15.3
2005	101.6	8.5	11.5	134	15.1	9.3
2006	120.4	18.4	11.5	140	14.4	5
2007	144.3	19.9	11.8	149	13.4	6.2
2008	166.5	15.4	13.5	150	13.7	0.5
2009	153.8	-7.6	11.1	136	11	-9.1
2010	208.9	35.8	11.9	152	10.9	11.5
2011	229.3	9.7	12.6	159	11.9	4.5
2012	229.8	0.2	14	159	12.6	0.5

Source: World Bank Databank: http://databank.worldbank.org/data/views/reports/tableview.aspx



Source: IBGE:http://www.ibge.gov.br/home/estatistica/populacao/estimativa2013/estimativa_tcu.shtm

<Figure 5> Population and Urbanization Trends in Brazil.

65 to 85% of the population from 1980 to 2013, with a decrease in rural population. Brazil's population growth rate levelled off in the last decade and over the period from 2000 to 2013, averaged of 1.07% per year, below replacement rate. In the 1980s, population was growing at slightly over 2% per year and then fell to 1.55% per year in the 1990s.

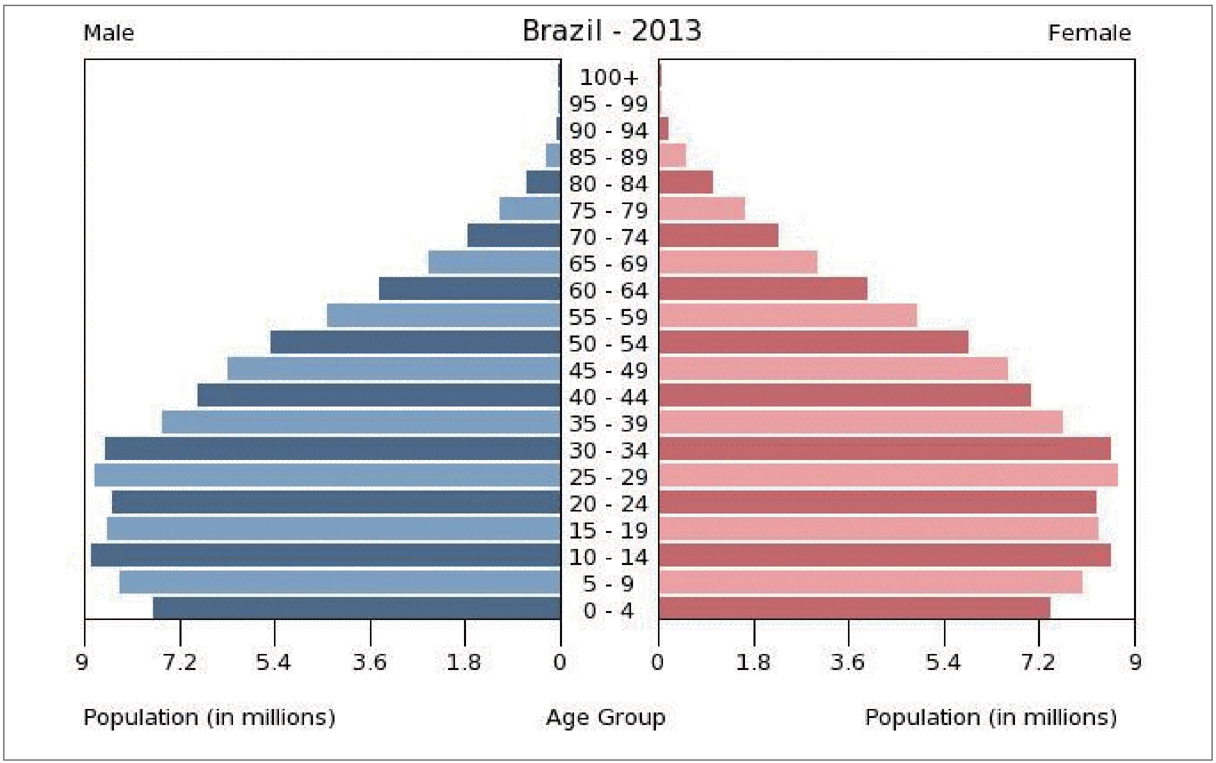
Because it is such a large country, population density is low, averaging about 23.4 people per km^2 in 2012 (see Table 4). As the proportion of people living in urban areas is so high (85%), it is clear that vast areas of the country have very few people.

Despite the slow growth in population, Brazil has a relatively young population (Figure 6), with 40% of the population below the age of 25. Life expectancy reached 73.6 years of age in 2012.

<Table 4> Population Density in Brazil

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Persons/ km^2	21.4	21.6	21.9	22.1	22.3	23.1	23.3	23.6	23.9	23.4

Source: Index Mundi: http://www.indexmundi.com/g/g.aspx?v=21000&c =br&l=en



Source: Index Mundi: http://www.indexmundi.com/brazil/age_structure.html

<Figure 6> Population Pyramid in Brazil

1-1-4. Recent Economic Developments

The middle class is growing, and a significant proportion of the population has been lifted out of poverty. However, with the upcoming FIFA World Cup in 2014 and the Rio de Janeiro Olympic games in 2016, the Brazilian government will be challenged in its administrative capacity to ensure security and the smooth running of these events.[15] Some citizen's groups are unhappy with the huge allocation of the government resources to these projects, even though they will entail investments in areas such as urban and social development and transportation infrastructure, which should benefit the population.

The World Cup projects are just a part of a bigger national problem casting a pall over Brazil's grand ambitions: an array of lavish projects conceived when economic growth was strong that now stand abandoned, stalled or wildly over budget. The country is currently suffering from the post-boom slowdown, and many segments of the population blame their political leaders for incompetence and wasteful spending, while basic services for millions remain dreadful. Indeed, Brazil has run up against numerous delays and cost overruns, and is building bus and rail systems for spectators that will not be finished until after the games are over.[16] Some economists say the troubled projects reveal a crippling bureaucracy, irresponsible allocation of resources and corruption.

15) The Heritage Foundation. 2014. Brazil. http://www.heritage.org/index/pdf/2014/countries/brazil.pdf

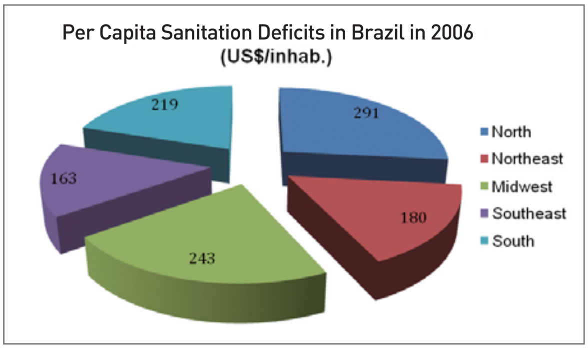
16) *Romero, S. 2014, 12 April. Grand Visions Fizzle in Brazil. New York Times*. http://www.nytimes.com/interactive/2014/04/12/world/americas/grand-visions-fizzle-in-brazil.html?emc=eta1

Huge street protests have been aimed at costly new stadiums being built in cities like Manaus and Brasília, whose small fan bases are almost sure to leave huge numbers of empty seats after the World Cup events are finished. The growing list of troubled development projects includes a $3.4 billion network of concrete canals in the drought-plagued hinterland of northeast Brazil — which was supposed to be finished in 2010 — as well as dozens of new wind farms idled by a lack of transmission lines, and unfinished luxury hotels blighting Rio de Janeiro's skyline. Economists surveyed by the nation's central bank see Brazil's economy growing just 1.63% in 2014, down from 7.5% in 2010, making 2014 the fourth straight year of slow growth.

The Transnordestina, a railroad begun in 2006 in northeast Brazil, illustrates some of the pitfalls plaguing projects big and small. Scheduled to be finished in 2010 at a cost of about US $1.8 billion, the railroad, designed to stretch more than 1,000 miles, is now expected to cost at least $3.2 billion, with most financing from state banks. Officials say it should be completed around 2016. Brazil's transportation minister expressed exasperation with the delays in finishing the railroad, which is needed to transport soybean harvests to port. He listed the bureaucracies that delay projects like the Transnordestina: the Federal Court of Accounts; the Office of the Comptroller General; an environmental protection agency; an institute protecting archaeological patrimony; agencies protecting the rights of indigenous peoples and descendants of escaped slaves; and the Public Ministry, a body of independent prosecutors.[17)]

1-1-5. Effects of Economic Factors

Despite the significant economic development of Brazil in the last 30 years, a series of bottlenecks still hinder the effective investments in water and sanitation in the country, where a significant deficit stills remains, independent of the level of regional development (Figure 7, showing per capita sanitation deficits in 2006).



Source: World Bank (2008)

<Figure 7> Per Capita Sanitation Deficit in Brazil's Regions in 2006

Until recently, this deficit had to do with the lack of political will to tackle the water and sanitation problem. However, with recent laws and policies, such as the National Sanitation Law (2007), the Public-Private Partnership Law (2004), and the 2013 National Basic Sanitation Plan (Plansab), it is expected that the investments in the water and sanitation sector will increase.

An example of this new approach is the private investment in water and sanitation in the cities of Palmas and Recife (state capitals), through state concession and public-private partnership (PPP) agreements, respectively. Since the investment needed to meet the sanitation requirements in both capitals surpasses investment capacity of both states, the private investment and management expertise of corporations will help to tackle the significant sanitation deficits in those capitals. It is expected that these investments will contribute to the regional green growth in the coming years, due to an improvement in water quality and its positive consequences for the population's health and quality of life.

17) *Romero, S. 2014, 12 April. Grand Visions Fizzle in Brazil. New York Times*. http://www.nytimes.com/interactive/2014/04/12/world/americas/grand-visions-fizzle-in-brazil.html?emc=eta1

1-2. Social Factors

Brazil has made progress in recent years for in improving the quality of life of its citizens, as shown by the fact that Brazilians' general satisfaction with their lives is higher than the OECD average, despite lower than average scores in some topics on the Better Life Index.[18)]

1-2-1. Human Development Index

The country has fared quite well in social indicators over the last decade. Gross national income per capita (in purchasing power parity) has risen in current terms from US $6,840 in 2000 to 11,530 in 2012, for an average of 4.5% per year (see Table 5). Brazil has been one of the fastest growing countries in the world. Life expectancy has also been rising, from 70.26 years in 2000 to 73.62 years in 2012.

<Table 5> Gross National Income (GNI) Per Capita and Life Expectancy in Brazil from 2000-2012

Year	GNI per capita, Current international $	Life expectancy at Life expectancy birth, total (years)
2000	6,840	70.26
2001	6,940	70.57
2002	7,140	70.87
2003	7,290	71.16
2004	7,840	71.44
2005	8,260	71.72
2006	8,790	71.99
2007	9,520	72.26
2008	10,080	72.53
2009	10,080	72.80
2010	10,890	73.08
2011	11,300	73.35
2012	11,530	73.62

Source:http://databank.worldbank.org/data/views/reports/tableview.aspx#

In terms of the Human Development Index (HDI) shown in Table 6, Brazil's overall HDI registered tremendous improvement over the period form 1980 to 2012, rising from 0.52 in 1980 to 0.73 in 2012. The greatest advance for Brazil was in the HDI for education, which rose from 0.40 to 0.67 over the period. The most rapid advances were made from 1980 to 2000 in education, but the index kept rising in the last decade. Health indicators also had a significant rise, from 0.67 in 1980 to 0.85 in 2012. Improvements in health indicators were steady throughout the period. Income did not make a comparable improvement, especially in the 1980-2000 period, but had already started at a higher level (0.63 in 1980 to 0.68 in 2012).

<Table 6> Human Development Index for Brazil: Health, Education and Income, 1980-2012

Year	HDI	HDI – Health	HDI – Education	HDI – Income
1980	0.52	0.67	0.40	0.63
1990	0.59	0.73	0.49	0.63
2000	0.67	0.79	0.60	0.64
2005	0.70	0.81	0.65	0.65
2006	0.70	0.82	0.65	0.66
2007	0.71	0.82	0.66	0.66
2008	0.72	0.83	0.66	0.67
2009	0.72	0.83	0.67	0.67
2010	0.73	0.84	0.67	0.68
2011	0.73	0.84	0.67	0.68
2012	0.73	0.85	0.67	0.68

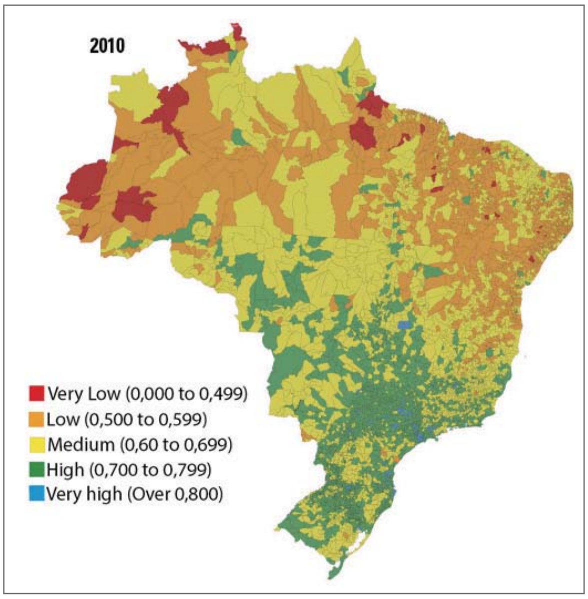
Source: http://countryeconomy.com/hdi/brazil

1-2-2. Five Regions of Brazil [19)]

Brazil is a country with extreme regional differences, in geography, climate, economic development and in social indicators such as health, infant mortality and nutrition. The richer South and Southeast regions enjoy much better indicators than the poorer North and Northeast. The five major regions of Brazil are shown in Figure 1, and a map of the Municipal Human Development Index is presented in Figure 8. As can be seen from Figure 8, the North and Northeast show

18) OECD Better Life Index. http://www.oecdbetterlifeindex.org/countries/brazil/
19) Embassy of Brazil in Wellington. 5 Regions of Brazil. http://www.brazil.org.nz/page/five-regions.aspx

much lower human development indicators than the West-Central, Southeast, and Southern regions.



Source: http://www.atlasbrasil.org.br/2013/en/destaques/faixas_idhm

<Figure 8> Map Showing Municipal Human Development Indices in Brazil

The Northern Region (Amazonas, Pará, Acre, Rondônia, Roraima, Amapá, and Tocantins states) lies mostly within the Amazon basin. Lush tropical rain forests largely cover it. Besides the Amazon, there are also numerous other rivers in the area. By volume, this area has the largest concentration of fresh water in the world and 12% of the earth's fresh water reserves. There are two main Amazonian cities: Manaus, capital of the State of Amazonas, and Belém, capital of the State of Pará. There was renewed interest in the Amazon's mineral wealth and agricultural potential in the 1960s and 1970s. Favourable changes in legislation related to mineral concessions and the readiness of state companies to form joint ventures with foreign corporations increased exploration and mining.

The Federal Government sponsored a variety of colonization schemes, all based on the idea that the unpopulated Amazon forest could provide land for the people in the drier northeast. The government incentives to encourage farming in the Amazon resulted in the region becoming increasingly threatened by environmental problems. Development projects and domestic migration during the 1970s and 1980s led to deforestation of almost 330,000 km^2 of forest in the region and widespread forest fires. The Brazilian government then introduced various policies to control development. Fiscal incentives and credits to livestock and agricultural projects in the area were suspended, and exports of timber were prohibited. Since 1989, the rate of deforestation has been considerably reduced, and protection of the Amazon is being monitored by satellite. Domestic and international efforts are coordinated through the Pilot Program for the Protection of the Brazilian Rain Forest, sponsored by the European Community, the United States, and many other countries.

The Northeast Region (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Bahia, Alagoas, and Sergipe), which contains 30% of Brazil's population, is subject to chronic drought and is the driest region of the country. The area has important economic possibilities, including major oil fields, and the Federal Government in recent years has been giving the Northeast special attention through the Superintendency for the Development of the Northeast (SUDENE). Considerable resources have been allocated to its improvement. Pernambuco and Bahia were the first major centers of colonial Brazil, and they exert a strong influence on Brazilian culture. Much of what is typically Brazilian in music, folklore, cuisine, and social habits originated in this region. The two largest cities in the northeast are Recife and Salvador.

The West-central region (Mato Grosso, Mato Grosso do Sul, Goiás, and the Federal District) is covered with extensive savannas and tropical grasslands, and is sparsely populated. Once one of the more isolated areas of the country, this region has experienced a rapid expansion of its rural production and established new industries. The nation's capital, Brasília, founded in 1960, is located in this region. The Federal Government has set aside vast areas in the west-central region as reservations for the indigenous people who originally lived on them. Also the wildlife paradise is in this region, the Mato Grosso swamplands (Pantanal Mato-grossense).

The Southeast Region (Rio de Janeiro, São Paulo, Minas Gerais, and Espírito Santo) is highly industrialized and is the economic hub of Brazil. The region includes the cities of São Paulo, Rio de Janeiro, and Belo Horizonte; the majority of the country's population lives in this region. São Paulo and Rio de Janeiro (São Paulo in particular) have traditionally been the centers for manufacturing and commerce in Brazil, although their dominance has declined. The area is rich in minerals, and its agriculture is the most advanced in the country, producing coffee and grains for export, as well as a variety of both fresh and processed foodstuffs, milk, and meat for domestic consumption.

The Southern Region (Paraná, Santa Catarina, and Rio Grande do Sul) is also highly developed. As in the Southeast Region, there is a balance between the rural and the manufacturing sectors. Toward the south, the plateau drops to the wide plains called pampas, where the traditional grazing activities produced the gaucho, the Brazilian equivalent of the cowboy. In the west, located on the border between Brazil and Argentina, is Iguaçu Falls, one of the most beautiful natural wonders in the world. The second largest hydroelectric dam in the world (Itaipu) is located on the Paraná River that separates Brazil and Paraguay. The largest city in this region is Porto Alegre, capital of Rio Grande do Sul, Brazil's southernmost state.

1-2-3. Employment

In terms of employment, over 68% of people aged 15 to 64 in Brazil have a paid job, slightly more than the OECD employment average of 66%. Some 80% of men are in paid work, compared with 56% of women. In Brazil, 12% of employees work very long hours, higher than the OECD average of 9%, with 15% of men and 9% of women working very long hours.[20]

The level of unemployment in the labor force has been falling steadily since 2004, even through the recession (see Figure 9). More and more jobs have been created as the

Source: http://www.tradingeconomics.com/brazil/unemployment-rate

<Figure 9> Unemployment Rate in Brazil, 2002-2014

20) OECD Better Life Index. http://www.oecdbetterlifeindex.org/countries/brazil/

economy has grown. Brazil's formal economy generated a record 2.2 million new jobs in the first nine months of 2013, though the pace of employment creation slowed in September, according to the Ministry of Labor.[21)] Based on the previous record in 2008, 2.09 milion new jobs were created between January to September. The unemployment rate hovers around 5%. The figure for formal employment does not include day labourers and other temporary workers, the self-employed or people who work "off the books".

Employment gains in September 2013, when 246,875 new positions were filled, compared with nearly 300,000 the previous month, fell short of government forecasts.[22)]

1-2-4. Income Inequality and Social Reform

One of the most serious problems facing Brazil today is its highly unequal distribution of wealth and income, which is among the highest in the world. In a country with such striking inequalities, programs for reducing poverty and social exclusion are in the high priorities.

By the 1990s, more than one out of four Brazilians were surviving on less than US $1.00 per day. In the period from 1990 to 1998, 13 million people were lifted from poverty, thus reducing the percentage of the poor population in the country from 43.8% to 32.7% of the total. The number of people living on less than US $2 per day (poverty level) fell further from 21% of the population in 2003 to 11% in 2009. Extreme poverty (people living on less than US $1.25 per day) also dropped dramatically, from 10% in 2004 to 2.2% in 2009.[23)]

<Table 7> GINI Index in Brazil, 2001-2012

Year	GINI index
2001	0.601
2002	0.594
2003	0.588
2004	0.577
2005	0.574
2006	0.568
2007	0.559
2008	0.551
2009	0.547
2010	NA
2011	0.519
2012	0.519

Source: 2001-2009: http://databank.worldbank.org/data/views/reports/tableview.aspx; 2011-12: https://www.cia.gov/library/publications/the-world-factbook/fields/2172.html

Thus, inequality was considerably reduced between 2001 and 2009, when the income growth rate of the poorest 10% of the population was 7% per year, while that of the richest 10% was 1.7%. Income inequality measured by the Gini index[24)] fell from 0.601 in 2001 to reach a 50-year low of 0.519 in 2011,[25)] as shown in Table 7. Despite these achievements, inequality remains at relatively high levels for a middle-income country.

1-2-5. Education

After having reached almost universal coverage in primary education, Brazil is now struggling to improve the quality and outcome of the school system, especially at the elementary and secondary levels. As shown in Table 6, Brazil has made great advances in education since 1980.

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21) *Brazil Trumpets Record Pace of Job Creation. 2014, 21 April. Latin American Herald Tribune*. April 2014: http://www.laht.com/article.asp?ArticleId=372987andCategoryId=14090

22) Ibid.

23) http://www.worldbank.org/en/country/brazil/overview

24) The Gini Index is a measurement of the income distribution of a country's residents. It ranges between 0 and 1 and is based on residents' net income. It helps define the gap between the rich and the poor, with 0 representing perfect equality and 1 representing perfect inequality. See: http://www.investopedia.com/terms/g/gini-index.asp (accessed 20 April 2014)

25) http://www.worldbank.org/en/country/brazil/overview

The education process is still evolving, but there have been major advances in attendance in the past 20 years. An increase in school attendance for children of 5-6 years old jumped from 37.3% to 91.1% over the 1991-2010 period. Young people from 11 to 13 years in the final years of primary school increased from 36.8% to 84.9% over the period, while youth from 15 to 17 years who completed primary went from 20% to 57.2%. Despite these positive gains, over 40% of young people in the 15 to 17 age range have not yet completed primary education.

The proportion of 18 to 20 year olds who have completed high school has also increased by nearly 30% (from 13 to 41%). It is the component that made the most progress in Brazil between 1991 and 2010.[26)] The adult population who have completed primary education has gone from 30.1% to 54.9%.

Fernando Henrique Cardoso's Government (1994-2002) defined the expansion of elementary education as a priority in its policy, and the focus on education is a priority in the current government of President Dilma Rousseff. The education system in Brazil has made a great deal of progress, and the expansion of elementary education has resulted in significant growth in secondary school enrolment. The National Program for School Textbooks distributed free of charge over 350 million school textbooks from 1995 to 1999. In 1998 alone, around 110 million school textbooks were distributed to students of elementary and secondary education.

Other programs that have been introduced are the Program School TV, established in 1997, which covers over one million teachers and 28 million students Also, the Program on Information Technology in Education (PROINFO) which has resulted in the placement of 30,000 computers and ancillary equipment in over 2000 schools, thus benefiting around 200,000 students. For 2001 the target was to put in place 100,000 thousand computers in 6,000 schools. Between 2000 and 2010, 65% of municipalities grew above the national average, and in 2010 with emphasis on the south and southeast of the country. The north and northeast regions of Brazil have more than 90% of the municipalities still in the bands of Low and Very Low Human Development in the Education sub-index (see Figure 8).[27)]

The Ministry of Education's budget is 5.5% of Brazil's GDP, up to US $19 billion for 2013. The Ministry seeks to invest heavily in classroom infrastructure, learning technologies, textbooks, and other programs.[28)]

1-2-6. Health Care

Since 1988, the Brazilian constitution has guaranteed that everyone have access to medical care in Brazil. This service can be obtained from the public national health system, from private providers subsidized by the federal government via the Social Security budget, or from the private sector via private insurance or employers.

The Unified Health System (SUS) that was established is decentralized, with local control requiring the participation of communities and funding models at federal, state, and municipal levels. Likewise, the Basic Care Threshold (PAB) has decentralized services, in order to eliminate discrimination and reduce the potential for fraud. Federal funds are channelled directly to municipalities, without the interference of intermediate authorities. The National Supplementary Health Agency was created, and health plans and insurance schemes are now regulated. This has contributed to the major improvements in health as shown in the HDI index for health in Table 6.

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26) http://www.atlasbrasil.org.br/2013/pt/destaques/educacao/

27) Ibid.

28) http://export.gov/brazil/static/CC_BR_DoingBusiness_CCG_PDF_Chap4_EducationandTraining_Latest_eg_br_062843.pdf

Another major initiative was the emergence of generic medicines on the Brazilian market since 2000. These generic medicines are sold at prices 30% to 55% below their brand-name equivalents, but with the same therapeutic properties. Several programs, either created or expanded since 1995, have become instruments of this change.

The Community Health Agent Program was created so that trained employees can disseminate information on basic health care to smaller communities. Currently these agents serve 65 million citizens. The Family Health Program, started in 1994, had the goal of providing health care to around 21 million people. From 328 teams, at its very beginning, it grew to 6,000 in 1999 operating in all regions of the country. During the same period, the number of municipalities served increased from 55 to 2,000.

Today, 27,000 Family Health teams are active in nearly all Brazil's 5560 municipalities, each serving up to about 2000 families or 10,000 people. Family Health teams include doctors, nurses, dentists, and other health workers. Annual resources for primary health care reached about US $3.5 billion in 2013, with US $2 billion of that money devoted to the Family Health Program out of an overall government health budget of about US $23 billion.[29)]

Community participation is crucial to the program's success. In some municipalities, meetings are held every month at the clinic attended by members of the community, including representatives from the church, NGOs and schools. Service providers find out the needs of the people in the municipality. The major challenges are to convince people that the system can work to their benefit and to persuade the authorities to devote more money to primary health care. In Brazil, primary health care remains the most effective way to provide greater access to health services. The SUS works, but it is not operating to its full capacity because there are many obstacles, including the difficulty of helping people in rural areas.[30)]

Vaccination program have also been initiated. In one day, every year, around 20 million children in Brazil are vaccinated against several diseases, including poliomyelitis. Coverage has increased for pre-emptive vaccines against flu, pneumonia, German measles, measles, hepatitis B, meningitis, diphtheria, and tetanus. Nine million people over the age of 65 are vaccinated against the flu every year. Brazil is also producing vaccines against the H1N1 swine flu virus. The Brazil-made vaccines will be made possible, thanks to French company Sanofi Pasteur for transferring the technology to Brazil's Butantan Institute, in São Paulo.[31)]

The World Health Organization has singled out Brazil as an example in AIDS care as well, because it maintains one of the best AIDS pre-emption programs in the world. It is one of the few countries that supplies free of charge to infected persons the medicines that delay the progress of HIV. Brazil's AIDS program has become a model for other developing countries. It has stabilized the rate of HIV infection and the number of AIDS and HIV-related deaths has fallen. Brazil has bypassed the major drugs firms to produce cheaper, generic AIDS medicines.

Finally, the Program for the Reduction of Infantile Mortality, created in 1995, concentrates actions geared to immunization, sanitation, nutrition, and health care

29) ____. *2008. Flawed but Fair: Brazil's Health System Reaches out to the Poor. World Health Organization* 86(4). http://www.who.int/bulletin/volumes/86/4/08-030408/en/ (accessed April 21 2014)

30) Ibid.

31) *Brazil to Produce H1N1 Flu Vaccine. 2013, 19 June. New Straits Times*. http://www.nst.com.my/latest/brazil-to-produce-h1n1-flu-vaccine-1.303237?localLinksEnabled=false

for women and children. As a result, from 1990 to 1999, the rate of infantile mortality declined from 50.9 to 36.1 per thousand born alive: a 29.1% drop in nine years.

Life expectancy has increased in the country, by 14% (9.2 years) between 1991 and 2010. Among municipalities, it still varies from 65 to 79 years, a difference of 14 years between the higher and lower life expectancy at birth. In the Municipal Human Development Index (IDHM), Longevity is the sub-index that shows the greatest reduction in the difference between the highest and lowest results found in Brazilian municipalities over the past two decades: 0.222. All municipalities are in the range of Medium, High, or Very High Human Development in IDHM Longevity (see Table 7 and Figure 8).

1-2-7. Access to Water and Sanitation

Among the achievements in water and sanitation in Brazil is an increase in access to water piped on premises from 78% to 92% between 1990 and 2010; an increase in access to improved sanitation from 68% to 79% in the same period; a functioning national system to finance water and sanitation infrastructure; a high level of cost recovery compared to most other developing countries; as well as a number of notable technical and financial innovations such as condominial sewerage and the output-based subsidy for treated wastewater called PRODES.

Among the challenges is the still high number of poor Brazilians living in urban slums (favelas) and in rural areas without access to piped water or sanitation; water scarcity in the Northeast of Brazil; water pollution, especially in the Southeast of the country; the low share of collected wastewater that is being treated (30-35% in 2012[32]); and long-standing tensions between the federal, state, and municipal governments about their respective roles in the sector.[33]

Brazil was one of the top ten countries to increase access to water supply and sanitation over the period from 1990 to 2008. It was the fourth largest (after China, India and Indonesia) in providing access to sanitation (an increase of 50 million people over the period) and fifth largest in providing access to water supply (after China, India, Indonesia and Pakistan), with an increase of 54 million people from 1990 to 2008.[34] That is a remarkable achievement.

1-2-8. Effects of Social Factors

Brazil has experienced very rapid economic growth over the past 14 years and has very low unemployment. Moreover, the health and education indicators show very positive overall social development trends. However, certain parts of the country are lagging far behind in all the human development measures, particularly the north and the northeast. The North has suffered from overexploitation of its mineral and forest resources and poorly planned development, while the northeast faces chronic drought and water shortages for agriculture and domestic use. Large areas of these two regions have low or very low human development indices (see Figure 8). There are huge differences among regions and municipalities in access to water and sanitation, levels of education, and life expectancy. Moreover, there has been quite a bit of discontent with regard to the large sums being spent on international events at the expense of social programs for disadvantaged people.

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32) *Brazil Wastewater Treatment Plants Market Forecast and Opportunities, 2018. 2014, 16 Jan. PR Newswire*. http://www.prnewswire.com/news-releases/brazil-wastewater-treatment-plants-market-forecast--opportunities-2018-240467461.html

33) http://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Brazil

34) WHO/UNICEF Joint Monitoring Program. www.wssinfo.org

Because of the perception of inadequate employment, housing, health, and education services, especially in urban slums and remote rural areas, accumulated during the last 40 years, the people, including many stakeholders, are pushing for reforms and tangible social benefits. Most people do not consider environmental protection and conservation of water resources as top priorities. Extension of social program and community participation will be essential to the continued success of the country. While high employment levels have helped to bring families out of poverty, the serious income inequality may cause unrest unless there is more attention to such services as housing, water, and sanitation.

1-3. Political Factors

1-3-1. Political System

Brazil is a federative republic composed of 26 States and one Federal District where the capital Brasília is situated. Each State has its own government, with a structure that mirrors the federal level, enjoying all the powers (defined in its own constitution) that are not specifically reserved for the Federal Government or assigned to the Municipal Councils. The head of the state executive branch is the Governor, elected by direct popular vote under the Federal Constitution. The one-chamber state legislature is a State Assembly. The state judiciary follows the federal pattern and has its jurisdiction defined so as to avoid any conflict or superimposition with the federal courts. At the municipal level, there are over 4,400 Municipal Councils that are autonomous in strictly local affairs. The Municipal Councils operate under the provisions of the Basic Law of Municipalities.

The national legislature is the National Congress (Congresso Nacional) composed of two houses: the Chamber of Deputies (Câmara dos Deputados) and the Federal Senate (Senado Federal). The number of members in the Chamber of Deputies from each State and the Federal District is proportional to its population. Deputies are elected for four-year terms by direct secret ballot under the system (adopted for all elections for public office) of universal franchise. The Senate is composed of three Senators from each state and the Federal District, elected for a term of eight years. Senatorial elections are staggered (one-third and then two-thirds) every four years, in elections held concomitantly with those for the Chamber of Deputies. A Deputy and a Senator can stand for re-election without restriction. In 1993, there were 81 Senators and 503 members of the Chamber of Deputies.

The President of the Republic, with powers clearly defined in the Constitution, is the head of the Executive Branch. The President and the Vice President are elected for a four-year term, and may be re-elected for a second term. The Constitution allows Congress to impeach the President under special circumstances. The Vice President automatically fills the office of President for the remainder of the original term should the presidency fall vacant. The Constitution defines further succession should that be necessary. The President appoints the Ministers of State, who are directly responsible to him and whom he may dismiss at any time. A Minister may be summoned to appear before the Chamber of Deputies, the Senate or any of its committees.[35)]

35) http://www.brazil.org.nz/page/politicalinstitutions.aspx

1-3-2. Political History

Over the centuries, Brazil's history has been colourful with periods of political and commercial turmoil, but also periods of stability and prosperity. After the Portuguese discovery of the South American land 1487-1497, The Treaty of Tordesillas (1494) settled possession of these new lands, by drawing a line between the territories being given to Portugal and to Spain.

During the colonial period, expeditions expanded the territory that would later become independent Brazil. It also saw a growth in sugar production and trade in sugar. The discovery of gold after 1690 provided an important source of revenue for Portugal. Coffee became another source of wealth in the 18th century, and favourable growing conditions made Brazil the biggest coffee producer in the world.

Brazil gained independence from Portugal in 1822, and the son of the King of Portugal was crowned Emperor of Brazil. The fall of the monarchy and the abolition of slavery in 1888 led to the creation of a republic. The emerging republic adopted a federative system that still exists today, and the former provinces were transformed into States. The parliamentary system was replaced with a presidential one, as well as a bicameral Congress (Chamber of Deputies and Senate) and an independent Supreme Court.

In 1930, the government was overthrown by force for the first time, and Getúlio Vargas, who was to govern Brazil for the next 15 years, came to power. During and after World War II, there was some political instability culminating ina caretaker administration in 1954 that was installed when the constitutionally-elected President committed suicide.

Under President Juscelino Kubitschek (1956-61), the founder of Brasília, Brazil experienced five years of accelerated economic expansion. There was political instability over the next few years and a military coup took over the country in March 1964. The following five presidents, all of their military generals struggled with an unstable country from 1964 to 1985. The first of the five, Castello Branco, attempted to stabilize the country's political and economic situation.

By 1968, the economic strategies appeared to be working, but the government became increasingly repressive. Between 1967 and 1974, Brazil enjoyed one of the greatest rates of economic growth in the world with real growth as measured by Gross Domestic Product (GDP) reaching 14% in 1973. Slowly, democratic rule was restored with more political freedom and a process of re-democratization was started.

In 1985, Tancredo de Almeida Neves was chosen president by an Electoral College. His election was significant because he was not only the first civilian president to be elected in 21 years, but also because he was the candidate of an opposition coalition. He was rushed to hospital on the eve of his inauguration, dying five weeks later. His vice president José Sarney, was sworn in to replace him.

In October 1994, the Brazilian people elected President Fernando Henrique Cardoso with a 53% majority on a 3-year tenure. The new President, one of Brazil's most prominent social scientists, took office intending to promote further economic and social changes, such as the liberalization of the economy; promotion of sustainable development; human rights; and fiscal, administrative, and agrarian reforms. President Cardoso was re-elected in 1998 for a second four-year term. During his two mandates, President Cardoso drove important reforms, both in the economic and the social fields.

Luiz Inácio Lula da Silva was then elected in 2002. In the few months before the election, investors were concerned by Lula's campaign platform for social change, and his identification with labor unions and leftist ideology. After taking office, however, Lula maintained Cardoso's economic policies, warning that social reforms would take years and that Brazil had no alternative but to extend fiscal austerity policies.

In 2005, Lula's administration was accused of corruption and misuse of authority, forcing some of his cabinet members to resign. Most political analysts at the time expected that Lula's political career was finished, but he managed to hold onto power, partly by highlighting the achievements of his term, and distancing himself from the scandal. He was re-elected President in the general elections of October 2006.

Having served two terms as president, Lula was forbidden by the Brazilian Constitution from standing again. In the 2010 presidential election, Lula's favoured successor, Dilma Rousseff, was elected and assumed office on January 1, 2011.[36] President Rousseff is the first woman to be elected president. She was the former chief of staff of outgoing president Lula and had previously served as energy minister in his government.During the election campaign, Ms.Rousseff made it clear that she represented continuity with the Lula's government, under which millions of Brazilians saw their standard of living rise. She is known to favour a strong state role in strategic areas, including banking, oil industry, and energy.

Dilma Rousseff was born in 1947 and grew up in an upper middle class household in Belo Horizonte, in the coffee-growing state of Minas Gerais. In the 1960s, she became involved in left-wing politics and joined the underground resistance to the military dictatorship that seized power in 1964. In 1970, she was jailed for three years and reportedly tortured. After her release at the end of 1972, she studied economics and went on to become a career civil servant.[37]

1-3-3. Effects of Political Factors

The democratization process in Brazil, starting in the mid- to late-1980s, has resulted in a series of laws and policies that empowered the population, including the decision-making process with respect to water management.

National water, environment, and sanitation policies are adequate to meet the country's current natural resources conservation needs. In the case of the conservation and management of water and the environment, these issues are still secondary on the national agenda, despite several successful initiatives that have been implemented in the recent past. Issues of adequate housing, education, water and sanitation take priority in both people's minds and government programs.

In that regard, a strong connection between effective policies and green growth, with socio-economic improvements, is still lacking in the political arena. One example is sanitation, where the National Sanitation Law of 2007, which establishes mandatory municipal sanitation plans and investments, has not yet resulted in effective gains in the sector, mainly because of lack of political will within the local governments. It is widely recognized that sanitation systems, such as sewage collection systems, due to their "hidden" nature, do not generate political gains. The socio-economic impacts of the lack of appropriate water and sanitation systems in the country are clear, since the majority of deaths by infectious diseases are caused by water-borne agents. However, it is expected that this reality will change with political pressures from the stakeholders, since the improvement in quality of life and economic development are only effectively achieved with proper water and sanitation policies.

36) Edited and restructured from. http://www.brazil.org.nz/page/history.aspx

37) *Brazil Country Profile. 2014, 14 Aug. BBC News*. http://news.bbc.co.uk/2/hi/americas/country_profiles/1227110.stm#leaders

1-4. Environmental Factors

The exploitation of the Amazon rainforest, much of which is in Brazil, has been a major worry for environmentalists, even more so on an international scale, since the forest is a vital regulator of the climate. It is also an important reservoir of plants and animal life.

A drive to move settlers to the Amazon region during military rule in the 1970s caused considerable damage to vast areas of rainforest. Deforestation by loggers and cattle ranchers remains controversial, but government-sponsored migration programs have been halted. In 2005 the government reported that one fifth of the Amazon forests had been cleared by deforestation. Deforestation has been slowed down by extra policing and pressure from environmental and consumer groups. The government has fined illegal cattle ranchers and loggers, while the food industries have banned products from illegally deforested areas, such as soya beans and beef. Officials estimate that deforestation in 2010 fell to 5,000 km^2 for the year, down from 7,000 km^2 the year before and a peak of 27,000 km^2 in 2004.

Brazil's natural resources, particularly iron ore, are highly prized by major manufacturing nations, including China. Thanks to the development of offshore fields, the nation has become self-sufficient in oil, ending decades of dependence on foreign provider.

There is a wide gap between rich and poor, but the World Bank has praised the country for progress in reducing social and economic inequality. Much of the arable land is controlled by a handful of wealthy families, a situation that the Movement of Landless Rural Workers (MST) seeks to redress by demanding land redistribution. It uses direct protest action and land occupation in its quest. Social conditions can be harsh in the big cities of Rio de Janeiro and São Paulo, where a third of the population lives in favelas or slums.

1-4-1. River Basin Transfers

Brazil is struggling with a number of environmental problems including deforestation, but the two situations related to water resources and ecosystems have become much more apparent recently.

A major water transfer project in São Francisco river, aiming at the water supply for 6 million people in the semiarid Northeast, has been the object of protests by environmental groups. They claim that the project could worsen the social situation of groups living along the banks of the São Francisco River, including indigenous peoples and Afro-Brazilian communities in the rural areas of the river basin.

The groups are concerned that the waters will be transported through the proposed network of 700 km of canals to irrigate large agro-export plantations, which will benefit only a minority of the population while putting people at risk in the areas where the waters will be transferred from. However, most of the transferred water will be used to supply water for isolated cities and communities, and only the surplus water will be used for irrigation.

In early October 2013, more than 500 representatives of river bank communities, indigenous groups, environmentalists, and NGOs camped out to protest in Cabrobo in Pernambuco. Participants went to Brasilia to march against the diversion of the São Francisco River in March 2014, and planned more marches later in the year in the capital and other parts of Brazil.

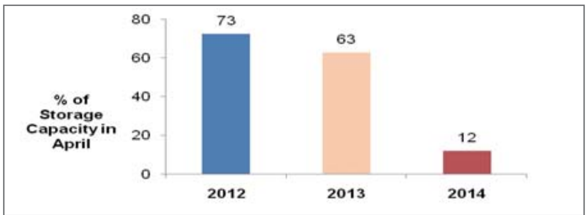
Protestors say that the São Francisco should be revitalized through the decontamination of its water that has been polluted by industrial and urban waste. What is needed are irrigation projects for the benefit of local communities and the protection of human rights among indigenous peoples living along the banks.[38)]

38) *Martin, J.P. 2007. Brazil: Water Rich Country At Risk. Water: A Human Right under Threat*. Special edition, 39:20: October 31. Latin American Press.

However, despite the protests and financial problems with some contractors, the works continue, and the São Francisco Water Transfer Project is expected to be completed in 2015. The Project's high socio-economic benefits are aligned with the green growth objectives, since millions of isolated inhabitants of the Northeast will have access to safe drinking water, and will benefit from the economic development of the region.

1-4-2. Current Drought Situation

Another recent environmental problem stems from the drought that hit southeastern Brazil in late 2013 and early 2014. São Paulo's largest water system, the Cantareira, was at a critically low level in early 2014 and was in danger of running short if the rainfall volume does not substantially increase to fill its six reservoirs before mid-2014, according to a recent technical study by the Brazilian organization PCJ Consortium[39] (Figure 10). São Paulo's dry spell began in December 2013, when the rainy season typically starts. In January, the city was supposed to receive between 200 and 300 mm of rain, but instead there was a deficit of 100 to 200 mm. São Paulo's drought-like weather conditions were caused by a strong high-pressure center, that until recently had been preventing cold fronts, and in turn, rainfall from drenching the state. Although it has rained recently, there is very little likelihood that the rains will be able to replenish the Cantareira.



Source: O Estado de São Paulo (2014)

<Figure 10> Volumes Stored in the Cantareira System in the Month of April

The Basic Sanitation Company of the State of São Paulo (Sabesp) said, however, that lack of rainfall is not the only reason for the Cantareira's diminishing water reserves. January 2014 was the warmest in São Paulo's history, causing the state's water consumption to shoot up to extremely high levels. In February, São Paulo's water supply was not sufficient to meet the demand of nearly 12 million residents across both the São Paulo metropolitan area and Greater Campinas region, where 60% of the population depends on water from the Cantareira, according to Francisco Lahoz, civil engineer and Executive Secretary of the PCJ Consortium.

São Paulo's water availability even before the dry spell was only 200 m^3 per person per year, well below the international minimum standard of 1,500 m^3. But Sabesp, the São Paulo State sanitation company, is not just encouraging people to conserve water; it is paying them to do so. Those who receive water from the Cantareira are eligible for a 30% discount on their water bill through September 2014 if they reduce consumption by 20%. Yet despite the cash incentive, many São Paulo residents are dissatisfied with both city and state officials, who they believe could have prevented such a serious water shortage.[40]

With several million people's water security and two metropolitan regions accounting for 14% of Brazil's GDP in jeopardy, São Paulo state is in a race against time to solve a critical water problem – not just for the short term, but for the long term. For now, the São Paulo state government and civil society are expecting the current measures – economic incentives and water rationing – to be effective in lowering the demand enough to avoid a catastrophic situation.

39) *Dehnert, E. 2014, 21 February. Failed Rainy Season Gives 12M Sao Paulo Residents a 'Very Critical' Water Crisis. E&E Reporter Climate Wire*. http://www.eenews.net/stories/1059994891/print.

40) Ibid.

In order to meet the demand, the São Paulo state government has developed a long-term water management plan, called "The Macro-Metropolis Plan" that incorporates three of the state's major metropolitan regions, including São Paulo and Campinas. The goal is to build infrastructure such as reservoirs and dams that will adequately supply water to 30 million inhabitants across 152 municipalities. Construction has already begun on a major water diversion project, called the São Lourenco Water Producing System that will supply additional water to the São Paulo metropolitan area beginning in 2018, probably too late to avoid the present crisis. Much more energy and time needs to be invested into finding solutions to this problem over the coming years, including improved long-term planning, demand management, and water re-use.[41)]

In April 2014 the British newspaper *The Guardian* reported that the drought in Brazil was going to drive the price of coffee beans to a record high, and reported fears that the drought in Brazil could lead to a global shortage of coffee.[42)]

The drought was so bad in Brazil's dry northeast that food prices are expected to rise for most of the year. Inflation is expected to rise well above the average over recent years. Prices will also rise with the higher demand for food coming in June when the World Cup comes to the country. Beyond the food component of inflation, many service prices are likely to rise for the tourists, and those price hikes will likely last long after the World Cup ends.[43)]

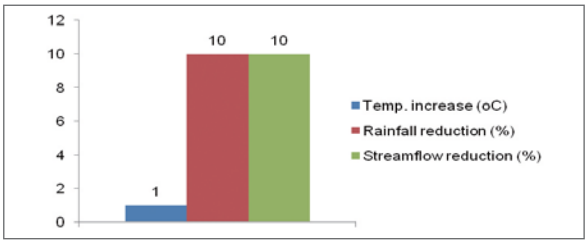
1-4-3. Effects of Environmental Factors

The significant deforestation process over the past 50 years in Brazil has caused many impacts on water and other natural systems. In addition to the loss of natural biodiversity, deforestation contributes to accelerated river sedimentation and reductions in the baseflow of rivers.

It was estimated in 2004 that the annual economic impact of off-site sedimentation in Brazil was US $3.5 billion, not considering the additional costs of water treatment and reservoir volume losses (Chaves et al., 2004). If the latter were added, that figure could easily have tripled.

Another important impact from widespread deforestation is the base-flow reduction during the dry season, as a consequence of reduced infiltration and groundwater recharge rates.

Hence, both water quality and water quantity issues result from deforestation, generating increasing socio-economic costs and hindering the country's development. Additionally, widespread deforestation could cause important climate impacts, which could lead to regional climate and hydrologic changes (Figure 11).



Source: Hoffmann and Jackson (2000)

<Figure 11> Expected Climate and Hydrologic Impacts Resulting from Widespread Deforestation in the Brazilian Savannah

41) *Dehnert, E. 2014. Failed Rainy Season Gives 12M Sao Paulo Residents a 'Very Critical' Water Crisis. E&E Reporter Climate Wire*, February 21. http://www.eenews.net/stories/1059994891/print.

42) Neate, R. 2014. *Drought in Brazil Drives the Price of Coffee Beans to a Record High. The Guardian*, April 10. http://www.theguardian.com/world/2014/apr/10/drought-brazil-coffee-beans-prices

43) *Rapoza, Kenneth. 2014, 25 March.Brazil's Biggest Drought in Decades Also Worsens Interest Rate Outlook. Forbes*. http://www.forbes.com/sites/kenrapoza/2014/03/25/brazils-biggest-drought-in-decades-also-worsens-interest-rate-outlook/

1-5. Technical Factors

Brazilian science and technology have achieved a significant position in the international arena in recent decades. The central agency for science and technology in Brazil is the Ministry of Science and Technology, which was created in 1985 under the Sarney government. This ministry has direct supervision over the National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais – INPE); the National Institute of Amazonian Research (Instituto Nacional de Pesquisas da Amazônia – INPA); and the National Institute of Technology (Instituto Nacional de Tecnologia – INT). The ministry is also responsible for the Secretariat for Computer and Automation Policy (Secretaria de Política de Informática e Automação – SPIA). The ministry channels much of its resources to fellowship programs that have no clear mechanisms to make the fellows become active in the country's science and technology institutions. Groups such as universities, scientific societies and special interest groups, compete for resources and control of the country's agencies of science, technology, and higher education. The Brazilian Society for Scientific Development (SBPC), a semi-autonomous association of scientists, has become a strong advocate for more public resources and the protection of national technology from international competition.[44]

1-5-1. Technical Education

The education sector in Brazil is ranked as the 10th largest sector in the economy, and generates about US $75 billion per year. Brazil has 51 million students in the basic education system (which includes pre-school, elementary, and high school), and around 6 million students enrolled in university courses. In 2015, 10 million students will be in universities, many of whom will be supported by Federal Government loans. The education sector is one of President Rousseff's highest priorities. Brazil needs to deliver a high standard of education for its population so that the country can continue on its growth trajectory. For that reason, the government of Brazil is investing in a wide range of educational programs.[45]

The government's Scientific Mobility Program is expected to provide over 100,000 scholarships to undergraduate and graduate students from Brazil for one year of study at colleges and universities in the U.S. and other foreign countries. The program's specific focus is on promoting scientific research, increasing international cooperation in science and technology, and initiating and engaging students in a global dialogue through international education. The Ministry of Education's budget is 5.5% of Brazil's GDP, up to US $19 billion for 2013. The Ministry seeks to invest heavily in classroom infrastructure, learning technologies, textbooks, and other programs.

Approximately 80% of Brazilian students studying abroad come from Brazil's southern and central eastern states. São Paulo has the largest applicant pool, and attracts the most talented students to its own university campuses. The capital city of Brasilia has the highest GDP per capita in the country, at approximately US $25,000. The state of Rio de Janeiro, home of the largest company in Latin America, Petrobras, is the country's energy hub, attracting many engineering and science majors.

The Brazil Scientific Mobility Undergraduate Program is focused on the STEM fields (Science, Technology, Engineering, and Mathematics). Engineering and computer science are by far the most popular majors; however, a number of students are enrolled in social

44) Brazilian Science and Technology. Wikipedia. http://en.wikipedia.org/wiki/Brazilian_science_and_technology

45) *Education and Training in Brazil. Helping U.S. Companies Export*. Export.gov. http://export.gov/brazil/static/CC_BR_DoingBusiness_CCG_PDF_Chap4_EducationandTraining_Latest_eg_br_062843.pdf

science, business, and the arts (focused on products and processes for technological development and innovation). Below are the top 10 fields of study among Scientific Mobility students[46] :

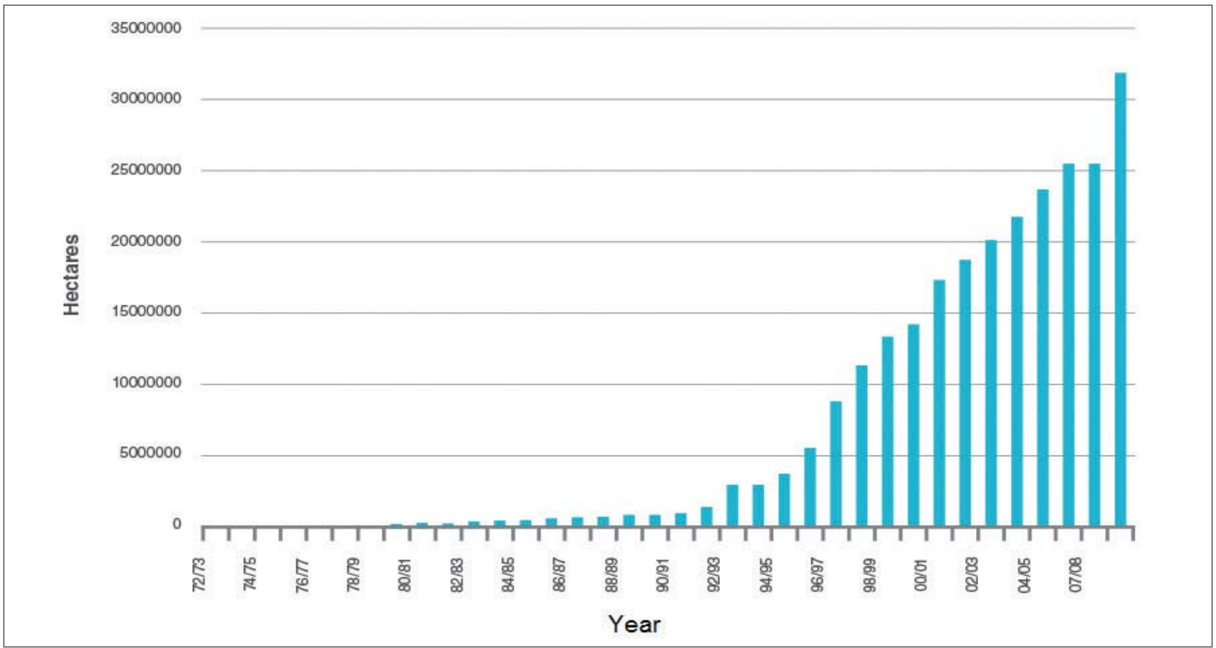
- Mechanical Engineering,
- Electrical Engineering,
- Computer Sciences,
- Industrial Engineering,
- Civil Engineering,
- Computer Engineering,
- Biology,
- Medicine, and
- Environmental Science and Engineering.

A thriving market for digital textbooks in Brazil has become a recent focus for U.S.-based companies, such as Amazon. In early 2014, Amazon concluded a major contract with the Brazilian Ministry of Education. The National Fund for Educational Development (FNDE) has been working with Amazon to convert and wirelessly distribute more than 200 textbooks to hundreds of thousands of public high school teachers via "Whispercast". The company states that 40 million eTextbooks have already been distributed through its service.[47]

1-5-2. Effects of Technical Factors

Technical developments are also contributing to the improvement of water resources management and the promotion of green growth in Brazil. These factors include the utilization of soil and water management technologies, such as no-till agriculture and efficient irrigation in the rural areas, and water reuse in urban areas and industry.

Despite the high rainfall erosivities and the high erodibilities of the country's soils, which were responsible



Source: Brazilian Federation of No-Till Planting (FBPDP) 2013: http://www.febrapdp.org.br/download/PD_Brasil_2013.jpg

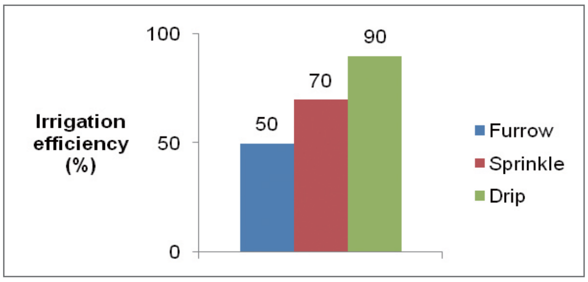
<Figure 12> Expansion in the Area of No-till Agriculture in Brazil

46) *Education and Training in Brazil. Helping U.S. Companies Export*. Export.gov. http://export.gov/brazil/static/CC_BR_DoingBusiness_CCG_PDF_Chap4_EducationandTraining_Latest_eg_br_062843.pdf

47) *Buckingham, A. 2014. Amazon Lands Major Textbook Distribution Deal in Brazil. Betanews*, March 18. http://betanews.com/2014/03/18/amazon-lands-major-textbook-distribution-deal-in-brazil/

for rapid sedimentation rates of reservoirs in the past, the introduction and the widespread adoption of advanced agricultural technologies, such as no-till planting (Figure 12), which reduces erosion up to 80% compared to conventional tillage (Dedecek et al., 1986), have contributed to the generation of important environmental services and green development.

In the case of irrigation, which accounts for 70% of consumptive water use in Brazil, new and more efficient technologies, such as drip irrigation and irrigation based on crop requirements are contributing to reduce the high water demands of the past (Figure 13).



Source: Brazilian Agricultural Research Agency (EMBRAPA) (2014): http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Uva/UvasSemSementes/irrigacao.htm#irriga004

<Figure 13> Irrigation Efficiency of Different Systems

1-6. Concluding Remarks

Brazil's recent economic growth and development and its improvements in human development indicators, such as health and education, have been instrumental in pulling a huge number of people out of poverty. However, this growth and development hides major inequalities among the regions of Brazil and discontent with economic inequality.

Access to education, health care and drinking water supply has improved greatly throughout the country, but again there is a deficit for people living in urban slums and remote rural areas of the north. People are starting to express their discontent through protests against the government and its spending on showy international projects.

There is also some indication that the people are not actively involved in many of the decisions made on their behalf, in such areas as water resources management, despite the existing water and environmental laws empowered the stakeholders. However, dispute resolution among water users has improved, but there needs to be more consultation and discussion before large projects are imposed on the people living in river basin.

It is expected that the advancements in technology and adequate water and environmental policies, will reduce the observed impacts in the future. An example is the adoption of BMPs by farmers and the establishment of basin committees and agencies in the last 10 years.

2. Water Governance and Institutions

In the last 25 years, the water resources management structure in Brazil has evolved from a centralized and rigid system, to a modern and dynamic process. In the past, very organized water user sectors, such as hydropower, dominated the water management process, with the other users and society in general playing a small role.

This has significantly changed after the adoption of the1988 Constitution, the National Water Policy Law, and other important legal instruments. This new framework allowed the establishment of a series of institutions and agencies, which are developing and effectively implementing IWRM in Brazil, contributing to the country´s green growth.

Among the new initiatives being implemented are:

- Water conflict mitigation using licensing and economic instruments;
- Empowerment of the local population and stakeholders, through river basin committees;
- Establishment of water information measuring systems (precipitation, streamflow, water quality)

throughout the country;
- Integrated river basin planning as a tool for water management; and
- Establishment of federal and state water regulating agencies.

The above initiatives, in turn, resulted in improvements in water quantity and quality across the country, better health for the human population and ecosystems, as well as access to water resources for economic development, which are the requirements for green growth.

2-1. Water Laws, Administration, and Institutions

2-1-1. Water Laws

Brazilian Constitution. The Brazilian Constitution of 1988, promulgated after the democratization process in the 1980s, has established the foundation of a new era of water resources management in Brazil. In article 21-XIX of the Constitution, the Union was given the competence of establishing the National System of Water Resources (SINGREH), and the criteria for licensing water uses.

Having defined water as a public resource, the Constitution has also established the different water domains in the country, namely, state and federal rivers (depending on their location with respect to the states' geographical limits), as well as groundwater (states' domain).

National Water Law. Less than 10 years after the promulgation of the Constitution, the National Water Law No. 9433/97 was passed in 1997. Based on its French counterpart, the Brazilian Federal Water Law established a series of innovations in the country's water resources management process. The foundations of Law 9433 include:

- Water, though public, has 'economic value';
- Management shall allow for the multiple uses of water;
- The watershed is the geographical unit for water management; and
- Water management shall be decentralized.

Additionally, the holistic directives incorporated in Law 9433 established the basis for Brazil's green-growth development, particularly with respect to:

- Water quantity and quality goals being equally important;
- Water management should incorporate the physical, biological and socio-economic diversities of the country; and
- Water management should be compatible with soil and environmental management in river basins.

The water resources management instruments established by Law 9433 include:

- Water plans,
- Classification of water bodies according to their dominant uses,
- Water use licensing,
- Water charging, and
- Water Resources Information System.

Law 9433 has also created the National Council of Water Resources (CNRH), a deliberative and consulting institution, responsible for the establishment of the national water policy. The CNRH operates as the last instance court for water-use disputes.

The decentralization process initiated by Law 9433 started with the creation of river basin committees, formed by water users, civil society, and different levels of government. These participative institutions define the criteria for water use allocations, establish the value of water tariffs, and approve basin plans prepared by water agencies.

In addition to the basin committees, a series of national and state water institutions help implement the national, state, and basin water policies, and are presented in Section 4.1.2.

Although the Brazilian Constitution establishes that only the Union has the legislative capacity with respect to water and water management (Article 22-IV), every state in the country has passed state water laws. These laws, in turn, have the potential to generate regional water disputes, particularly where two states seek the same (shared) water resource. The São Paulo water supply crisis, in early 2014, is one example of this conflicting policy, where the states of São Paulo and Rio de Janeiro dispute the (shared) water of the Paraiba do Sul river.

Law 9984/00. In the year 2000, Federal Law No. 9984 was promulgated, creating the National Water Agency-ANA (Picture 1), and establishing its management competences. According to that law, ANA has the responsibility for implementing the national water policy in Brazil, established by federal laws, decrees, and CNRH resolutions.

Photo: courtesyANA, 2014: http://www2.ana.gov.br/Paginas/imprensa/noticia.aspx?List=ccb75a86%2Dbd5a%2D4853%2D8c76%2Dcc46b7dc89a1&ID=11256

<Picture 1> The National Water Agency (ANA)

Among its competences, ANA promotes the technical strengthening of river basin committees and basin agencies, such as the Piracicaba, Capivari and Jundiaí (PCJ) committee, in addition to initiatives aimed at the improvement of water quality, through pollution and sedimentation abatement (the latter established by Article 4-IX of law 9984). Among those initiatives, which contribute to green growth in Brazil, are the PRODES and Water Provider Programs.

Law 11445/07. This law has established the national policy on sewage and solid waste treatment. It requires that all municipalities and states prepare a sanitation plan, and empowers the local stakeholders with a social control of the planning and implementation process.

If adequately implemented, Law 11445 would contribute to the improvement of water quality in the river basins, which in turn would stimulate regional green growth. The PRODES developed by ANA, is funding the construction of sewage treatment plants in several municipalities, following the policies established by that law.

2-1-2. Water Administration

Following the directives of Law 9433/97, the National Water Resources Management System (SINGREH) is responsible for planning, regulating and controlling the use, the preservation and the reclamation of water resources.

The administrative structure within SINGREH is formed by the following federal, state, and basin institutions (Table 8):

- National Water Resources Council (NWRC- deliberative and consulting institution, responsible for the establishment of the national water policy, and to operate as the last instance court of water disputes;
- National Water Agency (ANA) – federal autarchy responsible for the implementation of the national water policy, and issues federal water use licenses;
- Secretariat of Water Resources (SWR) – acts as the secretariat of the NWRC;

<Table 8> Institutional Matrix of Brazil's SINGREH.

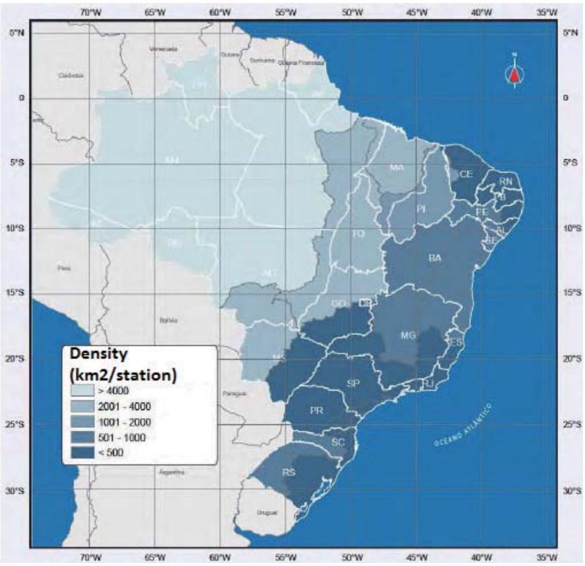
Scope/ Institution	Council	Government	Executive Mgt.	Parliament	Technical office
National	CNRH	SRH	ANA		
State	CERH	State govt.	State agencies		
Basin				Basin committee	Basin agency

Source: ANA (2013). Conjuntura de Recursos Hídricos do Brasil. Brasilia, 2013, p432 (in Portuguese).

• State Water Secretariats and Agencies (CERH) – implement the states' water policy and issue state water use licenses; and

• River basin committees – consulting and deliberating organization of water users and stakeholders, responsible for the water management at the basin level.

The National System of Hydrologic Information (SNIRH), in turn, is a key element for the effective water management in Brazil, having a total of 6,500 river gauging stations throughout the country, monitoring water quantity and quality (Figure 14).

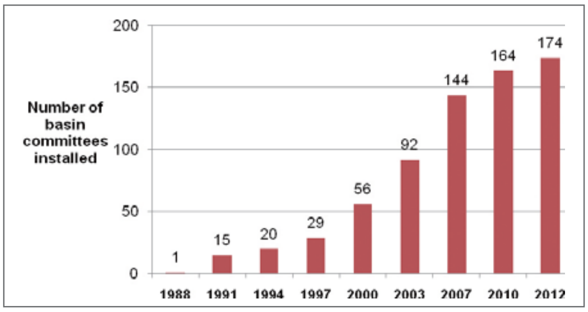


Source: ANA, (2013) Conjuntura de Recursos Hídricos do Brasil. Brasilia, 2013, 432 p (in Portuguese).

<Figure 14> Density of River Gauging Stations in Brazil

Since the promulgation of Law 9433, the State Water Secretariats and Agencies (CERHs) and River Basin Committees have grown exponentially in Brazil (Figure 15). In December 2013, there were over 200 river basin committees installed in Brazi (ANA, 2013), particularly in the southeast, although not all of them are operational.

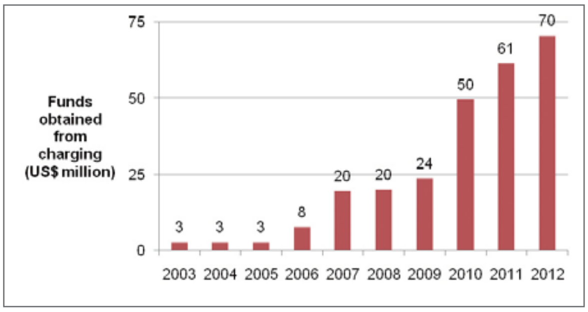
Until 2013, a total of eight river basin agencies had been created in Brazil, all of which are operational. The rapid implementation of the river basin committees and agencies has contributed to increasing amounts of funds



Source: ANA (2013). Conjuntura de Recursos Hídricos do Brasil. Brasilia (in Portuguese)

<Figure 15> River Basin Committees Installed in Brazil since 1988

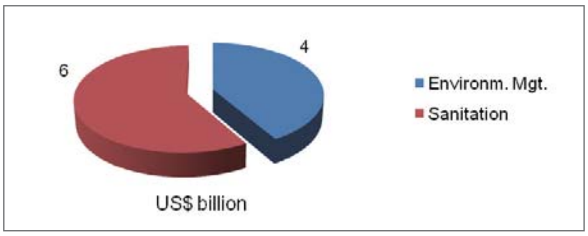
resulting from water use charges in Brazil, which have partially been used to promote greengrowth in the river basins (Figure 16).



Source: ANA (2013). Conjuntura de Recursos Hídricos do Brasil. Brasilia (in Portuguese)

<Figure 16> Funds Obtained from Water and Sewage Charges in Brazil since 2003

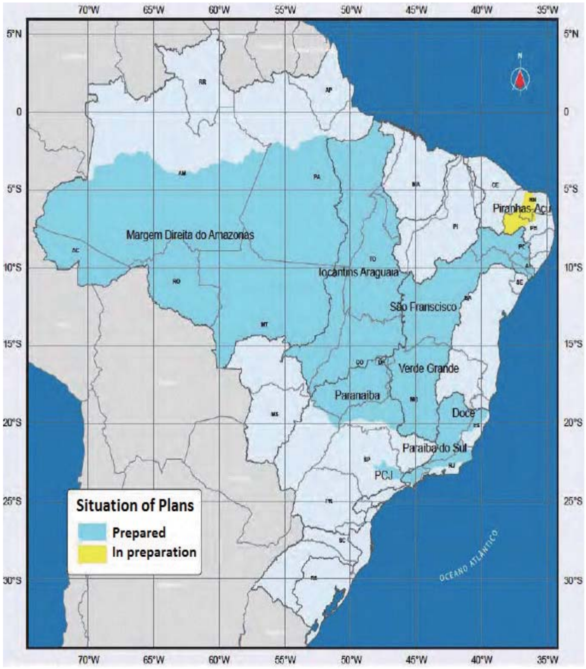
In addition to the funding obtained from bulk water charging, budgetary funds are allocated for water resources management in Brazil, which have contributed to green growth, including environment management and sanitation. Figure 17 indicates that those investments are significant, totaling over US $10 billion in 2011 values.



Source: ANA (2013)

<Figure 17> Investment in Sanitation and Environment Management in Brazil in 2011 from Budgetary Funds

Several investments in IWRM and sanitation in Brazil have been directed to issues that were previously identified in basin plans. Figure 18 shows that most of the federal river basinsin central Brazil had their basin plans prepared in 2012. These are expected to contribute to the effectiveness of water and natural resources management.



Source: ANA, (2013)

<Figure 18> Situation of the Federal River basin plans in 2012.

2-2. Basin-level Institutions: Piracicaba, Capivari and Jundiaí River Basins

One of the most active basin institutions in Brazil is the Piracicaba-Capivari-Jundiai (PCJ) Basin Committee, and its corresponding basin agency. Created in 2000 by Resolution #05/2000 of CNRH, the federal PCJ Basin Committee has the objective of implementing IWRM principles in the basin.

The PCJ Basin Committee has a total of 50 members (with voting capacity), representing the federal and local governments, water users, stakeholders, NGOs and the civil society of the states of São Paulo and Minas Gerais. The PCJ Basin has a total area of 15,300 km^2, covering both states, and spanning 62 municipalities (Figure 19).

Due to its strategic location in the country, the PCJ Basin is economically very important, given that its gross economic product represents 5% of Brazil's GDP.

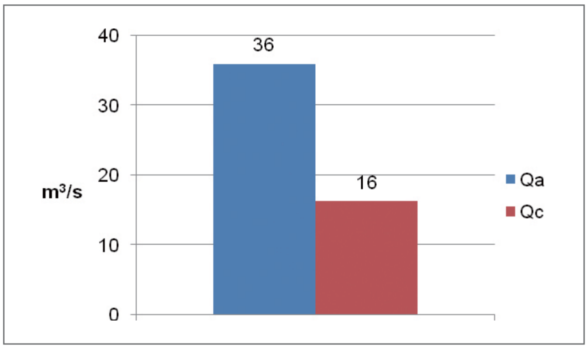
Among the current water use conflicts occurring in the basin is the water dispute between the water supply, industry and irrigation sectors, including the potential water shortage of the Cantareira system, which supplies

Source: PCJ River Basin Committee Website (in Portuguese). http://www.comitespcj.org.br/ (Accessed May 2, 2014)

<Figure 19> The Piracicaba-Capivari-Jundiai (PCJ) River Basins

60% of the water in the city of São Paulo. According to figure 21, 44% of the available mean flow of the basin (Q_a) is consumed by different water users (Q_c), a ratio that is rapidly approximating the water stress threshold (50%).[48)]

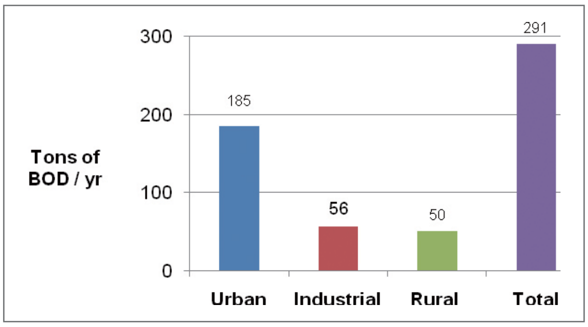
In addition to the imminent water stress condition indicated by Figure 20, there are watersheds within the PCJ Basin that experience even higher Q_c/Q_a ratios, particularly those where the population is denser.



Source: PCJ Committee, (2007): www.agenciapcj.org.br/antigo/download/Dados_hidrometeorologicos.pdf

<Figure 20> Mean Annual Water Balance (Available vs. Consumed Water) in the PCJ Basin

Another important water conflict is the environmental and human impact of untreated sewage released in the basin's rivers (Figure 21), from urban and agricultural (sugar cane industry) sources.



Source: PCJ Committee (2007): www.agenciapcj.org.br/antigo/download/Dados_hidrometeorologicos.pdf

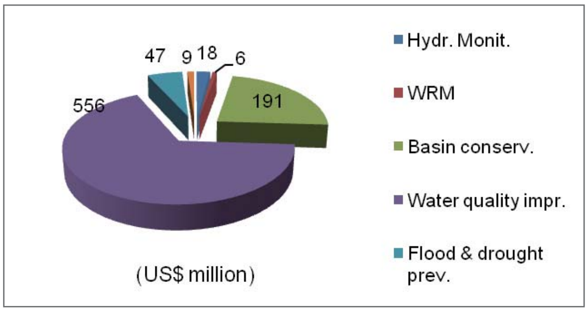
<Figure 21> Remaining Untreated Sewage Released in the PCJ Basin from Urban, Industrial and Agricultural Sources

In order to tackle the water problems and impacts above, several actions were started in the PCJ Committee, including:

- Hydrologic monitoring and basin plans,
- Water resources management,
- Basin conservation,
- Water quality improvement,
- Protection against floods and droughts, and
- Capacity building.

The PCJ Basin conservation program involved the implementation of ANA's Water Provider Program in a few of its watersheds such as Extrema in Minas Gerais. In the case of the water quality improvement, the PCJ Basin Committee implemented the PRODES to treat the sewage of some cities around the basin.

The budget for the above activities for the 2012-2025-period is contained in the last Basin Plan and resulting in part from water use charging in the PCJ Basin, which are expected to contribute to regional green growth, is shown in Figure 22.



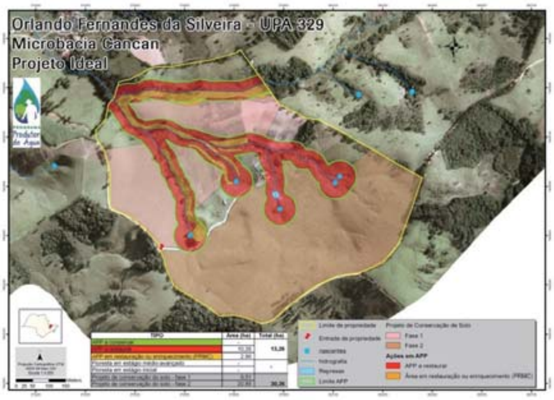
Source: PCJ Committee (2007)

<Figure 22> Budget for the PCJ Basin Activities for the 2012-2025 period

In addition to the new sewage treatment plants recently installed in several cities of the PCJ Basin, Payment for Environmental Services (PES) projects, following the 'provider is paid' philosophy of the 'Water Provider Program' (ANA), were implemented in the basin. These

48) Secretariat for Water Resources (SWR). 2006. Plano Nacional de Recursos Hidricos, Brasilia.

projects, involving erosion control and the reforestation of riparian areas, are being introduced, particularly in strategic water supply watersheds (Figure 23).

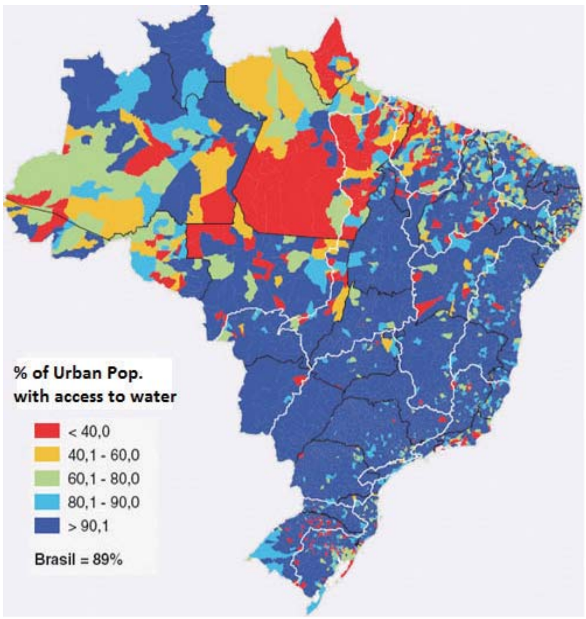


Source: PCJ Committee, (2014): http://www.comitespcj.org.br/images/Download/Livro_ConservadorDasAguas.pdf

<Figure 23> Example of a PES Riparian Reclamation Project Designed for a Cattle Farm in the PCJ River Basin

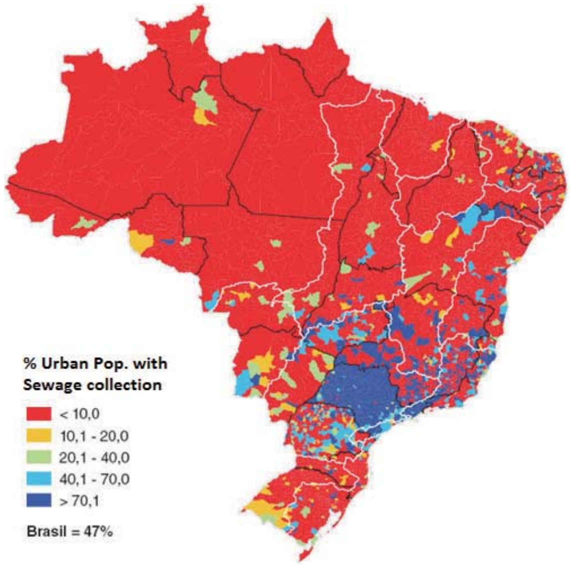
2-3. Municipal Water and Sanitation Institutions

In Brazil, water and sanitation services are provided either by public or private entities, at the state or municipal level. Residents in Brazilian municipalities generally have good access to clean drinking water (Figure 24), except in parts of the north and northwest. On the other hand, except in the central and southern regions of the country, sanitation systems, particularly sewage collection and treatment are still limited (Figure 25).



Source: ANA (2013)

<Figure 24> Brazilian Municipalities and Their Level of Access to Safe Water



Source: ANA (2013)

<Figure 25> Brazilian Municipalities and Their Sewage Collection Levels

On average, the country's safe water supply and sewage collection are 90% and 47% respectively, levels which should be improved if socio-economic and environmental goals are pursued. Additionally, the collected sewage shown in Figure 25, less than 40% (on average) is treated appropriately, i.e., the remaining 60% is released untreated into the country's rivers.

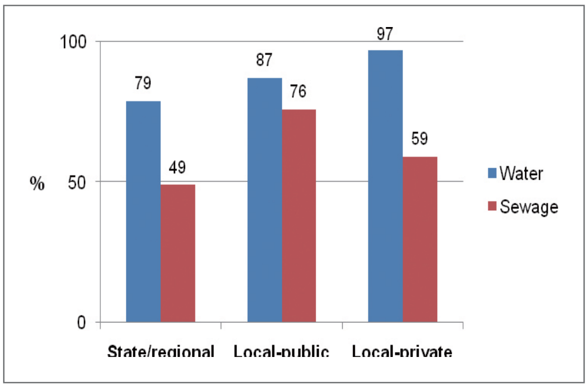
It is not surprising that there is a strong correlation between Figure 25 (sewage collection) and Figure 8 (municipal HDI), showing the importance of basic water and sanitation services to human development.

The private sector has increased its participation in sanitation investment and administration in Brazil, as shown in Table 9. So far, the type of sanitation administration (public, private or public-private) has not significantly influenced the efficiency of sanitation services, as shown in Figure 26.

<Table 9> Participation of the Private Sector in the Sanitation Administration in Brazil

Municipalities	Population (million inhab.)	Investment (R$ million)	% of Brazil Pop.
217	15.0	1,865	8.0

Source: IBGE, (2014):http://www.ibge.gov.br/home/estatistica/populacao/ atlas_saneamento/default_zip.shtm



Source: Ministério das Cidades (2014): http://www.pmss.gov.br/pmss/PaginaCarrega.php?EWRErterterTERTer=349

<Figure 26> Efficiency of Sanitation Services Provided by Different Types of Administration.

Although the Sanitation and Solid Waste Law of 2007 provided the legal and institutional basis for tackling the water and sanitation problems indicated by Figures 24 and 25, and despite the decentralized nature of the sanitation management process (run by states and municipalities), there are several bottlenecks which hinder appropriate sanitation development in Brazil[49], including:

- Limited technical and financial capacity of the poorer cities and states to tackle the huge sanitation deficits;
- Lack of political will to invest municipal and state funds in water and sanitation works;
- Uncertainty about the sanitation concession authority (states vs. municipalities);
- Lack of perception by the poorer population on the important nexus between sanitation, socio-economic development, and health;
- Lack of willingness to pay for basic sanitation services by the poor population living in slums; and
- Lack of appropriate enforcement of water quality standards and water pollution in river basins.

The new National Basic Sanitation Plan (Plansab) that was introduced in 2013 purports to be a long-term guide for the sector, a map for universal water and sewerage services by 2033. As a guide, however, it was already out of date when it was established. The Plansab was based on overly optimistic assumptions. Of the three scenarios presented, even the most pessimistic presupposes that Brazil, in the 20 years ahead, will grow at 3% per year and that the government will be capable of investing increasingly in infrastructure projects of high quality, competent execution, and according to fixed deadlines. This does not correspond to current reality in Brazil. The country is growing slower than projected, and the government invests irregularly, causing projects to decelerate. Moreover, there is a shortage of capable managers in the public sector. Still, the Plansab serves as a reference of what needs to be done.

In order to overcome some of the bottlenecks, water managers, users, and stakeholders have to improve their capacities in IWRM functions and tools, with assistance from the basin committees and authorities. Appropriate indicators could be applied showing the connection between adequate water management and the resulting socio-economic and environmental gains. Appropriate and widely available training and capacity building for men and women in the watershed will be essential to this process.

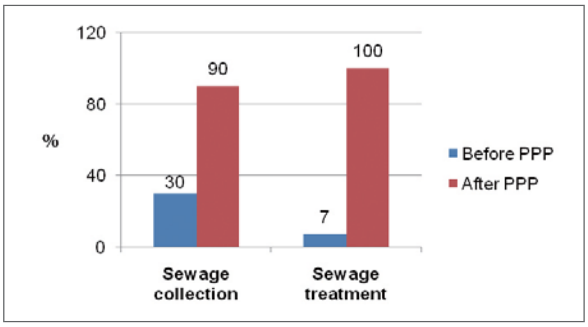
49) Pinto, M.T. 2011. Review of the O&M Initiatives for Improving Wastewater Treatment Plants in Brazil. Brasilia: IWA, 31.

2-4. Market-oriented Institutions

Considering that bulk water in Brazil is a public good and that water licences cannot be commercialized, other options of market-oriented administration in the water and sanitation sector have been developed in the country. The first one is that states and municipalities have granted concessions for water and sanitation administration to the private sector; and the second is the public-private partnership.

Despite a few municipal concessions for water and sanitation services to the private sector, market-oriented instruments and institutions are still in the beginning stages in Brazil. However, with the promulgation of the Public-Private Partnership (PPP) Bill (Law # 11079) in 2004, this reality is slowly changing.

One recent example of a promising PPP in the sanitation sector is the Recife metro area sewage project, where the contractor Odebrecht and the Pernambuco state sanitation company (COMPESA) will invest a total of US $2.0 billion until 2025, benefiting 3.7 million people in the state's capital (Figure 27). The revenues from water and sewerage tariffs over the next 20 years are estimated as US $14 billion, indicating that the initiative is economically feasible.



Source: Compesa (2014): http://www.compesa.com.br/saneamento/ppp

<Figure 27> Sewage Collection and Treatment Indices in the Recife Metro Area, before and after the Investments in the PPP Sanitation Program

A successful public-public partnership was also recently established by the National Water Agency (federal level) and public (state and municipal levels) sanitation institutions. The Basin Pollution Control Program (PRODES), created in 2002, provides a financial incentive for the construction of sewage treatment facilities based on their BOD abatement performance (examples of PRODES projects are presented in section 6 below).

In the PRODES ANA co-finances the sewage treatment plants built by the states and municipalities, but only pays after the plants are finished and operating. This reduces the risk of ending up with uncompleted facilities, which is typical with other federal financing projects in Brazil.

It is expected that, in the next 10 years, with the results obtained from the existing public-private and public-public partnerships serving as an example of successful water administration, the sanitation deficit in Brazil will be considerably reduced.[50)]

Another aspect in which market-oriented instruments are fostering water-use efficiency and pollution abatement is the use of water and sewerage tariffs and financial instruments in river basins, established by the National Water Law.

River basin committees such as the Paraiba do Sul and the PCJ have passed water and sewage charging tariffs based on water-use and sewage treatment efficiencies. Therefore, water users are charged based on their water consumptive use (i.e., diverted volume minus returned volume), and sewage is charged based on the released volumes and on the BOD abatement level.

Therefore, tariff levels for water abstraction and sewage release were established in the committees in such a way that, in the long run, large industrial and sanitation

50) M.T. Pinto, 2011. Review of the O&M Initiatives for Improving Wastewater Treatment Plants in Brazil. Brasilia: IWA, 31.

users would prefer to invest in technologies which would reduce water consumption and increase sewage treatment levels, instead of paying for increased tariffs.

Unfortunately, these advancements in market-oriented instruments have only been effective in a few developed river basins, with existing water-use conflicts and participating users and stakeholders. It is expected that the successes experienced in those basins would be followed by other less developed basins in Brazil, particularly those where water-use conflicts exist.

2-5. Community-centered Institutions

In addition to the government and basin-level institutions, local and non-governmental organizations also participate in the water governance process in Brazil, including:

- Inter-municipal water consortia,
- Water user associations, and
- NGOs.

The inter-municipal water consortia are water associations formed by municipalities and companies, aimed at the reclamation of water resources and the capacity building of basin stakeholders in integrated water management.

Photo: Courtesy PCJ Consortium, (2014): http://www.agua.org.br/apresentacao-arquivos.aspx?id=98

<Picture 2> Water Saving Campaigns with Children

One of them is the PCJ Inter-municipal Consortium, formed by municipalities and companies within the PCJ basin. Among the program and activities currently being developed by the PCJ Consortium are:

- Helping municipalities obtain financing for sanitation works;
- Programs to reduce water losses for municipalities;
- Reclamation of water supply basins;
- Water monitoring campaigns; and
- Introducing water saving campaigns in schools (Picture 2).

One good example of a water user association in Brazil is the Association of Farmers and Irrigators of Western Bahia (AIBA), with 1,300 members. Acting in a water-use conflict region, with hundreds of central-pivot irrigation systems (Picture 3), AIBA has, within its mission, the building of technical capacity for farmers and the mitigation of water-use conflicts.

Photo: AIBA (2014): http://aiba.org.br/informaiba/#

<Picture 3> A Central-pivot Irrigation System in Western Bahia

Two active NGOs with regard to water resources management initiatives in Brazil are the Nature Conservancy (TNC) and World Wildlife Fund (WWF). The former is technically supporting several projects within ANA's Water Provider Program (Picture 4), and the latter is implementing the Aguas Brasil reclamation project, financed by Banco do Brasil (Picture 5).

Photo: Courtesy TNC (2014): http://www.tnc.org.br/nossas-historias/press-releases/conheca-os-produtores-de-agua.xml

<Picture 4> Reforestation of Riparian Areas within the Water Provider Program

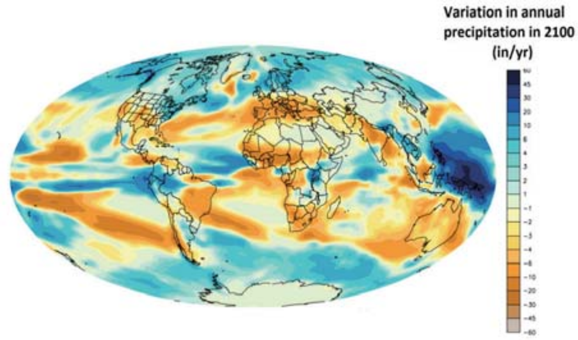
Photo: World Wildlife Fund (WWF) (2014): http://www.wwf.org.br/?30276/Agricultores-de-Braslia-sero-pagos-para-preservar-a-natureza

<Picture 5> Water Education Class within the Aguas Brasil Program

The advantages of initiatives such as TNC's and WWF's is that local stakeholders, including farmers and small water users perceive the importance of IWRM and their role in the water management process, therefore contributing to local green growth.

2-6. Payment for Environmental Services (PES) Program

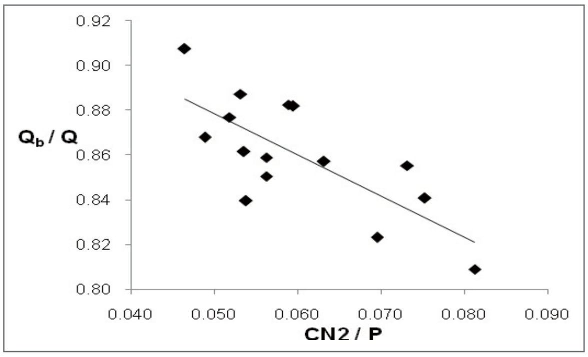
Program involving the payment for ecosystem services related to water resources are important not only to promote green growth, but also to reduce the impacts associated with human activities and climate change in strategic river basins. In the case of Brazil, the on-going climate variability, already threatening the water supply and hydropower generation today, could impact the water sector even more with the advent of future (and expected) climate change. Data from General Circulation Model (GCM) simulations indicate that the mean rainfall in central Brazil, which is the headwater for several important basins of the country, will experience a reduction of up to 30% by the end of the 21st century, compared to 1990 values (Figure 28).



Source: Geophysical Fluid Dynamics Laboratory, National Association and Atmospheric Administration (NOAA) (2014): http://www.gfdl.noaa.gov/will-the-wet-get-wetter-and-the-dry-drier

<Figure 28> Expected Variation in Annual Precipitation in the World in 2100.

Therefore, the implementation of PES programs that can effectively reduce runoff and increase groundwater recharge could be invaluable in tackling climate variability and climate change threats. The rationale behind this is that PES would stimulate farmers and other stakeholders in strategic basins to adopt best management practices (BMPs) that are known to promote infiltration and groundwater recharge, augmenting baseflow during the dry season (Figure 29).



Source: Chaves et al., (2012)
Note: Qb is mean baseflow during the dry season, Q is the mean annual flow, CN2 is the basin mean runoff coefficient, and P is the mean annual precipitation

<Figure 29> Relationship between Normalized Baseflow (Q_b/Q) and Normalized Runoff Condition (CN2/P) in Different land-use and Management Scenarios in the Pipiripau Basin in Central Brazil

In Figure 29, as the runoff coefficient (CN2) is reduced by the adoption of BMPs in river basins, dry-season base flow (Q_b) is expected to increase, due to higher recharge, providing more water for water users in critical periods. An example of effective hydrologic gains from BMPs are those resulting from the ‘Paraná Rural Program’, implemented in the state of Paraná in the 1980s, co-financed by the World Bank. In addition to improved water quality, the dry season baseflow increased in many river basins, due to the construction of retention terraces and improved soil management.[51)]

Additionally, the incentive for the abatement of pollution point sources, such as urban waste-water treatment, is a key element to improve water security in strategic river basins. This could be achieved by PES program, where municipalities would participate in the solution of their pollution problems, by specially designed sewage treatment projects.

In both cases above (rural and urban), Brazil has designed and implemented water-oriented PES programs, such as the Basin Pollution Control Program (PRODES) and the Water Provider Program (WPP). Developed by the ANA, these programs have been implemented since 2001 on a national scale, and involve a new philosophy in water resources management, namely the payment for environmental services based on project performance.

2-6-1. PRODES

The PRODES was designed in 2001 and has been implemented by the ANA in several river basins in Brazil. The main objectives of the PRODES are:

- To reduce waste-water pollution from urban areas and improve water quality in strategic river basins of Brazil;
- To strengthen SINGREH and implement water management instruments in the country.

The main innovation of PRODES is that the financial support for the construction and improvement of sewage treatment plants (Picture 6) is based on the individual project’s BOD abatement performance, the payments given only after the works are completed.

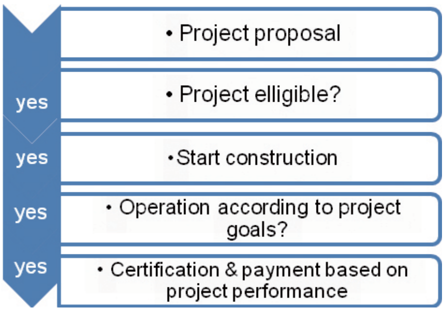
PRODES’ performance-based and product-oriented philosophy contributed to increase the efficiency of sewage treatment in strategic river basins, and avoided the risk of non-completion of federally-funded sanitation works, which was common in the past.

Photo: ANA (2009)

<Picture 6> Piçarrao Sewage Treatment Plant (Campinas-SP), Financed by PRODES

51) Chaves, H.M.L et al. 2004. Quantificação Dos Custos e Benefícios do “Programa do Produtor de Água”/ANA: I. Teoria. *Revista da ABRH*, vol. 9(3): 5-14

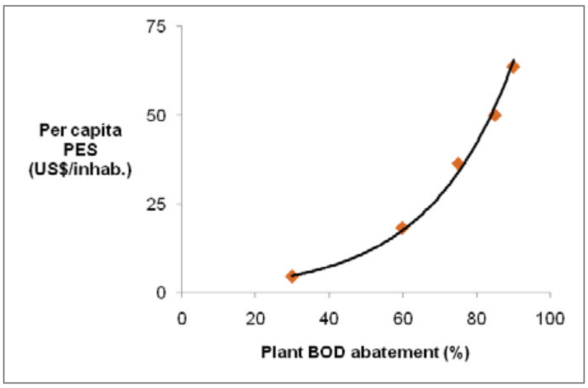
Therefore, depending on the project's pollution abatement performance and on the population served by the sewage treatment plant, ANA would finance up to 100% of the project cost. Both state and municipal sanitation (public) institutions are eligible for PRODES support, and they decide the type of wastewater treatment to be used. The approval and certification stages for a new PRODES project are presented in Figure 30.



Source:Adapted from ANA (2009)

<Figure 30> Approval and Certification Stages of a New PRODES Project

Figure 31 presents the performance-based financial model used by PRODES to pay for sewage treatment, based on the plant's level of BOD abatement. As illustrated in the figure, the higher the project performance and the environmental service provided, the higher is the per capita payment level, independent of the type of wastewater treatment system selected. This allows a greater flexibility to the sanitation company, because it can use the treatment system that the managers are familiar with.

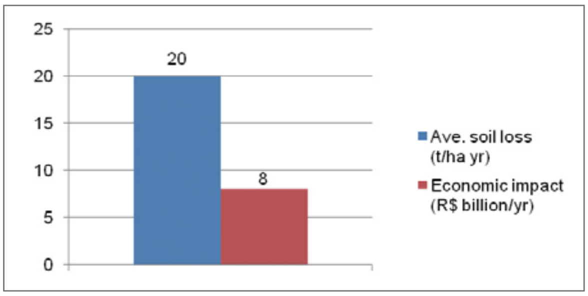


Source:Adapted from ANA (2009)

<Figure 31> Performance-based Payment Model for Sewage Treatment Plants within the PRODES Program, based on BOD Abatement

2-6-2. Water Provider Program

Although Brazil's large agricultural economy contributed significantly to the country's development and well-being, the combination of highly erodible soils and high rainfall damage causes high erosion and sedimentation rates, with significant socio-economic impacts (Figure 32).



Source: Manzatto et al. (2002)

<Figure 32> Average Soil Loss and Economic Impacts from Sedimentation in Brazil

In addition to the reduction in agricultural yields, the high erosion rates have contributed to the impairment of water supply sources and to the silting of reservoirs. Furthermore, since many Brazilian farmers are in dire economic conditions, they have limited alternatives to cope with this severe land and water degradation scenario.

To tackle this chronic problem, the ANA developed a program that would financially compensate participant farmers for their effective erosion and sedimentation abatement, in strategic river basins of Brazil. The Water Provider Program, created in 2004, has the following characteristics (Chaves et al., 2004):

- Voluntary participation;
- Payments based on erosion abatement performance;
- Suitable best management practice (BMP) design required for each farm;
- Any BMP is eligible, it is efficient in controlling erosion and sedimentation; and
- Payments made preferentially by downstream water users and/or local governments.

Even if the local or federal government contributes to the environmental payments to participating farmers, these would not be regarded as agricultural subsidies, since PES fall within the Green-box category of the World Trade Organization (WTO, 2004).

The rationale behind the Water Provider Program is that the erosion abatement obtained from BMPs in the farms would provide a similar reduction in sedimentation downstream, which would benefit water users and the aquatic ecosystem. Like the PRODES the participating farmers can select the type of BMP to be implemented, but the payment is based on the erosion abatement provided by the BMP.

In order to estimate the erosion and sedimentation abatement after the implementation of the BMP in farm fields, a simplified version of the Universal Soil Loss Equation-USLE (Wischmeier and Smith, 1978) was adopted (Chaves et al., 2004; ANA, 2011):

$$Ea\ (\%) = 100\ (1 - Z_1/Z_o) \qquad [1]$$

Where: E_a = % of erosion abatement in the field after the implementation of the BMP; Z_0 = the product of the USLE's use and management factor (C), and support practice factor (P) before the practice; and Z_1 = the product of the USLE's C and P factors (tabulated) after the practice.

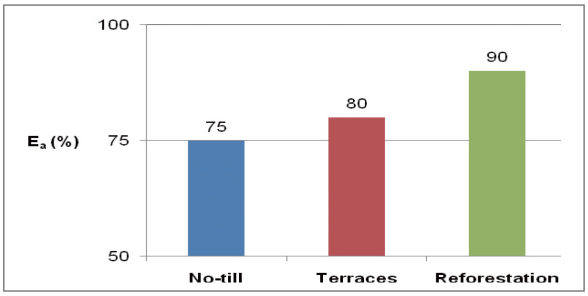
The advantage of using equation [1] to estimate the environmental service is that the Z factors are available for typical Brazilian conditions, in addition to the simplicity of application at the farm level. The eligible BMPs for the Water Provider Program are:

- Terraces,
- Reforestation,
- Gully control,
- Erosion control in farm roads, and
- No-till agriculture (Picture 7).

Photo: FBPDP (2014)

<Picture 7> No-till Agriculture in a Brazilian Farm

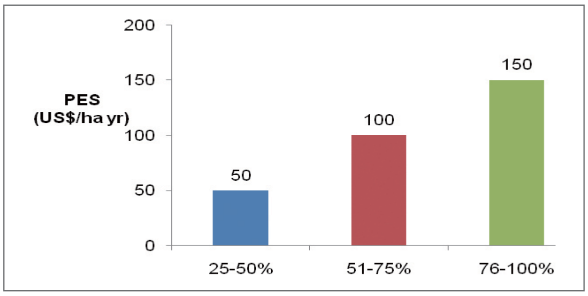
The expected environmental efficiency of different BMPs with regards to erosion and sedimentation abatement is presented in Figure 33. The advantage of the eligible BMPs of the WPP is that their environmental service with regards to erosion abatement is generally independent of the climate or region.[52)]



Source: Modified from Chaves et al.(2004)

<Figure 33> Erosion and Sedimentation Abatement Efficiency in Farm Fields, with Respect to the Condition Before the Project.

Depending on the economic importance of the erosion and sedimentation abatement in the basins, the payment values vary from US $25 to US $150 per hectare per year. As a general rule, the suggested payment values are presented in Figure 34.



Source: Chaves et al.(2004)

<Figure 34> Suggested Payment Values for Erosion Abatement Levels in the Water Provider Program

52) Chaves et al., 2004.

As an incentive, a bonus (US $50/ha/yr) is used to incentive existing model farmers, who are already providing environmental services with respect to erosion abatement. However, the payment values are effectively determined by the downstream water users or river basin committees that benefit from the water quality improvement upstream. The payments normally depend on the level of economic development of the region.

IV. Performance of Payment for Environmental Services Program

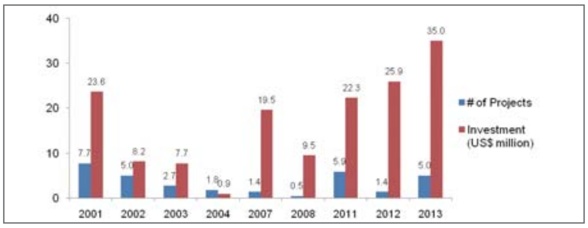
The performance of the two most important PES programs related to water (PRODES and Water Provider Program) are presented here. In order to assess their effectiveness, the socioeconomic, environmental, and program overall performances were evaluated, based on existing literature, interviews and on the questionnaires filled by several managers and stakeholders involved with them.

1. PRODES Performance

The performance of the PRODES is presented in the subchapters below, including general, social, economic, environmental and overall performance.

1-1. Generic Performance

Since 2001, a total of 66 PRODES projects (sewage treatment stations) have been contracted by ANA in six different states of Brazil (Table 10), with a total federal investment of US $152 million (Figure 35).



Source: ANA (2014)

<Figure 35> PRODES Projects Contracted by ANA and Their Respective Federal Investment since 2001

<Table 10> PRODES Projects Implemented in Brazil since 2001

Number	Project	Municpality	State
1	ETE Sta Mônica (Vó Pureza)	Campinas	SP
2	ETE Jardim das Flores	Rio Claro	SP
3	ETE Ribeirão dos Toledos	Santa Bárbara D'Oeste	SP
4	ETE Capuava	Valinhos	SP
5	ETE Pinheirinho	Vinhedo	SP
6	ETE Moreira César	Pindamonhangaba	SP
7	ETE Araretama	Pindamonhangaba	SP
8	ETE Sorocaba	Sorocaba	SP
9	ETE Itatiba	Itatiba	SP
10	ETE Lavapés	São José dos Campos	SP
11	ETE Hortolândia	Hortolândia	SP
12	ETE Piracicamirim	Piracicaba	SP
13	ETE CIC/XISTO	Curitiba	PR
14	ETE São Luiz do Paraitinga	São Luiz do Paraitinga	SP
15	ETE Tamandaré	Almirante Tamandaré	PR
16	ETE Padilha Sul	Curitiba	PR
17	ETE Barbosa Lage	Juiz de Fora	MG
18	ETE Balsa	Santa Bárbara D'Oeste	SP
19	ETE Sousas	Campinas	SP
20	ETE Praia Azul	Americana	SP
21	ETE Piçarrão	Campinas	SP
22	ETE José Cirilo/São Joa-quim	Muriaé	MG
23	ETE Córrego da Penha	Itabira	MG
24	ETE Estoril	Atibaia	SP
25	ETE Meia Lua	Jacareí	SP
26	ETE Bandeira Branca	Jacareí	SP
27	ETE Lençóis	Lençóis	BA
28	ETE Rib.S.José das Correntes	Ibaté	SP
29	ETE Onça	Belo Horizonte e Contagem	MG
30	ETE Arujá	Arujá	SP
31	ETE Biritiba Mirim	Biritiba Mirim	SP
32	ETE Cachoeira Paulista	Cachoeira Paulista	SP
33	ETE Guararema	Guararema	SP
34	ETE Parateí	Guararema	SP
35	ETE Dornelas	Muriaé	MG
36	ETE Francisco Velludo	Uberaba	MG
37	ETE Taubaté/Tremembé	Taubaté e Tremembé	SP
38	ETE Betim Central	Betim	MG
39	ETE Monjolinho	São Carlos	SP
40	ETE São Roque	São Roque	SP
41	ETE Bragança Paulista	Bragança Paulista	SP
42	ETE Conchas	Conchas	SP

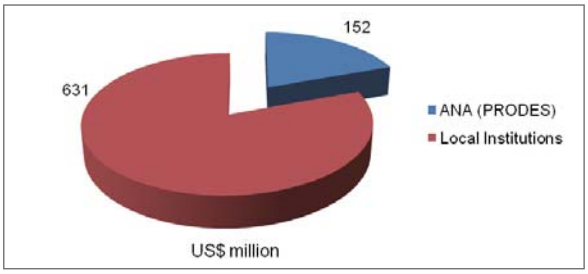
Number	Project	Municpality	State
43	ETE Pedreira	Pedreira	SP
44	ETE Araçariguama	Araçariguama	SP
45	ETE Pau D'Alho	Boituva	SP
46	ETE Capim Fino	Piracicaba	SP
47	ETE Alumínio	Alumínio	SP
48	ETE Campos de Boituva	Boituva	SP
49	ETE Jarinu	Jarinu	SP
50	ETE Joanópolis	Joanópolis	SP
51	ETE Sarapuí	Sarapuí	SP
52	ETE Ibirité	Ibirité	MG
53	ETE Serraria	Porto Alegre	RS
54	ETE Central	Jacareí	SP
55	ETE Patos de Minas	Patos de Minas	MG
56	ETE Pararangaba	São José dos Campos	SP
57	ETE Correios	Volta Redonda	RJ
58	ETE Barreiras	Barreiras	BA
59	ETE Cataguazes	Cataguazes	MG
60	ETE Mário Araldo Candello	Indaiatuba	SP
61	ETE Sarandi	Porto Alegre	RS
62	ETE Carmo do Paranaíba	Carmo do Paranaíba	MG
63	ETE Mateus Leme	Mateus Leme	MG
64	ETE São Gotardo	São Gotardo	MG
65	ETE Igarapé	Igarapé e São Joaquim de Bicas	MG
66	ETE Veneza	Ribeirão das Neves	MG

In addition to the federal funds provided by ANA (above), a total of US $630 million of counterpart funding was provided by local sanitation institutions and US $6 million came from water charging in river basins.

Although the Northeast region is the one with the most critical sanitation problems in Brazil, the large majority of the PRODES projects were implemented in the South and Southeast regions of the country. This was probably due to the lack of interest of the sanitation companies in the Northeast states in the program, the lack of managerial capacity, or both (ANA, 2014, personal communication).

1-2. Economic Performance

The funding from ANA/PRODES provided a significant financial leverage for local investments (Figure 36), which was responsible for important improvements in pollution control and green growth.



Source: ANA (2014) (personal communication)

<Figure 36> Financial Leverage Provided by PRODES' Financing until 2013

In Figure 36, it is observed that US $152 million provided by ANA has leveraged an additional US $631 million from local sanitation companies, part of which was obtained from bank loans and other financial aids. If the 1:4 ratio of sanitation investment to savings in health treatment costs determined by Fewtrell and Colford (2004)[53] is used, the total investment in sanitation works in PRODES (US $783 million) would have contributed to a savings of US $3.1 billion in health costs.

1-3. Social Performance

As far as the project social performance is concerned, more than 7 million people in six states benefited from improved water quality from PRODES projects by the end of 2013, based on the population served by the wastewater treatment plants built.

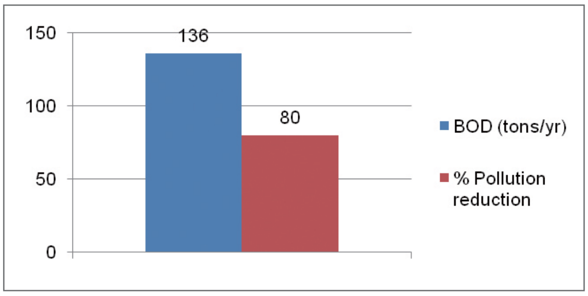
Although there are no figures for PRODES social performance yet, it is expected that the program has contributed to improved health and regional green

53) *Fewtrell, L. and Colford, J.M. Jr. 2004. Water, Sanitation and Hygiene: Interventions and Diarrhea.* Washington, D.C.: The World Bank. http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/Fewtrell&ColfordJuly2004.pdf.

growth, since there is a clear correlation between adequate sanitation and a reduced incidence of diarrhea and water-borne disease, and between the health of the population and regional GPD.[54)]

1-4. Environmental Performance

The implementation of 69 PRODES projects in the last 10 years have contributed to the abatement of 136 tons/yr of BOD in the projects' basins, which represent an 80% reduction in the waste-water pollution compared to the previous situation (with no project), as seen in Figure 37. Both reductions represent an important contribution to regional green growth, since BOD is one of the main pollutants that impacts fish and human health.[55)]



Source: ANA (2014) (personal communication).

<Figure 37> BOD Abatement and Relative Reduction in Waste-water Pollution in the Basins of the PRODES Projects

Table 11 presents the sewage treatment process used by the PRODES projects and their respective sewage flows. In that table, a total of 9,878 L/s of raw sewage are treated. Considering an average BOD abatement of 80%, a significant human & environmental service is expected in the basins.

<Table 11> Sewage Treatment Processes Used by PRODES Projects

Project	Treatment Process	Situation	Sewage Flow (l/s)
STP Jardim das Flores	UASB + Activated Sludge	Certification Concluded	67
STP Lençóis	UASB + Fac.Pond + Pol. Pond	Certification Concluded	13
STP S. José das Correntes	Anaer. Pond + Facultative Pond	Certification Concluded	70
STP Araretama	Activated Sludge	Certification Concluded	11
STP São Luiz do Paraitinga	Aerated Pond + Settling Pond	Certification Concluded	8
STP Biritiba Mirim	Aerated Pond + Settling Pond	Certification Concluded	55
STP Balsa	Anaer. Pond + Facultative Pond	Certification Concluded	42
STP Praia Azul	Activated Sludge	Certification Concluded	90
STP Piçarrão	UASB + Activated Sludge	Certification Concluded	556
STP José Cirilo/S.Joaquim	Digester + Anaerobic Filter	Certification Concluded	24
STP Estoril	UASB + Activated Sludge	Certification Concluded	89
STP Meia Lua	Activated sludge	Certification Concluded	28
STP Bandeira Branca	Activated Sludge	Certification Concluded	21
STP Santa Mônica	UASB + Activated Sludge	Certification Concluded	85
STP Ribeirão dos Toledos	Activated Sludge	Certification Concluded	80
STP Capuava	UASB + Activated Sludge	Certification Concluded	246
STP Pinheirinho	Activated Sludge	Certification Concluded	133
STP Moreira César	Anaer. Pond + Facultative Pond	Certification Concluded	41
STP Sorocaba I	Activated Sludge	Certification Concluded	641
STP CIC/Xisto	UASB + Pond	Certification Concluded	600
STP Jardim Candidés	UASB + Anaerobic Filter	Contract cancelled	10

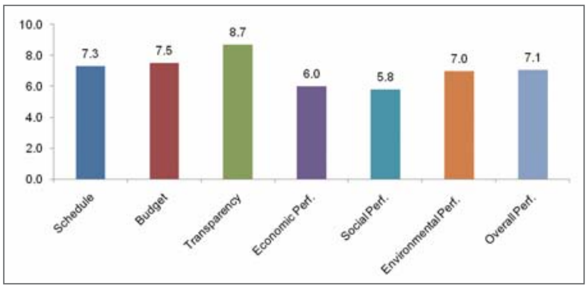
54) Filmer, D. and Pritchett, L. 1999. The Impact of Public Spending on Health: Does Money Matter? *Social Science and Medicine*. 49: 1309-1323.

55) Abrahams, R.G. and Seager J. 1990. The Impact of Storm Sewage Discharges on the Ecology of a Small Urban River. Water Science and Technology, 22: 163-171.

Project	Treatment Process	Situation	Sewage Flow (l/s)
STP Padilha Sul	UASB + Pond	Under Certification	439
STP Arujá	Aerated Pond + Settling Pond	Under Certification	240
STP Córrego da Penha	UASB + Trickling Filter	Under Certification	108
STP Itatiba	UASB + Submerged aerobic Filter	Under Certification	143
STP Monjolinho	UASB + FAD	Under Certification	635
STP Guararema	Activated Sludge	Under Certification	26
STP Onça	UASB	Under Certification	1.800
STP Barbosa Lage	Activated sludge	Under Certification	85
STP Piracicamirim	UASB + Aerated Ponds	Under Certification	84
STP Tamandaré	UASB + FAD	Under Certification	29
STP Dornelas	Digester + Anaerobic Filter	Works Concluded-Starting up	20
STP Taubaté - Tremembé	Activated Sludge	Under Works	619
STP Francisco Velludo	UASB + Aerated Ponds	Under Works	465
STP Betim - Central	UASB + Activated Sludge	Under Works	995
STP Cachoeira Paulista	Facultative Pond	Under Works	60
STP Parateí	Activated Sludge	Under Works	9
STP Sousas	UASB + Activated Sludge	Under Works	70
STP Lavapés (ampliação)	Activated Sludge	Under Works	963
STP Hortolândia	Aerated Pond + Settling Pond	Under Works	178
		Total	9878

1-5. Overall Performance

The overall performance score (0-10) of three PRODES projects was evaluated by the local managers who implemented or benefited from them, using an appropriate questionnaire. Figure 38 presents the average values of the three projects, considering implementation schedule, budget, socioeconomic, environmental efficiencies, as well as implementation transparency. Figure 38 indicates that the overall performance of the PRODES projects analysed in the present study was 7.0/10, which is considered good, despite their recent implementation.



Source: Questionnaire Results

<Figure 38> Overall Project Performance Score (0-10) of Three PRODES Projects, Evaluated by Local Managers and Stakeholders

2. Water Provider Program Performance

2-1. Generic Performance

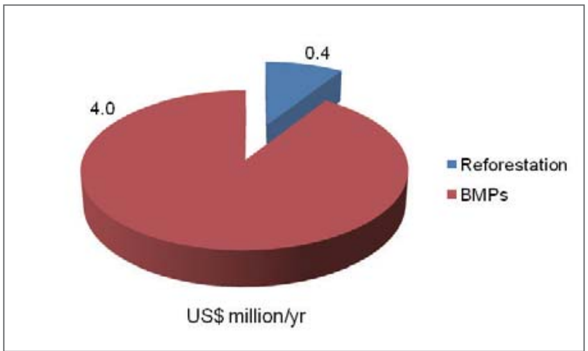
Since its conception in 2004, the Water Provider Program allowed the implementation of 16 projects in strategic basins of 11 Brazilian states. One third of those projects are advanced in terms of implementation, with the remaining 2/3 still in early stages.

In addition to the on-going WPP projects, there are at least other 40 initiatives being started at this moment, which lead ANA to start a decentralization process of the Program implementation with the states.

2-2. Economic Performance

The economic downstream benefits of the Water Provider Program, such as the one generated by base-flow increase during the dry season, it can be estimated using the opportunity-cost approach, taking into consideration the current drinking water prices and volumes. In the case of the Pipiripau river basin, these economic downstream benefits to the local population, resulting from reforestation and BMPs are presented in Figure 39.

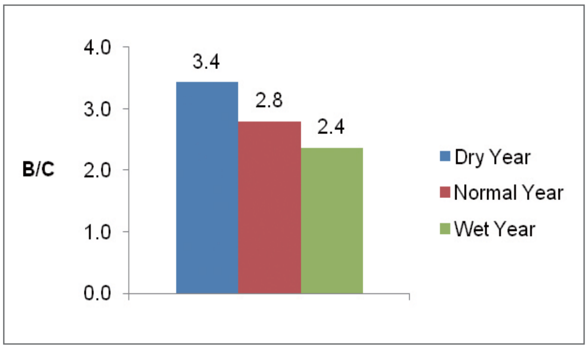
Figure 39 below indicates that the water consumers in the basin would gain an additional US $4.4 million in value per year, considering the previous condition (without the project). Similar results are expected for other basins in Brazil where the Water Provider Program is being implemented, which would also contribute to the country's green economy.



Source: Questionnaire results

<Figure 39> Expected Economic Downstream Benefits Resulting from Increased Water Supply Volumes during the Dry Season, in the Pipiripau Basin in Brasilia

As far as the recuperation of the program investments, hydrologic and economic simulations performed in the Pipiripau river basin indicate that the BMPs (reforestation, no-till, terracing) are economically feasible, as indicated by the high benefit/cost ratios with regard to combined water quantity and quality improvements (Figure 40).

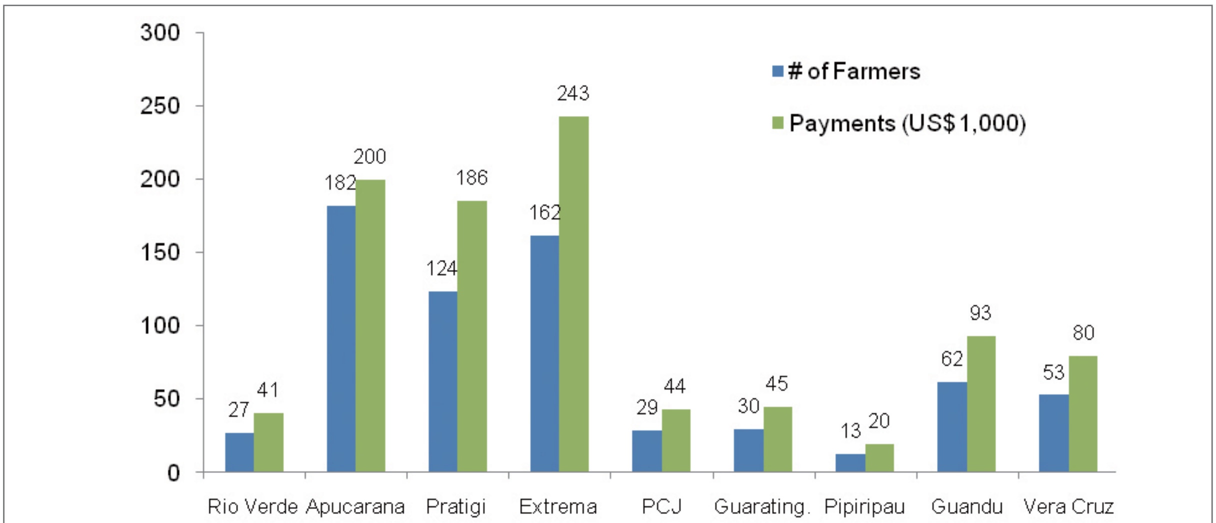


Source: Chaves, 2012.

<Figure 40> Benefit/Cost Ratios of Implementation of BMPs in the Pipiripipau River Basin (Combined Water Quality and Quantity), in Three Climate Scenarios

2-3. Social Performance

Figure 41 presents the number of farmers who benefited from environmental payments until April of 2014, with the corresponding environmental payments, in nine different Water Provider Program projects in Brazil.



Source: ANA (2014) (personal communication).

<Figure 41> Number of Farmers and Corresponding PES in Selected Water Provider Projects

The payments are in the form of investment in BMPs, to compensate farmer spending in practices, or regular payments resulting from reforestation of riparian areas (Picture 8).

Source: http://revistagloborural.globo.com/Revista/Common/0,,EMI156731-18095,00-OS+CULTIVADORES+DE+AGUA.html

<Picture 8> Farmer Receiving a Check in the Apucarana Water Provider Program

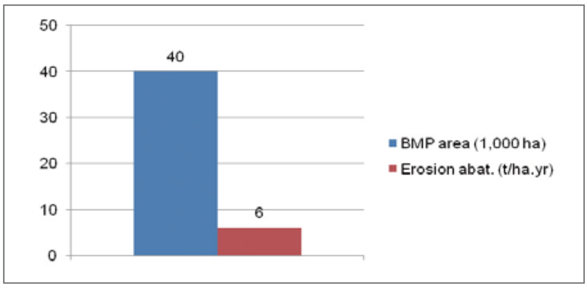
In order to improve the adoption rates for BMPs, which are selected in common agreement between farmers and program agents from a roster of eligible practices, farmers are trained in field workshops and accompanied by extension agents during the BMP implementation.

In addition to the recognition of the farmers' participation in IWRM, the payments for environmental services contribute to regional development and greengrowth, since they provide a new source of on-farm investment, which could contribute to improvements in farm yields, new jobs, and other benefits.

2-4. Environmental Performance

The total area of implemented BMPs and the corresponding erosion abatement resulting from different Water Provider projects in Brazil is presented in Figure 42.

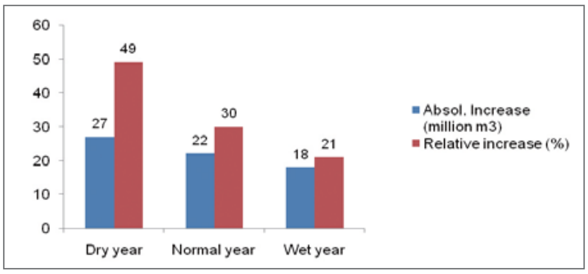
In addition to the water quality improvement resulting from erosion and sedimentation abatements in river basins, water quantity improvements are also generated with the implementation of BMPs in water supply watersheds.



Source: ANA (2014) (personal communication)

<Figure 42> Implemented Best Management Practices Area and Estimated Erosion Abatement in Water Provider Program Projects

Figure 43 shows that, with the adoption of BMPs by farmers, baseflow is expected to increase during the dry season due to higher infiltration rates and to improved groundwater recharge. Both improvements (water quality and quantity) contribute to the regional green growth.



Source: Chaves (2012)

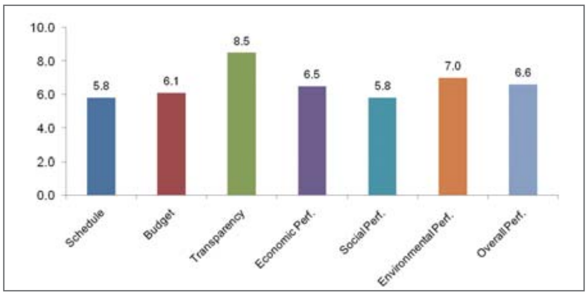
<Figure 43> Increase in Dry-season Baseflow in the Pipiripau River Basin After Introducing Best Management Practices as Compared to the Condition without Project, in a Model Simulation with Three Climate Scenarios.

Considering the results above, one can conclude that both the environmental, socio-economic and overall performances of a typical Water Provider project are positive, benefiting the water users and the aquatic ecosystem downstream, and improving green economy in rural areas, since the BMPs also improve agricultural yields.

2-5. Overall Performance

The overall project performance score (0-10) of four Water Provider Program schemes was assessed by questionnaires responded by local project managers and stakeholders. This assessment included schedule, budgetary, socioeconomic and environmental performances, and are presented in Figure 44.

As presented in Figure 44, the overall performance of the four Water Provider Programs was fair (6.6/10); this may be partly because of the recent implementation of the Program in Brazil.



Source:Questionnaire results

<Figure 44> Overall Project Performance Score (0-10) of Four Water Provider Program Cases, Evaluated by Local Managers and Stakeholders

V. Lessons Learned and Conclusion

Brazil has experienced very rapid economic growth since 2004 and has improved its health and education indicators, showing very positive overall social development trends. There is no question that the abundant water resources in Brazil, and its attention to water management in the last 25 years has contributed to growth and improved quality of life.

To ensure that water has been an engine of growth and has contributed to both environmental protection and social development, the Government of Brazil has implemented the types of policies recommended in the Water and Green Growth policy framework:

- Adopt river basin management plans using integrated water resources management (IWRM) principles;
- Value ecosystem services to ensure their conservation (e.g., PRODES, Water Provider Program);
- Promote technology transfer and invest in innovative tools to improve water and energy efficiency;
- Adopt a package of economic instruments, including demand management and incentives for cleaning up waterways, recycling and reuse of water; and
- Promote access to clean drinking water supply and sanitation as a key to poverty alleviation, public health and quality of life.

Many of these programs have been very successful and have contributed to the economic success of the country over the past few decades. In the economic sphere, the case study demonstrates a good example of green growth. However, there are still challenges related to protection and conservation of water resources and water supply and sanitation for an improved quality of life.

Some of the lessons learned and challenges still facing Brazil as it moves forward with its water management policies are described below.

Additional focus is needed to meet the deficit in sanitation services, especially in favelas in large cities and remote rural areas of the north and northeast.

Despite the significant economic development of Brazil in the last 30 years, a series of bottlenecks still hinder effective investments in sanitation systems in the country, where a significant deficit stills remains, independent of the level of regional development. However, the large deficits in basic sanitation and in institutional technical capacity in many basins, particularly in the northern and north-eastern regions, will still require a large effort and some decades to reach the level of developed countries.

At the same time, the Brazil Trata Institute notes that improved sanitation would result in economic, social and environmental improvements. The Institute calculates that if the entire population received sewerage services, there would be measurable effects not only in cutting down pollution that reaches water sources, but also in reducing deaths from gastrointestinal diseases, decreasing absenteeism from work throughout the country and improving educational outcomes for students.[56)]

To reduce the large deficits in sanitation and sewerage services, it is necessary that local water users and stakeholders perceive the connections between adequate water management and socio-economic development, and the importance of capacity building. It is widely recognized that sanitation and sewage collection systems, due to their "hidden" nature, do not generate political gains. It will be necessary for municipalities and states to partner with the private sector to tackle the large sanitation and sewerage deficit in the country.

Specific programs need to be stepped up on water resources management in the North and Northeast.

Certain parts of the country are lagging far behind in all the human development measures, particularly the north and the northeast. The North has suffered from poorly planned development, while the Northeast faces chronic drought and water shortages for agriculture and domestic use. Assistance in the implementation of IWRM principles and instruments to these regions is needed if the issues are to be effectively tackled. Lessons from successful basin experiences in the southeast, with the necessary adaptations, could be transferred to those regions.

Serious objections to water projects need to be addressed through consultation and dispute resolution.

Demonstrations in late 2013 and early 2014 showed opposition to the diversion of the São Francisco River and dams in the Amazon by representatives of river bank communities, indigenous groups, environmentalists and NGOs. Protestors say that the São Francisco should be revitalized through the decontamination of its water that has been polluted by industrial and urban waste before the water is transferred. Such concerns should be dealt with technically, using sound benefit/cost and environmental impact analyses, as well as timely dispute resolution processes. In addition, the authorities need to listen to the concerns of the stakeholders and try to resolve them in a mutually-beneficial way.

Communities need to be trained and empowered to manage water systems.

In the last 25 years, the water management process in Brazil has evolved from a concentrated, government-based administration to a decentralized, multi-use and basin-oriented management. In addition to the new legal framework, including up-to-date integrated water management policies, several water management institutions have been created in the period, at the federal, state, and basin levels. While these instruments and institutions have contributed to the improvement of water quality and quantity aspects, the participation of local communities in decision-making related to water management is still limited. Local and regional events promoting IWRM and green growth could be designed, showcasing good management practices and their socio-economic and environmental benefits. Better consultation with stakeholders is essential, since successful water management is a bottom-up process.

Continuous capacity building of water users and stakeholders is required, especially in water and environmental management.

Community members and experts need to be capacitated, not only in their own (individual) sectors, but in an integrated way. Since watershed management is an integrated process, its positive externalities (including green growth) could be clearly demonstrated to and perceived by all. There are a few river basins where participative

56) Coronato, M. and Imercio, A. 2014. *Brazil Asks for Water. Epoca*, 825: March 24: 48

water management has generated important advancements, including green-growth goals. The PCJ river basin, with the help of its basin committee and agency, as well as federal, state, and municipal funding, has achieved significant improvements in water quality and water-use efficiency in the last 10 years. These successful cases can be used to build technical and managerial capacity in other basins.

A better connection between effective policies and green growth, including socio- economic and ecosystem improvements, needs to be clearly demonstrated.

A strong connection between effective policies and green growth, with socio-economic improvements, has not been made clear in the political arena. This is the case in sanitation, where the National Sanitation Law of 2007 and the 2013 National Basic Sanitation Plan have not yet resulted in effective gains in the sector, partly because of lack of adequate finance and limited capacity within the local governments. It is expected that this reality will change with political pressures from the stakeholders, since the improvement in quality of life and economic development are only effectively achieved with proper water and sanitation policies.

Environmental education and showcasing PES programs could be effective in the promotion of green growth.

In order to speed up the effective water management in Brazil, examples of successful solutions in improving water quality and environmental protection can demonstrate that local, self-funded solutions could be obtained, with corresponding socio-economic and environmental gains. Wastewater treatment is a legal obligation of every municipality in Brazil,and every sewage treatment plant will have to meet legal compliance. A program like PRODES may help to accelerate this process.

On the other hand, PES may offer more room to promote the protection and revitalization of ecosystems. In PCJ and in other river basins, performance-based programs, such as PRODES and the Water Provider Program, can contribute to the abatement of urban pollution and rural sedimentation, respectively, mitigating water quality impacts and providing the necessary conditions to green growth. Political leaders, teachers, farmers, journalists and other key people could be trained in environmental and green-growth subjects, so that the important connections between effective water management and socio-economic development could be understood and pursued.

Monitoring, evaluation and follow-up would enhance PES systems.

A systematic monitoring, evaluation, and follow-up process integrated with the PRODES and Water Provider Program could ensure that relevant data and evidence are available to assess the effectiveness of both programs. This could be a very good complementary measure related to environmental education and showcasing PES programs.

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Sources are indicated with each photo.

Interview 1

Since the promulgation of the National Water Law (1997), several positive transformations have been experienced in IWRM in Brazil, particularly those relative to the implementation of the water policy instruments (water licensing, charging etc.). Additionally, several federal projects have been implemented in the last 20 years, which have positively impacted green growth. Among them, are the following: PROAGUA-Semi-Arid, Municipal Water Supply Atlas of Brazil, Watershed pollution control project-PRODES (ANA), and Water provider program (ANA).

There are several identified programs and policies promoting green growth in Brazil. PROAGUA-Semi-Arid (co-financed by the World Bank) helped the North-eastern states to establish the IWRM philosophy, and implement water supply works for the populations in the interior, increasing water security and allowing for their socioeconomic development. Municipal Water Supply Atlas of Brazil, which identified the bottlenecks and the potentials with respect to personnel and water demands in the country, and provided for sustainable solutions of water supply in the more isolated townships. Watershed pollution control project-PRODES (ANA), which provided the states with technical & financial support for the construction of sewage treatment facilities, where the payment was made after the works were completed, and based on its BOD abatement performance. Significant improvements in water quality were generated by PRODES, with consequent (positive) socioeconomic and environmental impacts in dozens of river basins. Water Provider program (ANA), which aims at the sedimentation abatement in rural and peri-urban water supply basins, where payments for ecosystem services were established to compensate the participant farmers for the water quality and quantity benefits they provided (after a technical assessment), based on the project performance. As a consequence, thousands of tons of sediment, which were carried to streams now remain in the farms, which positively impacted the socioeconomic and environmental development of the river basins where the projects were implemented.

The key reforms on the legal, administrative and policy fronts that Brazil has embarked on that have resulted in economic growth, with the least environmental consequences are: Legal – promulgation of the National Water Law and 27 state water laws. These allowed for decentralized water management, and multi-purpose water allocations; Administrative – creation of the National Water Agency, of the National Council of Water Resources, of dozens of river basin organizations, which allowed for the decentralization of water resources management in the country; and Policy – establishment of IWRM instruments, such as water licensing, water charging, development of basin plans, and the establishment of a national water resources monitoring system. An example of this incorporation is the new Sanitation & Solid Residue Law, which aims, among other things, at the improvement of the water quality aspects in the river basins. However, the way the prioritization is made regarding the allocation of funds for sewage & solid residue disposal still allows for political interference, limiting the technical aspect of the analyses.

Basin Cleaning-Up Program – PRODES (ANA) and Water Provider Program (ANA) are innovative programs where participants are paid for the ecosystem services based on the performance of their projects, and after they are established. Both provide for an improvement of water quality in the river basins, and therefore contributing to regional green growth. Individual water metering program & water reuse – aimed at buildings and multiple water utility users, improving water use efficiency and promoting green growth. To promote green growth, better integration between natural resource managers (water, environment), aiming at a common (and sustainable) socioeconomic development, conserving the environment is needed. Also, Advancements in elaboration of water resources plans, incorporating environmental needs in water allocations & climate change scenarios, as well as ecological & sectorial zoning issues.

Interview 2

At Odebrecht we have been promoting strong focus on the triad innovation-productivity-sustainability. Specifically with respect to water and green growth the infrastructure company (Construtora Norberto Odebrecht) has implemented over the years a number of programs focusing on water use efficiency and waste water treatment at our infrastructure construction sites. At the macro level Odebrecht has its own Sustainability Policy which provides the strategic framework for our activities. Amongst the focus of our Policy the rational use of natural resources (e.g. water, energy, etc.) is a key component. Programs involve for example innovative treatment systems for close water use cycle in our equipment maintenance shops, allowing for the separation of oil and water. Similarly, there are a number of innovative initiatives on close water use cycle in our concrete production systems so that water can be reused in the production line. Such programs reduce costs, promote more sustainable use of water resources and increase productivity.

In the Santo Antonio Hydroelectric Project we started an innovative program for organic water treatment at our water treatment plant (using tannin as flocculating agent as oppose to aluminum sulfate or other components). This has promoted zero water waste and, additionally, allowed the use of the sludge as organic fertilizer for the reforestation of areas that had been affected during construction. Other programs involve the treatment of grey water for use in secondary systems at constructions sites in Rio de Janeiro (for the 2016 Olympic Games). Metering of water distribution systems in our job sites is another initiative with direct positive impact in promoting water use efficiency. Equally important is the fact that Odebrecht, as one of the largest infrastructure construction companies in the World, has been involved for 70 years with the implementation of water related infrastructure such as pipelines, water and wastewater treatment facilities, irrigation systems, water ways, ports, hydropower plants, among others. A significant share of Odebrecht´s work is directly related to the implementation of systems to provide water for multiple uses and our focus is to develop such systems relying on state of the art technologies and strong quality controls so as to ensure that the infrastructure (hardware) developed is capable to operate efficiently and reliably.

Programs focusing on water use efficiency and water reuse, directly contribute to reducing pressure for the expansion of new water supplies systems. They contribute to conserving water resources and to reducing water use conflicts. Additionally, programs that reduce costs with water supply and/or water treatment in job sites have a direct positive economic impact in the projects. A number of programs such as the organic water treatment initiated in one of our projects has been disseminated and scaled up and is now used by a number of municipal water treatment systems in the State of Rondonia. This is a direct contribution to green growth.

In the policy arena the energy matrix in Brazil is the "cleanest" in the World, having over 46% of its energy based on renewable sources. This is possibly one of the best examples of policies focusing on green growth. The use of ethanol and the focus of energy generation systems on hydropower have proven to be rather successful policy choices. Additionally, Brazil is now moving toward systems that integrate hydropower with wind and biomass energy production, focusing on capturing the natural complementarity amongst these sources of energy production. The growth of wind and biomass energy generation systems will benefit from the hydroelectric production system promoting overall efficiency gains and reducing pressure for the use of hydrocarbons and other non-renewable alternatives. With respect to legal reforms the passage (since 1997) of the Water Law, the Law that created the National Water Agency (ANA), the Water and Sanitation Law and, more recently, the Solid Waste Management law are relevant pieces of legislation. Advances in the legal frameworks are yet to be fully translated into strengthened institutional capacities to implement policy instruments and to deliver well planned investments. This is particularly challenging at subnational levels and when intersectoral coordination is required.

As indicated previously Odebrecht has been focusing on two main areas that directly contribute to water and green growth. Primarily and very important is the company´s focus on state of the art engineering and innovation technologies for the design and implementation (construction) of the projects in which it is involved. A number of such projects are related to water infrastructure and have a significant impact in Brazil and in other countries as well. For example, over the past 10 years Odebrecht has been amongst the top three world contractors in hydropower development. This has allowed for the exchange of successful experiences and lessons learned contributing to improvements in important hydroelectric project in Latin America and Africa, generating benefits to local economies, to communities and to the environment. A second area of focus is the promotion of water use efficiency in our job sites. Many examples of initiatives adopted by Odebrecht were listed in the response to the first question above.

In general Governments should put in place clearer and better incentives to promoting green growth. Such incentive should focus, for example, on sustainable procurement frameworks in which companies that voluntarily advance the green growth agenda are recognized and obtain competitive advantages. Governments should also be more proactive in the development of strategies and plans (e.g. basin plans) that promote green growth and that effectively guide public policies and investments. It is essential to provide political and financial support to the implementation of plans that are well conceived, technically robust and developed through participative processes.

There is no doubt that the incorporation of environmental aspects and concerns to water resources management and development plans have had a profound impact in promoting environmental preservation, social development and improvements to well-being and quality of life. Development strategies and projects now take into account a wide range of objectives amongst which environmental aspects have important weight. This contributes to the development and implementation of more sustainable projects. The flip side of such processes is increased complexity since multiple objectives and often conflicting priorities have to be taken into account. Policy instruments and investment plans will increasingly involve hard choices, and consensus will be rarely obtainable. Better, transparent and legitimate decisions can only be reached by increasing social awareness regarding tradeoffs and development options.

Interview 3

The main water management initiatives that contribute to green-growth in Brazil are: Progestao Program, PRODES, Water Provider Program, and Interaguas Program. Progestao Program: capacity building and financial support program for the states, helping with the establishment of state water councils, basin committees etc. Watershed pollution control project-PRODES (ANA): provides the states with technical & financial support for the construction of sewage treatment facilities, where the payment was made after the works were completed, and based on its BOD abatement performance. Significant improvements in water quality were generated by PRODES, with consequent (positive) socioeconomic and environmental impacts in dozens of river basins. Water Provider Program (ANA): aims at the sedimentation abatement in rural and peri-urban water supply basins, where payments for ecosystem services were established to compensate the participant farmers for the water quality and quantity benefits they provided (after a technical assessment), based on the project performance. As a consequence, thousands of tons of sediment, which were carried to streams now remain in the farms, which positively impacted the socioeconomic & environmental development of the river basins where the projects were implemented. Interaguas Program: multi-sectorial program aimed at the capacity building of different water management & water users groups in Brazil, using IWRM as a main tool.

The key reforms on the legal, administrative and policy fronts that Brazil has embarked on that have resulted in economic growth, with the least environmental consequences are: Legal – main legal framework are the National Water, Environmental and Sanitation laws. Several instruments, such as water & environmental licensing, water tariffs, water & environmental plans are used in that regard. Administrative – creation of the National Water Agency, of the National Council of Water Resources, of dozens of river basin organizations, which allowed for the decentralization of water resources management in the country. Policy – the most important are the National Water, Environment, and Sanitation policies, established by their respective federal & state laws, with associated funds and executive agencies responsible for their application.

Several new technologies which are now promoting green-growth were developed by research funded by the Water Sector Fund (CT-Hidro). Additionally, programs such as Agua Doce (EMBRAPA), provides isolated communities with potable water supply systems. Green-growth and overall sustainability can only be achieved with an efficient water management system, that balances water demands with local supply. In order to achieve it, it is necessary that planning, infrastructure development, operation and management be accomplished, providing good quality water and reducing the risks of extreme events. Additionally, investment in the area of R&D and sufficient funding for IWRM activities are necessary, as well as the integration of water planning with regional development.

In the last 10 years, environmental aspects & concerns have been incorporated in the water plans. The examples of positive impacts or the incorporation in the environment, educational, and social well-being are: Integrated soil & water conservation policies and programs in river basins, providing better quality water and reducing the risks of floods; Integrated forest & water management, through the reclamation of riparian forests, reducing the impacts of river sedimentation and contamination; and Reclamation of groundwater recharge areas with BMPs, increasing water security during the dry season.

Interview 4

The river basin committees (RBCs) of Brazil, and, in particular, the RBCs of Sao Paulo, following a decentralised and participative approach toward water management, have used state water funds as well as royalties from the hydropower sector to tackle water-related issues in the basins, such as sewage pollution and sedimentation. Among the successful programs implemented in different basins in Brazil, which had implications for green growth, were Basin Pollution Control Program (PRODES) and Water Provider Program (WPP).

Programs such as PRODES and the 'Water Provider' provided significant improvements in water quality of the river basins, and allowed new private and public investments, in urban and rural areas. The sectors which benefited from this 'green-growth' stimulus were those of industry, agriculture, hydropower (energy) and tourism. The improvement of water quality in the rivers allowed for a reduction in water treatment costs. These positive externalities, in turn, attracted investments and stimulated the creation of new jobs and overall socioeconomic gains in the region.

Both legal, administrative, and policy instruments have contributed for a more balanced development, with efficient water use and environmental protection in several Brazilian basins. Legal: The National Water Law & State Water Laws and the Sanitation & Solid Waste Law allowed for an organized and decentralized process of water & pollution management in river basins, using effective management instruments such as water licensing, charging, basin plans, and river monitoring. Administrative: The river basin committees have helped the state agencies in the environment licensing and enforcement processes, which in turn, allowed for a more effective basin organization operation. Additionally, the basin organizations partnered with the municipal consortiums for a broader action in tacking basin issues, such as pollution & sedimentation control. Policy: in the policy arena, the approval of river basin plans by the basin committees, allowed for the identification of the basin hot-spots, such as water deficits and critical environment issues, such as pollution and soil erosion.

Brazilian basin committees have induced / promoted new water management approaches and technologies which allowed for regional green-growth. Among them are: i) water reuse in the industrial sector, ii) increased water use efficiency in irrigation, and iii) integrated basin pollution control. In addition to the direct benefits to the environment and to the region economy, those approaches & technologies provided synergies with other river basin management strategies, integrating upstream & downstream users & processes, reducing production costs, and promoting collective well-being.

Some initiatives are needed to improve green-growth in the river basins, including: Capacity building of stakeholders – water users & stakeholders need to be continuously capacitated in water & environment management, not only in their own (individual) sectors, but in an integrated way. Since the watershed management is an integrated process, its positive externalities (including green-growth) could therefore be perceived by all; Environmental education – teachers, journalists and other key people could be trained in environmental & green-growth themes, so that the nexus between water management & socioeconomic development could be understood and sought; and Communication – local & regional events promoting IWRM and green-growth could be designed, showcasing good management practices and their socioeconomic & environmental benefits.

Considering that IWRM at the basin level and environmental management are inseparable, a few examples of integration of environmental issues in water plans in Brazil are: Treatment of solid waste – considered in the past as a separate process, it has been integrated in the water plans in the last 10 years, particularly after the promulgation of the Sewage & Solid Waste Law, in 2007; Reclamation of riparian forests – considered as a buffer against water pollution and sedimentation, the reclamation of riparian forests and high-erosion lands have been tackled in the most recent water plans; Integration of groundwater & surface water – only recently water managers have recognized the importance of analyzing these two resources in an integrated way in the new water plans. The hydrologic & socioeconomic gains obtained from this process could foster the widespread use of this approach in the future; and Integration of continental & coastal waters – similar to the case above, this form of integrated management would allow for socioeconomic & environmental gains.

Interview 5

The National Water Law, PRODES Project & Water Provider Program, and the Construction of water mains in the north-eastern semiarid region embarked positive implications for green growth in Brazil. National Water Law – has established a platform for the effective management of water resources in Brazil, integrating the water & the environment. Its instruments (e.g., water licensing, charging, water plans) has allowed for the multiple use of water, and thus creating the conditions for green-growth. PRODES & Water Provider Programs – the former has contributed to the clean-up of sewage pollution of urban and peri-urban river basins, and the latter has helped in the sedimentation abatement in rural basins. Both contribute to the development green-growth, since good quality water is an important input to several human activities. Water mains in the Brazilian NE – this project, co-financed by the World Bank, has connected the isolated communities with the large reservoirs, providing the necessary means for socioeconomic development, with little environment impact.

The key reforms on the legal, administrative and policy fronts that Brazil has embarked on that have resulted in economic growth, with the least environmental consequences are: Legal – The National Water Law, providing the necessary instruments for decentralized & participative water management (water licensing, charging, water plans), has allowed for the effective stakeholder participation in the decision-making process involving water resources. This provided for the incorporation of multi-sector & multi-resource management, reducing the environmental impacts due to the construction of water works. Administrative – there are more than 200 operational river basin committees in Brazil, which have decentralized the management process at the local level, giving the water users and stakeholders the platform for discussion of water issues & solutions, allowing for the incorporation of environmental aspects in the decision-making process. Policy – the establishment of the National Water Management Pact, involving 22 of the 27 Brazilian states, as well as several river basin committees, is putting water in the national agenda, as an essential resource for the sustainable development of the country.

What are the technological interventions which company/govt./basin organization has developed/promoted to foster green growth using water?

The following were developed to foster green growth using water: Incentive for the adoption of demand water management, including the use of more efficient water distribution systems, generating an important water economy for the multiple uses; Incentive for the adoption of more efficient irrigation systems (drip, etc.), replacing less efficient systems, which provided for water surpluses for other sectors; and Incentive for the use of water desalinization units in isolated areas of the northeast, contributing to the well-being and green-growth of those regions.

To promote green growth more, the following are needed: Adoption of the Low Carbon-Rational Water Use-Social Inclusion approach by river basin committees, sectors & stakeholders, which could contribute to more green-growth, particularly in environmental-sensitive regions; Integration of water planning with different sectorial development plans, creating a synergy which could foster green-growth; and raising public awareness, in order to create proactive citizens which could provide sustainable solutions in IWRM & green-growth.

The integration of water & environmental aspects in water plans has contributed to an effective environmental licensing process of water works & other interventions in the river basins. Water plans are now incorporating the cumulative effects of different interventions & works of different water sectors (industry, energy, irrigation), anticipating eventual environmental impacts downstream. Positive externalities of different economic sectors (e.g., agriculture, energy, industry) have been analysed in the water plans, with the identification of the resulting socioeconomic & environmental gains, and therefore green-growth.

China

Shanghai Pudong: Public Private Partnerships

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

CWRC Changjiang Water Resources Commission

CPI Corruption Perceptions Index

EPAD Environmental Protection Administration Department

EPBs Environmental Protection Agencies

EREO Environmental Rule Enforcement Office

ESD Environmental Supervision Department

EU European Union

GIS Geographic Information System

GPS Global Positioning System

GDP Gross Domestic Product

MOC Ministry of Construction

MOH Ministry of Health

MOHURD Ministry of Housing and Urban-Rural Development

MWR Ministry of Water Resources

NDPC National Development and Planning Commission

NDRC National Development and Reform Commission

OECD Organisation for Economic Co-operation and Development

PRC People's Republic of China

PDA Personal Digital Assistant

PPP Public-Private Partnership

R&D Research and Development

SPVWC Shanghai Pudong Veolia Water Corporation Limited

SDRC State Development and Reform Commission

SEPA State Environmental Protection Administration

SCADA Supervisory Control and Data Acquisition

UN United Nations

WRB Water Resource Bureaus

WHO World Health Organization

Executive Summary

The purpose of this report is to investigate the successful water management improvements of Shanghai Pudong Public-Private Partnership and its subsequent contribution to China's green growth. For the purpose of the analysis, we follow Saleth and Dinar's institutional framework on water in order to identify and explain the interaction between institutions and water sector performance. The analysis focuses on both exogenous and endogenous factors of change. Specifically, we study the economic, social, political, environmental and technological levels in which the Shanghai Pudong Public-Private Partnership took place and operated, the policies and institutions that mark the project's course from its initial stage in the 1990's until the present, and relevant changes in those policies and institutions over the last few decades.

The Shanghai Pudong joint venture initiative – established in city with strong economic growth and increased water pollution - is a good case to be analyzed using Water and Green Growth framework, i.e. a growth concept emphasizing the role of water with regards to achievement of higher levels of economic well-being and social equity linked with protection and revitalization of ecosystems. Overall, there is evidence that the joint venture project has been successful. Within a period of ten years, the partnership has allowed increased access to water services of better quality across a region that is characterized by an exponential population demand for water services and has been suffered which its water resources for a long period of time.

I. Introduction

1. Purpose of the Case Study

In this case study, we investigate how the Shanghai Pudong Public-Private Partnership became a water management improvement success story and contributed to China's green growth from an institutional perspective. This case also reveals how important the green concept—the consideration of the environmental and social aspects in addition to the economic one—is in the efficient management of water resources for green growth.

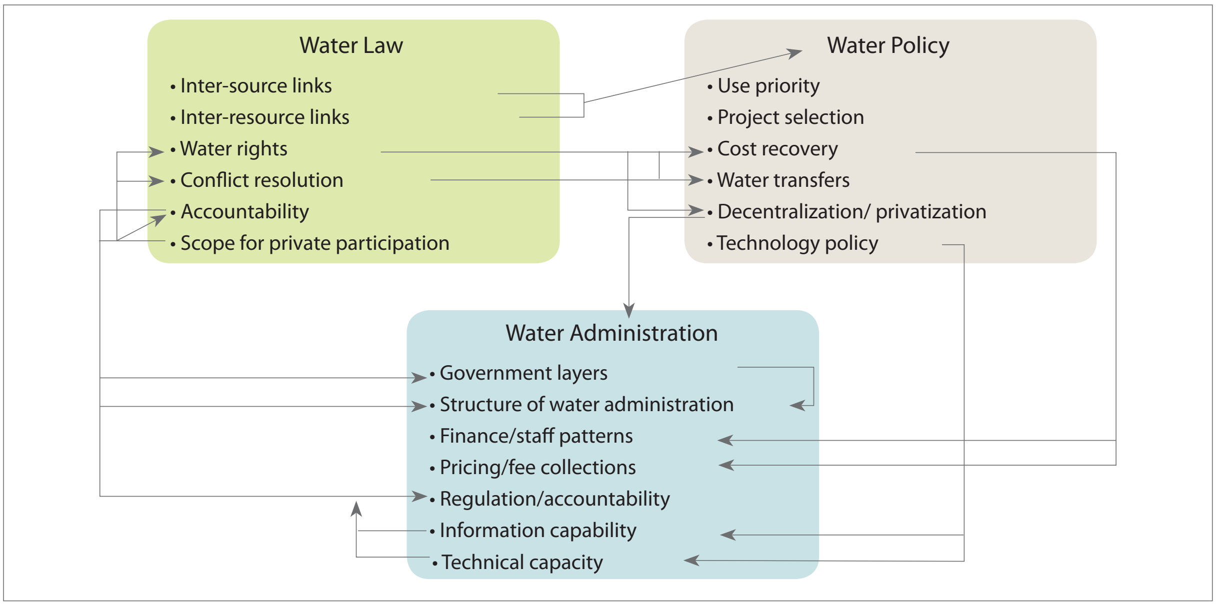
2. Case Study Methodology

2-1. New Institutionalist Approach

In this report we use a New Institutionalist Approach to analyze how the Shanghai Pudong joint venture contributed to China's green growth from an institutional perspective. The question of institutions became an important research topic in Economics, leading to the development of the theory of ownership and transaction cost theory that comprise what it is known as New Institutionalism. Institutions could be defined as behavioral rules that establish what is permitted and prohibited. Thus, the analysis of the construction and change of institutions can be used to understand social change (North, 2005). This approach is used to analyze the outcomes resulting from the institutions and policies involved in the Shanghai Pudong Public-Private Partnership. This report explores how the economic, social, political, environmental, and technical exogenous factors together with the Shanghai's water-related institutional framework and relevant policy mix led to the success or failure of the water-related green growth project.

2-2. Analytical Framework

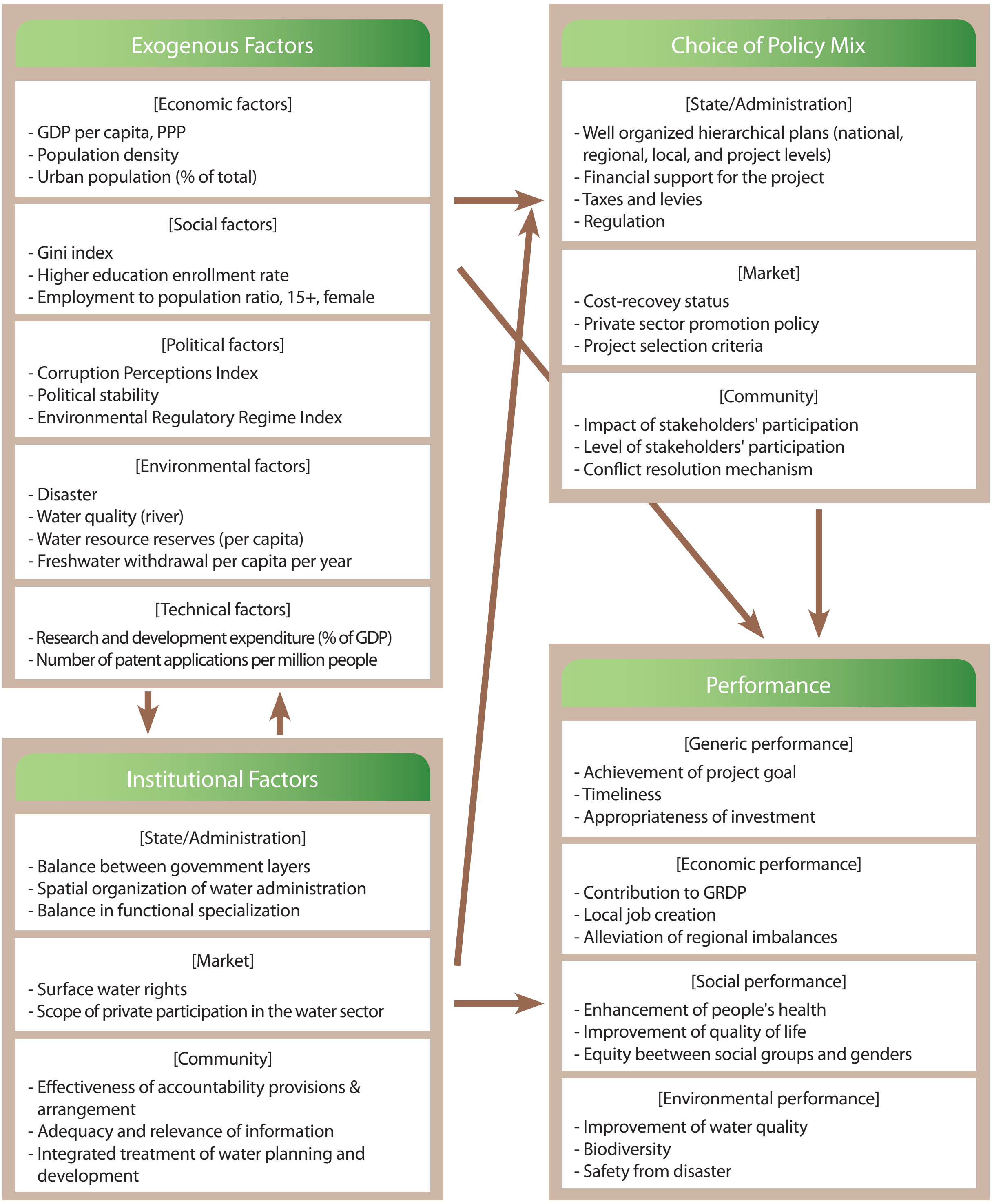
The report follows the analytical framework developed by Saleth and Dinar (2004) *The Institutional Economics of Water* (see Figure 1). In order to analyze the interaction between institutions and water sector performance, endogenous, and exogenous factors of change are identified and assessed. Exogenous factors refer to national or regional political systems, legal systems, populations, economic factors, and natural and environmental factors.



Source: Saleth and Dinar (2004)

<Figure 1> Saleth and Dinar's (2004) Analytical Framework

The Water and Green Growth project defines green growth as “a strategy that fosters economic growth and development, protects natural ecosystems and the resources and environmental services they provide, and enhances socially-inclusive development.” In this context, exogenous political factors are very important since they shape regulatory and administrative settings through legislation on water and green growth that reflect the real levels of political commitment. They are also important for the design and implementation



Source: Modified from Saleth and Dinar (2004)

<Figure 2> Institutional Framework Modified from Saleth and Dinar (2004)

of coordinating mechanisms among ministries and may allow or hinder cross-sectoral collaboration between diverse bureaus in the water and green growth fields. Economic factors influence the establishment of rational water tariffs and the provision of safety nets. Other factors like financial incentives for water saving users, tax breaks, and subsidies for green technology developers and users are also relevant for water and green growth. Finally, technological factors are important since technology contribute to green growth by cleaning the environment, conserving water and providing alternatives to large-scale infrastructure projects. The water sector comprises all water sources and uses (both consumptive and non consumptive), and all major water issues ranging from quantity-quality conflicts to drought-flood conditions. Water institutions are defined as “an entity defined interactively by three main components: water law, water policy, and water administration” (Saleth and Dinar, 2004, p.95) and include the legal framework, policy regime, and administrative or organizational arrangements. Saleth and Dinar’s institutional framework is re-categorized into state, market, and community (see Figure 2) to take into account the arguments about the drivers and instruments of economic and social development and environmental conservation based on the state, the market, and community. Clearly, the outcomes of a water-related project will differ if its institutional framework was predominantly state-driven, market-oriented, or community-centered.

3. Organization of the Report

The purpose of this case study is to investigate the economic, social, political, environmental, and technological levels in which the Shanghai Pudong Public-Private Partnership took place; the policies and institutions that mark the project’s course from its planning stage in the 1990’s until the present; and the changes in those policies and institutions over that time. From this investigation, the project’s performance is analyzed and lessons drawn.

The detailed structure of the report is the following: First, the Shanghai Pudong joint venture is summarized. Secondly, the external environment during the joint venture development period is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Statistics from the World Bank, OECD, and other sources, as well as survey results, and expert interviews are used to analyze how exogenous factors influenced policies and institutions affecting the Shanghai Pudong joint venture project. Thirdly, the institutional change, focusing on applied policies of the project period, is examined across state, market, and community dimensions. Fourth, the project’s performance is evaluated in terms of economy, environment, and society. Lastly, overall lessons are drawn from the foregoing analysis.

II. An Overview: Shanghai Pudong Joint Venture Project

1. Project Background

Shanghai is the fastest growing economic region in China and one of the fastest in the world. Since 1992 Shanghai has recorded double-digit growth almost every year. The total GDP of Shanghai grew from 540 billion Yuan in 2002 to 1.92 trillion Yuan in 2011 – almost four-fold growth in less than 10 years. The Shanghai Stock Exchange ranked fifth worldwide in 2011, with a trade value very close to the stock exchanges in Tokyo and London. Shanghai has become a leading global city, with a significant influence on commerce, culture, finance, technology, and transportation. Pudong New Area has a total area of 1,210 km^2, a total resident population of 5,175 million, and has governance over 13 streets and 24 towns (see Table 1 and Figure 3).

<Table 1> Administrative Division of Pudong

Type	Count	Name
Street	13	Lujiazui Street,Weifang Street,Tangqiao Street,Yangjing Street,Huamu Street,Jinyang Street,Hudong Street,Puxing Road Street,Shanggang Street,Nanmatou Road Street,Zhoujiadu Street,Dongming Road Street,Shengang Street
Town	24	Chuansha New Town,Zhuqiao Town,Jinqiao Town,Caolu Town,Zhangjiang Town,Heqing Town,Tangzhen Town,Gaoqiao Town,Gaodong Town,Gaohang Town,Sanlin Town,Beicai Town,Kangqiao Town,Zhoupu Town,HangTou Town,Xingchang Town,Xuanqiao Town,Huinan Town,Laogang Town,Wanxiang Town,Datuan Town,Nicheng Town,Shuyuan Town,Luchaogang Town

Source: Pudong New Area Government http://english.pudong.gov.cn/

Source: Migues (2008)

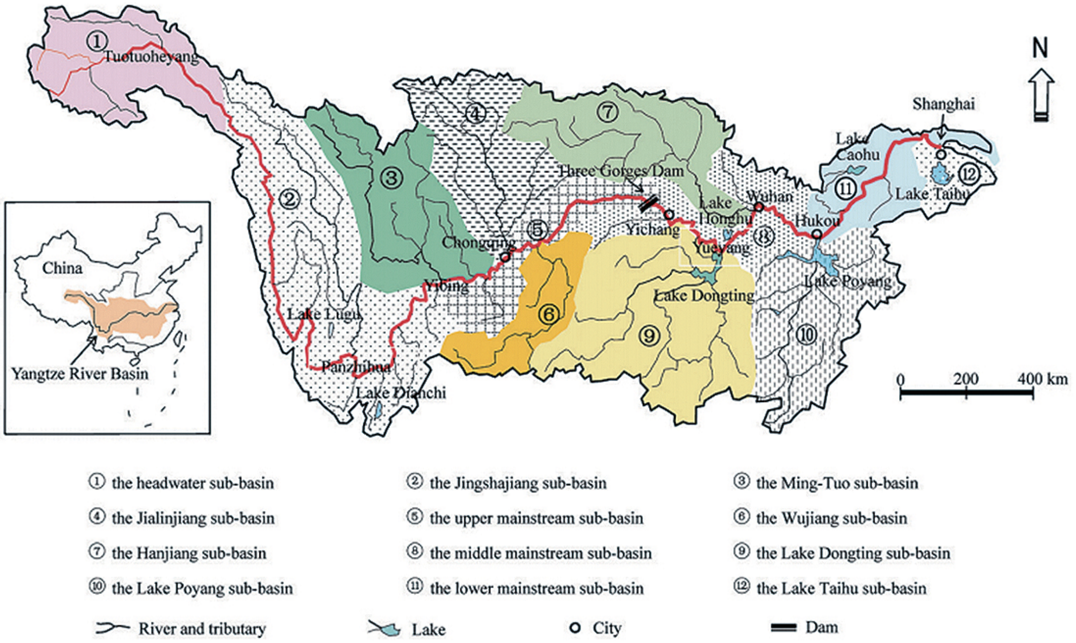
<Figure 3> Shanghai Pudong Location

Pudong New Area, a district of Shanghai declared Special Economic Zone in 1990, is a symbol of China's reform, modernization and liberalization. The rapid development of Pudong, since the 1990s represented a strategic move to open Shanghai and catalyze the economy of the entire Yangtze River Delta. The Delta is located on the east coast of China and comprises the territory of the municipality of Shanghai, and two provinces southern Jiangsu and northern Zhejiang (see Figure 4). This region has a marine monsoon subtropical climate. Its weather is warm and humid. However, temperature fluctuations are recurrent and winter temperatures can drop to record lows of -10°C. Rapid industrialization and urbanization during the period 2000–2010 has provoked prevalent environmental degradation, water shortages, and declines in water quality (Xu et al., 2014).

Source: Liu (2009)

<Figure 4> Yangtze River Delta

The Yangtze River (Changjiang) is the largest in China (6,300 km). It originates in the Geladandong Mountains on the (Tibetan) plateau following a west to east route ending in the East China Sea at Shanghai (see Figure 5). More than 4000 lakes are interconnected with the Yangtze River and its 3000 tributaries form a complete riverine–lacustrine network that supports a diverse fish fauna and human settlements. Due to its geographical features and history, this network has a high significance for humanity. Nevertheless, fish diversity has decreased and species loss accelerated since the 1950s. The World Wildlife Fund listed the river and its lakes in the Global Ecoregion 200 for priority conservation. The loss and degradation of habitats have led to endangerment of many species. Fu et al. (2003) found 361 fish species living in freshwater ecosystems in the Yangtze River Basin and Yue and Chen (1998) identified twenty-five endangered fish species in the basin. The white-flag dolphin is considered to be on the verge of extinction and common species, such as the carp are struggling for survival. Anthropogenic



Source: Fu et al. (2003)

<Figure 5> The Yangtze River Basin

activities (e.g. hydrological alteration, transportation, land reclamation, exotic species introductions, eutrophication, over-fishing, rapid sedimentation, deforestation, and land erosion) have provoked changes in the Yangtze River basin biodiversity. Hydrological alterations have had a huge impact on fish biodiversity, mainly to migratory fishes. For example, the Three Gorges Dam, is located in the basin. Dams provoke profound ecological changes and threaten fish biodiversity in the river (Fu et al., 2003). According to the World Wide Fund for Nature the main contributor of marine contamination in the Pacific Ocean is the Yangtze River Delta. Nevertheless, an environmental management system has been established and includes organizations such as the Environmental Protection Administration Department (EPAD), the Environmental Supervision Department (ESD) and the Environmental Rule Enforcement Office (EREO) (Liu, 2009).

<Table 2> Pudong's Timeline of Development

Year	Description
1980s	Pudong was a poor and rural area, consisting of vast stretches of farmland
1993	The Chinese Government opened the Pudong New Zone to overseas investment
1995	Construction commenced for Shanghai's second airport-Pudong International Airport
1996	Construction commenced for the 800 million Yuan Shanghai International Convention Centre
2002	Pudong and Veolia Water entered into China's first large scale Public Private Partnership for full water services for 50 years
2006	Several districts were integrated into Pudong, doubling the service area of the Shanghai Pudong Veolia Water Joint Venture
2008	Completion of the Shanghai World Financial Center – one of the world's tallest buildings
2009	Pudong confirmed as the site for a new Disneyland, to be opened in late 2015
2010	Over 70 million people visited the World Expo during its six-month period
2011	The Qingcaosha Reservoir started operation to serve over 10 million people

Source: SPVW (2012)

Pudong's GDP has increased at an average annual growth rate of 18.4% since 1990 to 236.5 billion RMB (23 billion euros) in 2006. Today, Pudong is an area of 570 km^2, with a population of 2.85 million people, where 4 trade zones, an international airport, the Shanghai Stock Exchange and the venue of the World Expo 2010. As a fast growing and rapidly modernizing city, Pudong's demand for clean and safe water is increasing rapidly at an annual average rate of 6%. Pudong, Shanghai's dynamic financial and commercial hub, is one of the key driving forces behind the growth of the city. It is where the World Expo 2010 was held, and where the four economic districts of free trade, financial zone and hi-tech park are located. The newest Disney Theme Park is also under construction in Pudong and is scheduled to open in late 2015 (see Table 2). The Key challenge for Shanghai Pudong authorities was to cater for this extremely rapid development and ensure water services would support the pace of growth. In operational terms, the challenge was:

- To match the needs of the population, growing from 2.65 million in 2002 to 3.6 million in 2011, and at the same time increase the level of service to ensure state of the art water, sanitation & health conditions;
- To ensure water services support the booming economy in the Pudong area, with a GDP increase from 124 Billion in 2002 to 540 Billion Yuan in 2011; and
- The two above constraints result in an increase of the Pudong service area from 320 km^2 in 2002 to 536 km^2 in 2011, which was to be duly planned for.

2. Approach

The Municipality established Shanghai Chengtou as the infrastructure development, operations and investment group, owned by the Shanghai Municipal Government. Established in 1992, Shanghai Chengtou has generated and invested over RMB 200 billion in 60 major infrastructure projects in Shanghai to alleviate the problem of traffic congestion, shortage of housing and environmental pollution. Chengtou Water, a division of Shanghai Chengtou, offers technical and managerial solutions to Shanghai regarding water supply and distribution, sewage and sludge management, as well as flood prevention and control. Based on that experience, the Shanghai Municipality confirmed in 1996 that water management was identified as one of the critical elements to support the pace of growth in the area, and enable this pace to be sustained over the next decades. The needed financing, commitment, and expertise lead the authorities to opt for a public private partnership for full water services over 50 years.

3. First Public-Private Partnership for Drinking Water in China

A Public-Private Partnership (PPP) model is a form of association between the public and private sectors that aims to provide public services that have been habitually provided only by the public entities (Liu and Yamamoto, 2009). The Pudong Water Corporation was created in 1999 when the Shanghai Water Authority separated the city's water supply system into four distinct and newly created state owned companies. The Shanghai Municipal Government decided in 2001 to launch an international bidding process for the selection of a professional partner for the water company. In May 2002, Veolia Water (then Vivendi Water) paid about $240 million for the purchase of a 50 percent stake in Pudong Water Corporation, the state-owned water company for Pudong at that time. Veolia was thus in charge of designing the technical solutions and building the facilities needed to provide water services. Veolia Water became the first foreign company allowed to participate in network construction and to provide water supply to end-users. Veolia is also active in China's wastewater treatment market (US Department of Commerce, 2005). Veolia has deployed the strategy of offering high premiums in order to win bids (with the anticipation that water tariffs may increase in the future) (Bhullar, 2013). In this case, Veolia Water was selected as the bidding winner "by offering 2.66 times premium of the net assets on the basis of the positive expectation that water sales would increase up to 3%. Thus, the number of customers would cross 0.5 million, and a fraction of the non-revenue water reduction, which was initially known to be over 30% due to network deterioration in Shanghai area, would greatly increase the profitability of the project" (Choi et al., 2010). Further, the Shanghai municipality requested the new joint venture should employ 100% of the staff in the Shanghai Pudong Water Company (Pedersen and Zhan, 2009). This joint venture is a landmark in public-private partnerships in China – it is the first time a private foreign water operator has shared the entire management of a Chinese water company. It covers the entire water cycle with a constant focus on protecting water resources and saving water. Shanghai Pudong Veolia Water Corporation Limited (SPVWC) became China's first public-private partnership for the management of the global drinking water service. The license for the 50-years water supply operations in the Pudong area started in September 2002. Veolia Water's partner in this project is Shanghai Chengtou, an infrastructure development, operations and investment group owned by the municipal government (Migues, 2008).

4. The Partners

4-1. Veolia Water

The world's leading operator of water service has been present in the water market in China since the 1980's. Across the world, Veolia Water's services include the design, construction and operation of water and wastewater plants and networks for industrial and municipal clients. Today Veolia Water operates in 20 out of 34 provinces, municipalities, autonomous regions, and special administrative regions in China.

4-2. Shanghai Chengtou Group

The Shanghai Municipal Government is present in the joint venture via Shanghai Chengtou Group, an infrastructure development, operations and investment group owned by the municipal government. Established in 1992, has invested over RMB 200 billion (20 billion euros) on 60 major infrastructure projects in Shanghai transport, housing, water, and waste water sectors. Chengtou Group employs 13,000 staff.

5. Achievements

In terms of achievements, the water service saw its network length growing from 1,975 km to 4,247 km (+115%) over a decade, with a 1,144,102 meters in 2012 compared to 573,000 in 2002. In qualitative terms, in 2007, a new national regulation was introduced to extend the number of parameters from 36 to 106, thus bringing the water quality control in China to similar levels as those in force in the United States and in Europe. This regulation was readily enforced in the Pudong area, thanks to the construction of the Deep Water Treatment plant, with a produced water quality meeting national, European and USA quality standards. In particular, substances including manganese are removed, which significantly improves the taste and odour of tap water in Pudong. Another characteristic of the operational performance of the service is the reduction of non-revenue water, which has dropped from 35% in 2002 to 26% in 2010. This is a key achievement of the Joint Venture in terms of reducing costs and wastage of water. A brand new customer service management system was installed, connected with optimized meter reading with PDAs and GPS localization. The main contributions of this Joint Venture to the quality of the water service in Pudong area can be summarized in:

- Water treatment capacity expansion (+28% from 1.25 Mm^3/d to 1.6 Mm^3/d));
- Increasing water quality and services to international standards. In-house analysis of 106 drinking water quality parameters;
- Bringing smart technology to network management (GIS, SCADA, Hydraulic Model, traceability, PDA for network maintenance);
- Innovation in customer services (management system, Call Centre, meters GPS localization and barcodes);
- Providing training and growth for the employees and promoting health and safety good practices; and
- Embracing social and environmental responsibility, in special providing water services for people in need, raising children's awareness in water conservation and minimization of carbon footprint.

III. The Case Study

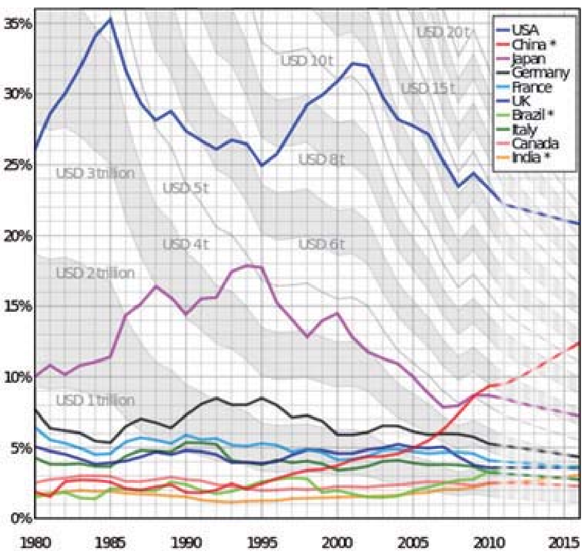
1. Exogenous Factors

The exogenous factors present a picture of the general context in which a project is carried out. This section presents the general national level of the Chinese context in which the Shanghai Pudong joint venture occurred across the economic, social, political, environmental, and technological dimensions. The economic, social, political, environmental, and technological contexts influence the formation, change, and performance of institutions, and likewise it influences the choice policies taken and their performance.

1-1. Economic Factors

1-1-1. Economic Growth and Structural Change

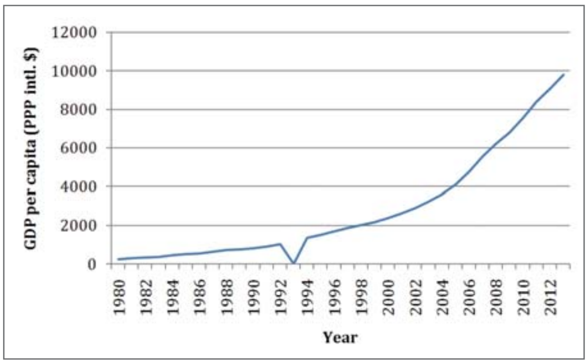
Since 2009, China is the world's second largest economy after the US. The World Bank estimated China's nominal GDP at 8.227 trillion US dollars in 2012. China's economy has had important structural changes. The most important changes occurred after



*Proportion of world (countries with data) nominal GDP for the countries with the top 10 highest nominal GDP in 2010, from 1980 to 2010 with IMF projections until 2016. Grey lines show actual US dollar values
Source: IMF, World Economic Outlook 2012

<Figure 6> Proportion of World Nominal GDP*

the economic reforms in the late 70s that derived in the change from a centrally planned system to a market-oriented system with a thriving private sector. The exports sector has played a major role in China's rapid economic growth. The growth rate in GDP measures the change in the seasonally adjusted value of the goods and services produced by the Chinese economy during the quarter. During the last quarter of 2013, the Chinese GDP increased 1.80 percent in comparison to the previous quarter. From 2010 to 2013, the quarterly variations were in average 1.99 percent, reaching an all time high of 2.60 percent in the second quarter of 2011 and a record low of 1.40 percent in the first quarter of 2012. Figure 6 shows that China's economy is the second largest in the world since 2009. From 1979 to 2013, the estimated China's average annual real GDP growth is 9.86%, reaching an historical high of 15.2% in 1984, and a record low of 3.8% in 1990. Based on PPP prices, the country's average annual GDP growth was 12.86%. Figure 7 shows China's Historical GDP per capita figures for the years 1978 – 2013.

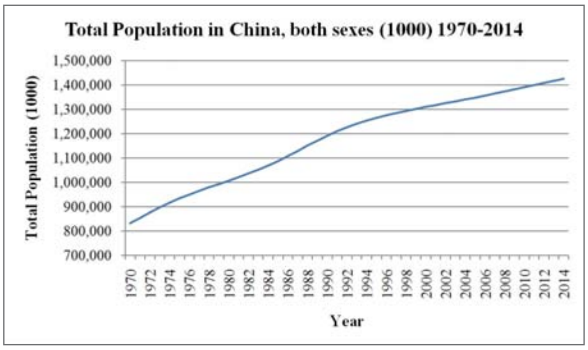


Source: National Bureau of Statistics of China

<Figure 7> China's Historical GDP per Capita (PPP intl. $) for 1980-2013

1-1-2. Population Movement and Urbanization

China is the world's most populous nation. The United Nations estimates that the total Chinese population in 2014 is 1,425,001,000 people (FAOSTAT). Nevertheless, according to the World Bank, China's population growth rate is 0.5%. China conducted its sixth national population census the 1st of November 2010. According to this census, 91.51% of the population was Han Chinese, and 8.49% were other minorities. In 1953, China took its first post-1949 census and the population stood at 583 million; by the fifth census in 2000, the population had more than doubled, reaching 1.2 billion. Figure 8 presents a summary of relevant demographic variables in China.



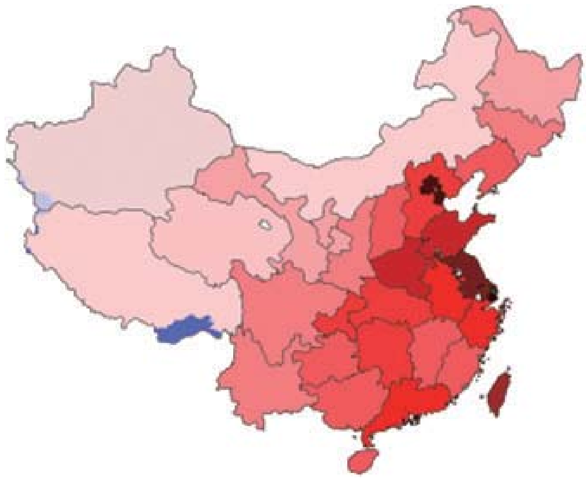
Population	1,425,001,000 (2014 estimation)
Growth rate	0.5% (2012)
Birth rate, crude	12.1 births/1,000 population (2012)
Death rate	7.2 deaths/1,000 population (2012)
Life expectancy	75 years (2012)
Fertility rate	1.7 children born/woman (2012)

Source: FAOSTAT and World Bank Database

<Figure 8> Demographics of China

1-1-2-1. Population Density and Distribution

According to World Bank Data, in 2012 China had a population density of 145 people per km^2. Figure 9 illustrates the regional variations in China's population density. The western and northern parts are not so densely populated when compared with the eastern half. The eastern coastal provinces are much more densely populated than the western interior because of the historical access to water. Most of China's population lives near the east in major cities. As previously discussed, following the reform policies of the 1970s, the urbanization in China increased at very fast rate. In 2005, China had 286 cities. Most of China's cities have a population of around one million. The two biggest cities in the country are Shanghai with 19 million people and Beijing with 17.4 million. The total urban population by the end of 2012 in Mainland China was 712 million (or 52.6% of the total population rising from 26% in 1990). The trends indicate that China will continue experiencing an increasing urbanization process. It is expected that nearly 70% of the population will live in urban areas by 2035. Over the next two decades China will build 20,000 to 50,000 new skyscrapers, and more than 170 cities will require mass transit systems by 2025.[1)]



*A population density map of the territories governed by the PRC and the ROC.

<Figure 9> Population Density Map*

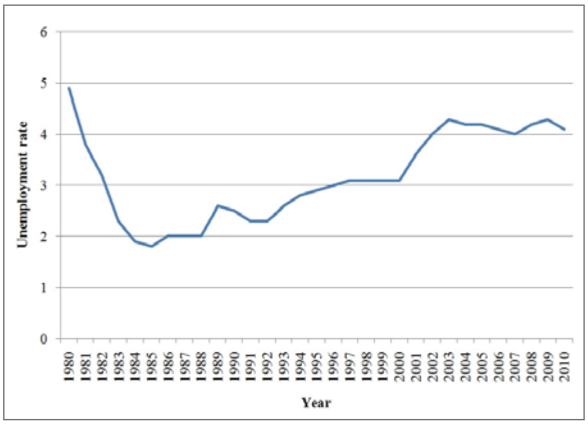
1-2. Social Factors

1-2-1. Income Inequality

China has experience quarterly GDP growth rates averaging 9.31% for the past two decades. Nevertheless, one of the most pressing issues is its income inequality. In 2009, the World Bank calculated a Gini index of 0.42 and estimated that approximately 11.8% of people in China live below the poverty line of 1.25 US dollar per day. On the other hand, increasing rural-urban migration fuelled the wage and social disparity. Large flows of rural migrants are attracted to the cities in hope of improving

1) UN (2011) http://esa.un.org/unup/Wallcharts/urban-rural-areas.pdf

their living conditions. The lack of relevant skills required in urban industries limits the jobs that rural migrants can take up; hence they are stuck in the lower end jobs. Then, due to the vast supply of rural labor low-end jobs are very competitive keeping the wages low. However, the unemployment rate has been under 5% in the last 30 years (see Figure 10). In regional terms, China's coastal provinces are relatively wealthy, and towards the west the country gradually becomes poorer. In general, coastal areas are wealthier than inland areas due to the advantages for transportation and trade that ports provide. It is therefore not surprising that the Chinese economic reforms started along the coast before trying them in the rest of the country. Income inequality and poverty may lead to serious social problems such as higher crime rates. Increasing tensions between the top and bottom income group may result in social conflicts if the problem is left unattended. These problems are foreseen to worsen in the future, hindering the economic development of China.



Source: World BankDatabase

<Figure 10> Unemployment Rate in China

1-2-2. Education Level and Equality of Opportunity

The Ministry of Education in China is in charge of the system of public education that includes nine years of compulsory education (elementary and secondary education). The attendance rate for primary school is 99 percent and an 80 percent rate for both primary and middle schools as reported by the Ministry of Education. Tax-funded higher education ended in 1985. Since then, university applicants must compete for scholarships based on academic attainment. The establishment of privately funded higher institutions in 1980s increased the number of undergraduates and people who hold doctoral degrees fivefold from 1995 to 2005. In 2003, China funded 1,552 higher education institutions (colleges and universities), 725,000 professors, and 11 million students. There are over 100 National Key Universities, including Peking University and Tsinghua University. Chinese expenditure in education has grown by 20% per year since 1999, now reaching over $100bn, and as many as 1.5 million science and engineering students graduated from Chinese universities in 2006. China published 184,080 papers as of 2008. China has also become a top destination for international students.

1-2-3 Effect of Social Factors

Romer (1986; 1990; 1994), Lucas (1988), Barro (1990), and other early endogenous growth theorists explain endogenous growth as arising from the mutual influencing of various growth factors amidst which increased investment in education leads to an increase in human capital, which in turn leads to technological progress and the accompanying rise in productivity that contributes to economic growth.

1-3. Political Factors

1-3-1. Bureaucratic Integrity

Transparency International annually publishes the Corruption Perceptions Index, an index of the perceived degree of corruption among public officials and politicians in a given country. A score of 7 indicates that a society is generally free of corruption, while a score of 3 indicates that a society's leadership is on the whole corrupt. In Transparency International's Corruption Perceptions Index (CPI), China has scored roughly around 5 out of a best possible score of 10 since 1995 and in 2013 ranked 80 in the world (see Table 3).

<Table 3> China's Transparency Index

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
INDEX	34	32	33	Not Found	36	36	35	36	39	40
RANK	71	78	70	Not Found	72	79	78	75	80	80
No COUNTRIES	145	158	163	Not Found	180	179	178	168	174	175

Source: Transparency International (http://www.transparency.org/)

1-3-2. Political Stability

China has a fairly stable and predictable business environment. However, there is little transparency in rules and other aspects of doing business. Many foreign companies have operated in China for long and have not experienced severe problems (unless they get into dispute with a Chinese partner or are involved in a politically sensitive sector). China is not a political risk hot spot, with little political violence, business interruption, strikes or riots. However, there has been a rise in political violence in China as the country feels the pain of a recession in the global economy and because of an income disparity between urban and rural communities. But actual physical damage to foreign assets appears to be minimal so far, as civil unrest has not targeted foreign businesses. There has been rising social unrest in China, but it typically remains localized and related to land, labor or environmental disputes.

1-4. Environmental Factors

1-4-1.Water Resources

The water resources of China are affected by both severe water quantity shortages and severe water quality pollution. A growing population and rapid economic development as well as lax environmental monitoring and enforcing have increased water demand and pollution. China has responded by measures such as rapidly building out the water infrastructure and increasing regulation as well as exploring a number of further technological solutions. China's water resources include 2,711.5 cubic kilometers of mean annual run-off in its rivers and 828.8 cubic kilometers of groundwater recharge. As pumping water draws water from nearby rivers, the total available resource is less than the sum of surface and groundwater, and thus is only 2,821.4 cubic kilometers, 80% of these resources are in the South of China. Total water withdrawals were estimated at 554 cubic kilometers in 2005, or about 20% of renewable resources. Demand is from the following sectors: 65% agriculture, 23% industry, 12% domestic. In 2006 626,000 square kilometers were irrigated.

1-4-2 Natural Disasters

China is frequently affected by natural disasters. More than 200 million people suffer the negative impacts every year (ADRC, 2005). China had 5 of the world's top 10 deadliest natural disasters and the top 3 occurred in China: the 1931 China floods, (death toll 3-4 million), the 1887 Yellow River flood (death toll 0.9-2 million), and the 1556 Shaanxi earthquake (death toll 0.83 million). Natural disasters are an important restricting factor for economic and social development, pose serious threats to life and property safety to China and its people. Due to such disasters, China's national security and social stability are also at risk and they stand in the way of economic development in some regions and poverty alleviation efforts.

1-4-3.Change in River Water Quality

Continuous deterioration of water quality is a major problem in China. The manufacturing sector has been identifiedas the largest contributor to river contaminationacross China. The introduction of poorly treated sewage, industrial spills, and extensive use of agricultural fertilizers and pesticides are major contributors as well. Furthermore, these water quality issues couple with seasonal scarcity of water to spark endemic water shortages, which frequently affect millions of people to some extent. According to the 2008 State of the Environment Report produced by the

Ministry of Environmental Protection, "the Pearl River and Yangtze River enjoyed good water quality, Songhua River was slightly polluted, Yellow River, Huaihe River and Liaohe River suffered from moderate pollution, and Haihe River was badly polluted. 46.2% of the 26 lakes (reservoirs) under national monitoring programs on their nutrition state suffered from eutrophication." [2)]

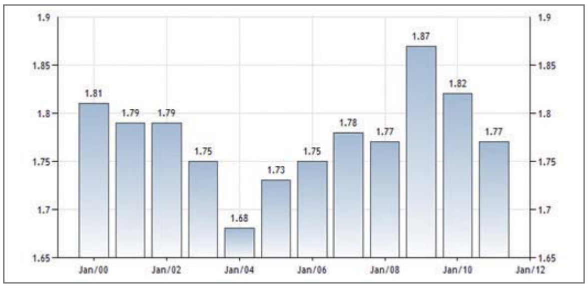
1-4-4. Impact of Environmental Factors

It is well documented that several China's aquifers suffer from arsenic contamination of groundwater. Arsenic related illnesses occur after long-term consumption of arsenic contaminated groundwater. Chronic exposure of arsenic in drinking water is associated with skin lesions (hyperkeratosis and melanosis), peripheral vascular disease, hypertension, blackfoot disease, and high risk of cancers. It is estimated that around 3 million people (mostly in rural areas) are exposed to high concentrations of arsenic, and 30,000 people have been diagnosed with arsenicosis (Sun, 2003; Sun et al., 2011). On the other hand, the WHO estimates that over 26 million people in China suffer from dental fluorosis due to elevated fluoride in their drinking water. In addition, over 1 million cases of skeletal fluorosis are thought to be attributable to drinking water. High levels of fluoride occur in groundwater and defluoridation is in many cases unaffordable.

1-5. Technical Factors

1-5-1 Research and Development Expenditure (% of GDP) in China

Research and Development (R&D) expenditures are current and capital expenditures (both public and private) on work undertaken systematically to increase knowledge. R&D covers basic research, applied research, and experimental development. R&D expenditure in China has been consistently above 1.65% of the GDP since the year 2000 (see Figure 11). In 2011, Chinese R&D spending more than doubled the Korean and UK spending (see Table 4).



Source: Trading Economics

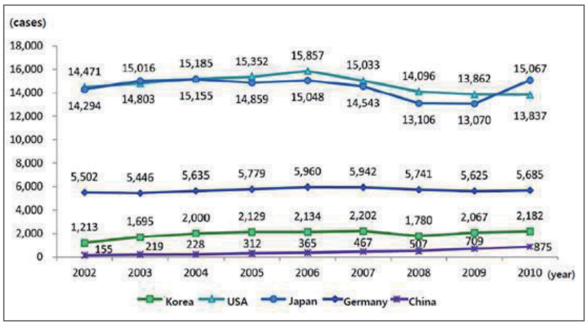
<Figure 11> Research and Development Expenditure (% of GDP)

<Table 4> Comparison of R&D Spending among Selected Countries

Index	Measures	China	USA	Japan	UK	Korea
R&D	0.1 billion US $	1043.2	4,015,8	1,788.20	398.6	450.2
Times (China=1)	Times	1	3.84	1.71	0.38	0.43
Percentage of GDP	Percentage	1.77	2,9	3.26	1.76	4.03

Source: National Science and Technology Commission-KISTEP, Report on the survey of R&D in Science and Technology 2011

In 2012, China invested 1.98% of its GDP into R&D. China's research intensity has tripled since 1998, whereas Europe's has barely increased. China has less than 0.7 patent families per million population but strong rises are observed for the country. While in 2002, 155 triadic patents were registered, this figure was 875 in 2010 (see Figure 12).



Source: OECD, Main Science & Technology Indicators (2012)

<Figure 12> Triadic Patents in 2002-2010, by Nation

2) Report available at http://english.mep.gov.cn/News_service/news_release/200906/t20090618_152932.htm

2. Water Governance and Institutions

In the previous section the influence that exogenous factors have on the institutional causes and performance of the Shanghai Pudong joint venture were presented. This section examines the direct and indirect influences that institutional factors have on the project, and how they evolved to support a green growth strategy. These institutional factors can be divided into legal, administrative, and policy elements (Saleth and Dinar, 2004). In this section, the influence of these institutional factors on state-driven, market-oriented, and community-centered projects' planning, execution, and results is explored. For this purpose, legal, administrative, and policy factors are recategorized and analyzed as government, market, and community-centered factors. Particularly, in order to investigate, among the institutional factors, the effect of policies with greater mutability and elasticity, the section is divided into sub-sections.

2-1. State-driven Institutions

The Chinese government has played a central role as both originator and decider of key policies in relation to Public-Private Partnerships (PPP) in the water sector and particularly in the Shanghai Pudong joint venture. Lee (2010), explains that one of the main duties of the communist regime is the provision of water and sanitation services in China that meets the basic needs of the population. We can identify two different periods with two different approaches in water provision services. The first period goes from 1950 to the early 1980s. During this period the government promoted equal and universal access to water based on socialism and egalitarianism and the involvement of the private sector in the provision of water services was discouraged. Socio Political and economic sensitiveness of water issues had a negative impact on urban water services. Therefore, several urban areas had difficulties in the access to tap water supply and deteriorating water quality. The government did not properly address those problems and the situation of water services deteriorated further. We can identify a transition period that started in the mid 1980s when some reforms to the sector started to be considered. However, Deng Xiaoping encouraged Pudong's fast transformation in 1992. The central government aimed to establishing Shanghai as one of the world's leading financial and economic centers, while making Pudong a modern showcase for the ongoing reform. Thus, it was declared a "special economic zone", making it eligible for a funding of €3 billion from 1990 to 1995, and €12 billion between 1995 and 2000 (Coignard, 2013). It is in the 1990s that there was a policy change and both central and local governments decided to involve private sector companies

<Table 5> Forms of Private Sector Participation

Private Sector Participation	Definition
Commercialization of public utilities	Transforms a public agency/utility into an independent corporation
Management contract	Contractual arrangement in which a private operator manages and maintains the service in a given period but without investment obligations
Lease contract	Short-term contract in which a private operator pays an agreed-upon fee to the government for the right to manage the facility
Greenfield contract (such as BOT, TOT, BOOT, etc.)	The government commits new investment projects to a private company, within the contract duration, the private operator manages the infrastructure and the government purchases the water by a contracted price (this price isn't necessarily determined by the actual water tariff)
Concession contract	A long-term contract in which a private operator bears responsibilities for operations and maintenance and also assumes investment and service obligations
Joint Venture	It is not a contract but, rather, an arrangement whereby a private company forms a legal entity with the public sector, in which both the private and the public parts share responsibilities and (investment) obligations
Full sale (or full divesture)	It is the sale of public assets to the private sector

Source: Adapted from Zhong et al. (2008)

<Table 6> Different Kinds of Participation of the Private Sector on China's Water Sector

Form of private sector participation	Asset ownership	Capital investment	Operations & maintenance	Contract period
Commercialization of governmental enterprises/ utilities	Public	Public	Public	Indefinite
Management contract	Public	Public	Private	3~5yr
Lease contract	Public	Public	Private	8~15yr
Greenfield(Bot-type)	Public/Public	Private	Private	20~30yr
Concession	Public	Private	Private	25~30yr
Joint venture	Shared	Shared	Shared	Indefinite
Sale or full divesture	Private	Private	Private	Indefinite

Source: Zhong et al. (2008)

(in order to attract investment, technology transfer, and management skills) in the provision of urban water services due to the process of rapid urbanization. Zhong et al. (2008), explain that in the Chinese water supply and wastewater treatment sectors various forms of private sector participation can be identified (see Table 5). The variations depend on the kind of involvement of such private companies in terms of asset ownership, capital investment, operations and maintenance and contract period. So far, foreign and local water companies have taken an active part in PPP projects. Table 6 summarizes the various forms of private sector participation and their characteristics.

2-1-1. Institutional Reform

The new forms of private participation in the water sector exposed in the previous section required a restructuring of water agencies and a whole new set of law sand regulations required for the implementation of a green growth strategy that will be presented in the following sections.

2-1-2. Laws and Administration

In China, there are many ministries and institutions that are involved in water management (see Table 7). Central institutions conform the main government structure and local levels administrative levels (in provinces, cities, and counties), are structured as mini-replicas of the central institution. For example, there is the State Environmental Protection Administration (SEPA). This agency has local equivalents: the Environmental Protection Agencies (EPBs). The most important law for the institutional arrangement of the water sector is set out in The Water

<Table 7> Ministries and Authorities Involved in Water Management

Ministries and Authorities	Description
State Environmental Protection Agency	Water pollution laws, regulations/ standards. Supervise/enforce. Water Environmental Function Zoning; Initiate WPM plans in key rivers and lakes. Monitor water quality.
Ministry of Water Resources	Integrated water resource management, water resource protection planning, monitoring water quantity and quality in rivers and lakes; issuing of water resource extraction permit; propose water pricing policy
Ministry of Construction	Urban water supply; urban wastewater treatment
Ministry of Agriculture	Rural and agriculture water use and agricultural non point pollution
Ministry of Land Resources	Water as a resource
State Forest Agency	Forests for conserving water sources
Ministry of Transportation	Ship transportation water pollution control
State Economic & Trade Com.	Industrial policies that affect wastewater discharge and its treatment
Ministry of Finance	Pollution levy proceeds management; decide wastewater treatment charge and water price policy
State Dev. Planning Com.	Pollution levy policy; wastewater treatment pricing policy, water pricing policy
State Council	Implementation regulation; administrative regulation and order; lead and coordination
National People's Congress	Legislations and law enforcement and supervision

Source: World Bank (2006)

Law (1988, 2002 –The 2002 amendment is intended for rational development, utilization, saving, and protection of water resources) that stipulates that the Ministry of Water Resources (MWR) and Water Resource Bureaus (WRB) are in charge of the administration and supervision of the quantitative aspects of water resource management (WB, 2006). On the other hand, the Ministry of Health (MOH) is responsible for supervision and management of the drinking water quality and its suppliers. In relation to PPP water projects, it is the Ministry of Housing and Urban-Rural Development (MOHURD) responsible of examining project proposals for PPP projects in the water sector before turning them to the to the State Development and Reform Commission (SDRC) (Lee, 2010).

The Changjiang Water Resources Commission (CWRC) was officially founded in February 1950. It is a river basin authority overseen by the Ministry of Water Resources. It has water administrative functions in the Yangtze River Basin and other river basins of south-western China. The Commission is responsible for water administration and law enforcement, integrated water resources management (including water conserving, allocation, and protection), basin planning, flood control and drought relief, river course management, key hydraulic project construction and management, river and extraction management, soil conservation, hydrology, scientific research as well as operation and stewardship of State owned assets.[3)]

2-2. Market-oriented Institutions

The Shanghai Pudong joint venture aim was to cater for the extremely rapid economic development in the area and to ensure that water services would support the pace of the population and economic growth. The needed financing, commitment, and expertise lead the authorities to opt for a public private partnership for full water services over 50 years as a water and green growth strategy. This sub-section discusses the market-based institutions that shaped the Shanghai Pudong joint venture.

2-2-1. Market-oriented Laws and Administration

One of the original government initiatives for PPP projects was the twenty-first Century Urban Water Management Pilot Scheme launched in 1997. The objective of this program was to liberalize water tariffs for projects with foreign capital. The initiative allowed favorable rates of return for water projects for foreign investors. Then, in 1998 the Urban Water Price Regulation was passed and guaranteed a net return rate of 8–10% to foreign investors. As a result, local governments were able to determine water tariffs based on the information of water service costs provided by water companies (Lee, 2007). Lee (2010) explains that the following laws are indirectly linked to PPP water projects: Water Law (1988a; 2002), Water Pollution Prevention Law (1984; 1996; 2008), Environmental Protection Law (1989), and Water and Soil Conservation Law (1991). The amended Water Pollution Prevention Law in 2008 strengthened the law enforcement of environmental regulatory agencies, such as the Ministry of Environmental Protection, through implementation of the discharge permit of wastewater and total pollution control. Such reinforcement of pollution prevention measures will lead local governments to put more investment in urban wastewater services, which provides more business opportunities to wastewater service companies. Although the history of PPP in the Chinese water sector is recent, market fundamentals have rapidly become mature. Table 8 illustrates the laws and regulations in urban water services discussed above.

3) Changjiang Water Resources Commission http://eng.cjw.gov.cn/eng-introduction.asp

<Table 8> Laws and Regulations Related to Public Private Partnership Water Projects in China

Year	Title
1989	The PRC Environmental Protection Law
1991	The PRC Water and Soil Conservation Law
1995	The Certain Matters Relating to Project Financing by Domestic Institutions Notice
1995	The Several Issues Concerning the Examination, Approval and Administration of Experimental Foreign Invested Concession Projects Circular (the BOT Circular)
1995	The PRC Security Law
1997	The Catalogue for Guiding Foreign Investment in Industry
1997	The Administration of Project Financing Conducted Outside China's Tentative Procedures (The Interim Procedures)
1998	The Urban Water Price Regulation
1999	The PRC Contract Law
2002	The PRC Water Law (revised, first in 1988)
2002	The Measures on the Guarantee of Fixed Profit Margins for Foreign Investment Projects
2002	The Foreign Investment Industrial Guidance Catalogue
2002	The Opinions Concerning the Acceleration of the Marketization of Urban Utilities Industries
2004	The Measures for the Administration of Concessionary Operation of Urban Utilities Industries
2004	Administrative Measures Concerning Urban Utilities Concession Rights
2004	The Circular on Accelerating the Reform of Water Price, Promoting Water Saving and Protecting Water Resource
2008	The PRC Water Pollution Prevention Law (revised, first in 1984, revised in 1996)

Source: Lee (2010)

2-2-2. Market-oriented Policies

The Shanghai government transferred the entire Pudong water supply operation to the joint venture company without any margin profit guarantees. The profit margin depends entirely on the efficient operation of the Joint Venture company and the development of the Pudong area. In addition, the price of water to consumers is a major risk for Veolia. The government sets pricing; however, reasonable costs and profits are the government's long-term principles when establishing water prices. Thus, if Veolia can operate the water supply efficiently and in the Pudong area grows, the water pricing policy risk may not be detrimental in the long term (US Department of Commerce, 2005). In its urban water management reform, China has made significant policy efforts in reforming water tariffs by issuing a series of policy documents and regulations (see Table 9).

<Table 9> Major Policies and Regulations Related to Water Price Management

Year	Policies
1987	PRC Ordinance on Price Management by the State Council
1994	PRC Ordinance on Urban Water Supply by the State Council
1997	PRC Price Law by the Standing Committee of National People's Congress
1998	Administrative Method on Urban Water Supply Price by formerly National Development and Planning Commission (NDPC)
1999	Circular on the Key Issues for Carrying out the Administrative Method on Urban Water Supply Price by former NDPC and the Ministry of Construction (MOC)
1999	Circular on Enhancing the Collection of Wastewater Treatment Charges and Establishing the Centralized Municipal Wastewater Treatment System by the former NDPC, the MOC and the State Environmental Protection Administration (SEPA)
2000	Circular on Enhancing Water Conservation in Urban Water Supply and Prevention of Water Pollution by the State Council
2001	Opinions on Improving Price Management by the National Development and Reform Commission (NDRC)
2001	Code of Conduct for Governments to Make Prices (Trial) by the NDRC
2001	Provisional Methods on Organizing Public Hearing for Governments to Make Prices by NDRC
2002	PRC Water Law by the Standing Committee of NPC (issued in 1988 firstly)
2002	Circular on Accelerating the Reform of Urban Water Supply Price by the former NDPC, the MOF, the MOC, the Ministry of Water Resource (MWR), and the SEPA
2002	Methods on Organizing Public Hearing for Governments to Make Prices by NDRC
2003	Circular on Enhancing Urban Water Conservation and Ensuring Sate Water Supply by the MOC
2004	Administrative Method on Checking & Ratifying Collecting and Managing the Charges for Hydro Engineering Project by the State Council
2004	Administrative Method on Raw Water Price of Hydro Engineering Projects by the NDRC and the MWR
2004	Circular on Accelerating Water Price Reform, Promoting Water Conservation, and Protecting Water Resource by the General Office of the State Council

Source: Zhong and Mol (2008)

Zhong and Mol (2008) explain that before 1990 decision-making on water tariffs was the monopoly of the state–bureaucracy. The government fixed water tariffs directly because water provision was considered a key public service. The first wave of water tariff increases took place under these conditions in the 1980s, accompanied by the installation of meters for individual (household) water consumers. The central government called for a reform in water service charges.

During the next Five Year Plan, the PRC Price Law (the Standing Committee of NPC, 1997) created a milestone in the institutional innovation of water tariff setting policies. The Price Law introduced a number of key innovations. Firstly, a clear principle was stipulated that decisions on urban water supply prices remained ultimately with the government. Secondly, the prefecture-level governments (so-called region-level cities) were empowered to administrate the urban water supply price and to set local water supply prices. This meant a further decentralization of decision-making power to lower level governments. Thirdly, a tariff plan became a requirement for water tariff setting. The water supply company has responsibility for making the tariff plan and to submit it to the local price authority, concretizing the role of the water supply companies in price settings. Fourthly, a higher-level price authority has to record the new tariff planning and inspect the price planning process, which could be regarded as the emergence of a supervising/auditing system for water tariff management. Finally, but not the least, the obligation to organize a formal public hearing during the water tariff setting process was stipulated. It should be noted that despite recent increases in water price, it remains quite low compared to other countries and in relation to the quality of services. The water tariff is the same for the whole Shanghai city, including areas managed by Veolia and areas managed by the Municipality (75% of the city).

2-3. Community-centered Institutions

2-3-1. Impact of the Policy for Promoting Stakeholders' Participation (Education, Communication, Raising Public Awareness)

The Shanghai Pudong joint venture has had an active role with the local community. A number of activities mainly focused on environmental education have been organized in topics related to water resources and environmental protection. Some other activities to increase the contact with the local community include school visits to the facilities and exchange with the communities about water contribute to general environmental awareness. Further, there has been cooperation with local universities through research cooperation agreements. The topics that have received research funds include water treatment optimization, health and safety, equipment and energy saving. Finally, innovation is promoted at all levels of through "Golden Ideas" awards (Migues, 2008).

2-3-2. Level of Stakeholders' Participation

In a PPP, there is by definition stakeholders' participation. Teisman and Klijn (2002), explain that the PPPs scheme is based on a framework of joint decision making rather than a principle-agent relationship. Further, in the partnering model "governments and private parties set up a joint platform in which all parties participate on a risk-bearing basis. Together, they specify the projects needed for further development of the project, and together they will be responsible for contracting out parts of the plan"(Teisman and Klijn 2002, p.195). The Shanghai Pudong joint venture was established with the two partners (Shanghai Chengtou Group and Veolia Water) in equal proportion (50% shares for each). The partners brought a depth local and international expertise to develop Pudong's water service. The company operates under a "system of collective leadership and joint decision-making" with 50%-50% representation in Executive Management Committee and Board of Directors. A well-balanced management team was established with rotation of main positions (General Manager and Chairman) every four years and distribution of key management positions between both shareholders. The same conditions to other water companies in Shanghai are applied to the Joint Venture: water quality, service levels, water tariff, laws, and regulations. No special subsidy was accorded.

IV. Performance of the Shanghai Pudong Joint Veuture

1. Generic Performance

1-1. Attainment of Project Objectives

The objectives of the Shanghai Pudong Joint Venture were expressed in Articles of Association: “The purposes of the Joint Venture Company are: to introduce advanced water supply technology and management experience, improve water quality, reduce cost, and provide high quality water supply services to the customers and the developments of Pudong Area” (Migues, 2008).

The strategies and action plans that were established for the joint venture are focused on the following points:

1) Improvement of the water quality to be in total compliance with the higher standards requested by China and Shanghai. According to the SPVWC (2012) report, this was achieved in 2007.
2) Improvement of the service. This was a commitment with the development of Pudong Area and with the city of Shanghai in terms of ensuring at all times the safety of the water supply and providing adequate water supply solutions. This has been achieved through the expansion of the water supply network and the facilities for water treatment SPVWC (2012).
4) Make the company profitable for the shareholders.
5) Make the Company a good place to work for the employees, providing professional satisfaction, development opportunities and fair compensation. According to Migues (2008), an average of 46 hours of training/employee each year, covering more than 90% of the employees was achieved 2007. With the aim of encouraging individual, team and company performance the salary system has been reformed. During this process, jointly developed with the Labor Union and the management, the structure of basic salaries, allowances, variable salaries, performance evaluation, and procedures was updated.

1-2. Timeliness of the Project

It took the joint venture10 years to meet its main targets in terms of network management, water quality and customer service. Since 2007 complies with the full range of international standards. In 10 years, the company has doubled its productivity. The methods employed are appropriate: “production capacity for the five existing plants increased by 28% from 2002 to 2011, which represents a 7% improvement in efficiency; the network was also expanded by an unprecedented 115%, using state-of-the-art treatment technology; finally customer relations have been optimized for the end customer” (Coignard 2013). In terms of long term sustainability of water resources, a new reservoir for untreated water in the Huangpu River is under development. Since water quality is an ongoing concern for the Shanghai authorities. Efforts have been done to ensure comprehensive compliance with ISO 22000 and HCSP1 standards. Here, Veolia Water’s expertise is crucial. These projects keep with the ambitions of a city seeking to establish itself as the country’s financial capital by 2020 and providing good quality water to its population.

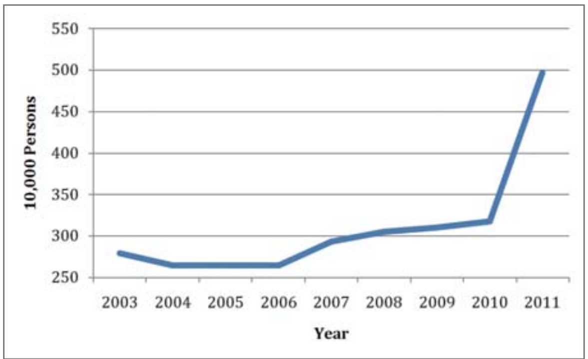
1-3. Economic Performance

The main objective of Shanghai Pudong joint venture was to ensure that water services would support the pace of fast economic growth in the region. This required to match the needs of a population growing from 2.65 million in 2002 to 3.6 million in 2011, and to ensure water services support the thriving economy in the Pudong area (with a GDP increase from 124 billion in 2002 to 540 billion yuan in 2011).

2. Contribution to Regional Production

2-1. Population of Shanghai Pudong

In the early 2000's, around 7,000 companies were already established in Pudong. In 2013, there were around 10,000 of them. The region attracted an important flux of migrants. The number of inhabitants increased by two million between 2000 and 2010, and the number of employed people passed from 2.792 million in 2003 to 4.973 million in 2011 (see Figure 13). This new population density led to increased demand for water services (Coignard, 2013).



Source: National Bureau of Statistics of China

<Figure 13> Number of Employed Persons in Shanghai (2003-2011)

There is evidence that there was an important increase on the coverage of the service during the period 2002-2008 in the Pudong Area (see Table 10). During ten years of the implementation of the PPP, there was an increase of 33% of the population served (the number of people benefiting from the overall improvement in water services has grown from 2.65 million to 3.6 million). In 2002, the initial service was 320 km^2. In 2006 there was a service extension of an additional 102 km^2 to the Pujiang Town. Finally, from 2007 to 2011 there was a further service extension of 114 km^2 to other 13 districts across the Pudong area SPVWC (2012). Increased metering (+99%) has made it possible to accurately determine consumption for households and businesses. These solutions have also helped control service costs (Coignard, 2013).

<Table 10> Growth in the Scope of Services

	2002: Start of the contract	End – 2011	Increase
Population served (Million inhab.)	2.65	3.6	33%
Service Area (km^2)	320	536	67.50%
Network Length (km)	1,975	4,247	115%
No. of Water Meter	573,000	1,144,102	99%
Water Production/ Capacity (m^3/day)	1,250,000	1,600,000	28%

Source: SPVWC (2012)

2-2. Adoption of Innovative Technology

Since 2002, the water distributed by Shanghai Pudong Veolia Water Corporation has complied with the 1985 Chinese water quality regulation. Recently, it has introduced advanced technology, management methods, and water quality improvement to achieve the 2007 Chinese national standard for water quality (that replaced the 1985 regulation). This standard extended the number of parameters controlled from 36 to 106. To meet the new 2007 regulation, the Joint Venture has identified main areas for improvement, including that of treatment technologies in water plants. Construction of ozone and activated carbon filtration units has started in the main water plant, and is planned for all water plants in the medium and long-term (Migues, 2008). The Joint Venture launched an extension plan for the Linjiang Water Treatment Plant in 2004, and a construction plan for Jinhai Water Treatment Plant in 2007. The two plans increased the total water production capacity of the Joint Venture from 1,250,000m^3 /day to 1,600,000m^3 /day.

3. Social Performance

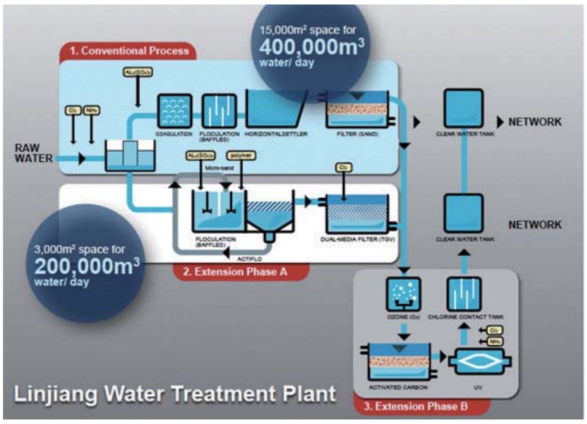
3-1. Improvement in Quality of Life

Shanghai is considered a water short city although geographically it is located in a water rich region (Ji-Yu et al., 1995). According to the Shanghai water authority almost all-surface water is polluted in different degrees due to anthropogenic activities. The water quality of the main surface water sources cannot meet the drinking water quality standards. Besides, the quality of water in Taihu Basin and the Yangtze River flowing through Shanghai has been worsening, and this is coupled with the impact of seawater upstream. The availability of clean surface water resources is decreasing. Thus, Shanghai is considered a pollution-induced water shortage city. The use of treatment technologies in water plants as discussed in the previous section has had a positive impact in terms of access and quality of water services. As reported by Coignard (2013), Pudong residents perceive an improvement in the quality of water due to the new drinking water system. Some residents have stated: “water quality is a lot better now. Before, we had to buy bottled water. Now, we just turn on the tap!” and “if there is a problem, the building manager tries to fix it first. If he can’t do it, then a technician is quickly on site. We’ve hardly had any interruptions in the water supply lasting more than three hours. The service is excellent. There are several ways to pay bills: at the post office, online, by cell phone or through the bank. It’s really easy.” Nevertheless, the water price has been gradually raising and this may cause some risk to the project’s reputation in China. For example, in July 2009 the water price in Shanghai was raised from RMB 1.84 (US $0.27)/m^3 to RMB 2.30 (US $0.34 USD)/m^3. This is a 26% increase in the price. Local reaction to the price hikes in Shanghai has been strong (China Water Risk, 2010).

4. Environmental Performance

4-1. Water Quality Improvement

As previously mentioned, Shanghai is considered a pollution-induced water shortage city. According to Jin-Yu (1995), Shanghai has three main water sources: the Huangpu River, the Changjiang River, and the groundwater. The Huangpu River is the most important water source for the city, but can no longer fill the water needs of Shanghai in quantity or in quality. The fast development of the Pudong area further aggravates the water shortage problem. To ensure the water quality, it is necessary to strengthen the protection of the river water upstream. Water quality deterioration around Shanghai has been linked to untreated domestic wastewater, frequent flooding, and street runoff all contribute. All these factors also severely affects Shanghai's drinking water sources (Yin et al., 2005). In order to obtain less polluted water, the major domestic water supply intake had to be relocated to further upstream of the Huangpu River (Yusuf and Wu, 2002). Another example of severe water quality problems faced by Shanghai is the Suzhou Creek, a tributary of the Huangpu River. It receives high emissions of untreated domestic and industrial wastewater. This Creek is approximately 125 km long and a part of it flows in the urbanized part of Shanghai before it joins the Huangpu River. The water is known for its black colour and bad odour. It has been subject to environmental rehabilitation (Yin et al., 2005). In 2005, Shanghai Pudong Veolia Water began its own program to monitor water quality. In 2011, an independent laboratory was created. It has the technology required to analyze 106 standard national parameters: 126,000 test results were provided for 3,850 samples that year.The laboratory has a remote transmission system to send data every two hours to the central system through a GSM module. The real-time monitoring device analyses four water quality throughout the network: temperature, chlorine, pressure and conductivity. The laboratory provides real-time water traceability from the point of production to the point of supply (Coignard, 2013). The Linjiang Water Treatment Plant and the Jinhai Water Treatment Plant use state-of-the-art technology that has allowed high quality and reliable water services to be provided during the 2010 World Expo and its 70 million visitors from all over the world (see Figure 14). This extension plan was implemented in 2 phases in 2004 and 2007. The installation of compact, advanced technologies has significantly increased space-efficiency, water quality, and treatment capacity at the Linjiang Water Treatment Plant.



Source: SPVWC (2012)

<Figure 14> Linjiang Water Treatment Plant

Linjiang is the first water treatment plant in China to use Actiflo. Compared to the conventional process, the advanced, compact Actiflo requires only one-third of the space to supply an additional of 200,000m^3 of water per day. This facility is capable of removing substances including manganese, which has significantly improved the taste and odour of tap water in Pudong (SPWC, 2012). Actiflo removes natural organic matter, endocrine disruptors, and pesticides. "In drinking water applications, its removal efficiency exceeds 90% for turbidity, colour, algae or arsenic. In wastewater applications, it produces high quality water, even in varying raw water conditions, with removal efficiency: >higher than 90% for total suspended solids, colloidal matter, total phosphorus, heavy metals and faecal coliforms, > of 60% for biochemical oxygen demand and chemical oxygen demand" (Veolia, 2014).

5. Overall Performance

All in all, it appears that the joint venture project has been successful. This PPP has allowed an increase in access to water services of better quality to a region that has been struggling with its water resources for a long time. The main objectives established in the association contract have been achieved in less than 10 years. There has been technological transfer, the water network has been increased as well as the number of people served. The water quality has been improved and the production costs have been reduced.

V. Lessons Learned and Conclusion

The Shanghai Pudong joint venture project is a good case to be analyzed using the Water and Green Growth (WGG) framework. WGG is defined as the growth concept that emphasizes the role of water in terms of achieving economic wellbeing and social equity coupled with protection and revitalization of ecosystems. Due to the anthropogenic activities in the area, Shanghai is considered a pollution-induced water short city although geographically it is located in a water rich region. Therefore, the key challenge for Shanghai Pudong authorities was to cater for an extremely rapid economic development ensuring that water services would support the pace of growth. There was a need to match the needs of a population growing from 2.65 million in 2002 to 3.6 million in 2011, and at the same time increase the level of service to ensure state of the art water, sanitation & health conditions. Also, to ensure water services support the booming economy in the Pudong area, and to increase the service area from 320 km^2 in 2002 to 536 km^2 in 2011, which was planned. There is a consensus in the literature that the Chinese government did not have the capital, technology, and management skills to cope with this pressing demand for water services. Therefore, the Chinese government has played a central role as both originator and decider of key policies in relation to public private partnerships (PPP) in the water sector and particularly in the Shanghai Pudong joint venture. In a PPP there is by definition a high level of stakeholder's participation, and is based on a framework of joint decision making rather than a principle-agent relationship (Teisman and Klijn, 2002). The Shanghai Pudong joint venture was established with the two partners (Shanghai Chengtou Group and Veolia Water) in equal proportion (50% shares for each). The partners brought a depth local and international expertise to develop Pudong's water service. The company operates under a "system of collective leadership and joint decision-making" with 50%-50% representation in Executive Management Committee and Board of Directors. A well-balanced management team was established with rotation of main positions (General Manager and Chairman) every four years and distribution of key management positions between both shareholders. The same conditions to other water companies in Shanghai are applied to the Joint Venture: water quality, service levels, water tariff, laws and regulations and no special subsidy was accorded. The Shanghai government transferred the entire Pudong water supply operation to the joint venture company without any margin profit guarantees. The profit margin depends entirely on the efficient operation of the Joint Venture company and the development of the Pudong area. The government sets water pricing; however, reasonable costs and profits are the government's long-term principles when establishing water prices. In this context, the results of the partnership have been very successful. The objectives of the joint venture were achieved in less than ten years, and there has been an increase of water access and an improvement of water quality that has matched the exponential population's demand for water services.

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Interview 1

Respondent 1 was required to provide his expert opinion about the "Shanghai Pudong Public-Private Partnership" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for water suppliers than for officials and users. He did not answer questions about the way that legal provisions of accountability administratively are translated and how effective they are in practice. He considers that water data is adequately collected, managed and publicized. He did not convey his opinion on how much the data is open to the public. However, he mentioned that data is available through websites, printed materials, company reports, government order and upon request. He stated that this data is an adequate for the planning, implementation, evaluation, coordination and conflict resolution and research of the project. Finally, he considers that the project does not represent an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA) but he did nit explained that the impacts of the financial support. He mentioned that for the company invested by both Chinese and foreign capital, the business tax would be 0% for the first 2 years and 50% for the 3-5 years. Finally, he stated that there are specific regulations directly affecting the project but he did not describe them. In the case of market policies, he did not answer questions about cost recovery. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that financial, equity and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the central and regional government along with firms participated in important decision-making, the local government, NGOs and residents were consulted. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that the local administration/government, and National Water Council and Tribunals could intervene in conflict resolution. He identified Tribunals and negotiation of Chinese and France government for foreign affairs for transboundary conflicts. When questioned about the overall performance of the project he identified as important factors that contributed to the successes of the project the investment, technology, and human resource of Veolia; Shanghai Pudong government's efforts; Cooperation between Veolia and local investor. Overall, he considers that the intended objectives of the project have been achieved 90%.

In terms of economic performance, he considers that there was a very positive impact on the gross regional domestic product, on job creation in the local economy and on technological performance; the most positive impact was on local development. In terms of social performance, he reckons that the project had a very positive impact on improving citizen participation in decision-making and the most positive impact on quality of life, on people's health and on gender equality. In terms of environmental performance, he considers that there was a positive impact on disaster safety a very positive impact on restoring biodiversity and the most positive impact on increasing environmental awareness and on water quality improvements.

Interview 2

Respondent 2 was required to provide his expert opinion about the "Shanghai Pudong Public-Private Partnership" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In his opinion, those legal provisions are more effective for water suppliers than for officials and users. He did not answer questions about the way that legal provisions of accountability administratively are translated and how effective they are in practice. He considers that water data is adequately collected managed and publicized and is open to the public. He mentioned that data is available through websites, printed materials, company reports, government order, and upon request. He stated that this data is adequate for the planning, implementation, evaluation, coordination and conflict resolution, and research of the project. Finally, he considers that the project does not represent an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management. However, he considers that the project is not aligned with the plans. He mentioned that the project did not receive financial support such as subsidies or Official Development Assistance (ODA). He did not identify taxes, levies, or tax deductions. Finally, he stated that there are specific regulations directly affecting the project like standards for water quality, water pressure and service. In the case of market policies, he mentions that there is partial cost recovery for household, industrial and commercial use. In relation to private sector promotion policies, he considers that users are favorable in particular sector. Finally, he mentioned that financial factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he only identified regional government, residents and firms. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that the local administration/government, and Tribunals could intervene in conflict resolution. He did not answer the question on mechanisms for transboundary conflicts. He did not answer questions about the overall performance of the project.

In terms of economic and social performance, he considers that project did not have any impact In terms of environmental performance; he considers that there was a positive impact on restoring biodiversity, on water quality improvements, and on increasing environmental awareness but no impact on disaster safety.

Interview 3

Respondent 3 was required to provide his expert opinion about the "Shanghai Pudong Public-Private Partnership" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are equally effective for water suppliers, officials, and users. He did not answer questions about the way that legal provisions of accountability administratively are translated and how effective they are in practice. He considers that water data is adequately collected, managed, and publicized. He reckons the data is somehow open to the public. He mentioned that data is available through websites, printed materials, company reports, and government order and upon request. He stated that this data is a little adequate for the planning, implementation, evaluation, coordination and conflict resolution and research of the project. Finally, he considers that the project does not represent an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that the case in question is subject to taxes, levies, or tax deductions but he did not elaborate more. Finally, he stated that there are specific regulations directly affecting the project, the government wants to introduce the new mode to have the international company to manage the water supply. In the case of market policies, he mentions that there is partial cost recovery for household, industrial and commercial use. In relation to private sector promotion policies, he considers that users are favorable in particular sector. Finally, he mentioned that financial, ecological and other factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the firms participated in important decision-making, while local government and residents were consulted. On the other hand, he mentioned that there are not clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that the local administration/government could intervene in conflict resolution. He identified Tribunals for transboundary conflicts. When questioned about the overall performance of the project he identified as important factors that contributed to the successes of the project the advance management of Veolia: e.g. the GIS to manage the ground and underground water resources. Overall, he considers that the intended objectives of the project have been achieved 80%.

In terms of economic performance, he considers that there was a no impact on the gross regional domestic product, a marginal positive impact on job creation in the local economy and very positive impact on technological performance and on local development. In terms of social performance, he reckons that the project had a positive impact on quality of life and on people's health, a marginal positive impact on improving citizen participation in decision-making and a very positive impact on gender equality. In terms of environmental performance, he considers that there was a very positive impact water quality improvements and on increasing environmental awareness and a marginal negative impact on disaster safety and on restoring biodiversity.

Interview 4

Respondent 4 was required to provide his opinion about the "Shanghai Pudong Public-Private Partnership" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for water officials than for water suppliers. In terms of legal provisions of accountability administratively are translated and how effective they are in practice; he mentioned grievance cells and local administration. He considers that water data is adequately collected, managed and publicized. He reckons the data is little open to the public. He mentioned that data is available through websites. He stated that this data is adequate for the planning of the project. Finally, he considers that the project does not represent an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that the case in question is subject to tax deductions: VAT (6%, the original is 17%). Finally, he stated that there are specific regulations directly affecting the project: water quality standards. In the case of market policies, he mentions that there is full cost recovery for household, use. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that other factors (management efficiency) were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the regional and local governments participated in important decision-making, and residents were consulted. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that tribunals, Judicial/legislative/constitutional could intervene in conflict resolution. He identified Tribunals for transboundary conflicts. When questioned about the overall performance of the project he identified important factors that contributed to the successes of the project the government plan and company's implementation. Overall, he considers that the intended objectives of the project have been achieved 50%.

In terms of economic performance, he considers that there was a positive impact on the gross regional domestic product and a marginal positive impact on job creation in the local economy, on technological performance and on local development. In terms of social performance, he reckons that the project had a positive impact on quality of life and on people's health, a marginal positive impact on improving citizen participation in decision-making and on gender equality. In terms of environmental performance, he considers that there was a marginal positive impact on water quality improvements and on increasing environmental awareness and no impact on disaster safety and on restoring biodiversity.

Interview 5

Respondent 5 was required to provide her expert opinion about the "Shanghai Pudong Public-Private Partnership" project. In terms of community institutional factors, she stated that there are explicit legal provisions for ensuring the accountability of officials and water suppliers. In her opinion, those legal provisions are more effective for water officials than for water suppliers. She did not answer questions about legal provisions of accountability administratively are translated and how effective they are in practice. She considers that water data is adequately collected, managed and publicized. She reckons the data is somehow open to the public. She mentioned that data is available through websites and printed materials. She stated that this data is adequate for the planning of the project. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies she declared that there are well-organized plans related to water management. She mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). She does not know about taxes and levies on the project. Finally, she stated that there are specific regulations directly affecting the project like water quality standards. In the case of market policies, she mentions that there is partial cost recovery for household use. In relation to private sector promotion policies, she considers that users are favorable in particular sector. Finally, she stated that financial factors were the criteria used in the project selection. In the case of community policies, she did not answer the question of stakeholder participation. On the other hand, she mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law like local administration/govt and river boards. She identified Tribunals and River boards for transboundary conflicts. When questioned about the overall performance of the project she identified an important factor that contributed to the successes of the project the government guidance. Overall, she considers that the intended objectives of the project have been achieved 50%.

In terms of economic performance, she considers that there was a positive impact on technological performance and on job creation in the local economy; a positive impact on the gross regional domestic product and no impact on local development. In terms of social performance, she reckons that the project had a very positive impact on quality of life, on people's health and on citizen participation in decision-making; and no impact on improving and on gender equality. In terms of environmental performance, she considers that there was a very positive impact on water quality improvements and no impact on increasing environmental awareness, on disaster safety and on restoring biodiversity.

Ecuador

Water Fund Mechanisms for Watershed Protection

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

ALBA AlianzaBolivarianapara los Pueblos de NuestraAmérica (Bolivarian Alliance for the Peoples of Our America)

AP Alianza País (AP)

BACI Before-after, control-impact approach

CAMAREN Consortium for Training in Renewable Natural Resource Management (Consorcio de Capacitación para el Manejo de Recursos Naturales Renovables)

CI Conservation International (Ecuador)

CONAIE Confederation of Indigenous Nationalities of Ecuador

COOTAD Código Orgánico de Organización Territorial (OrganicCodefor Territorial Organization)

CNPC China National Petroleum Corporation

CREO Movement for the Creation of Opportunity party (Movimiento Creando Oportunidades)

ECLAC Economic Commission for Latin America and the Caribbean

EEQ Empresa Eléctrica Quito (The Quito Electric Company)

ELECAUSTRO the Austro Electric Company

EMAAP-Q Quito Metropolitan Area Potable Water and Sewage Company (Empresa Metropolitana de Agua Potable y Alcantarillado de Quito) – changed name to EMAPS (see below) in 2008

EMAPA Ambato Potable Water and Sewage Company [Empresa Municipal de Agua Potable y Alcantarillado de Ambato]

EMAPAL Watershed Management Company of Azogues (Empresa Municipal del Agua Potable y Alcantarillado de Azogues)

ENEMDU National Survey on Employment, Unemployment and Underemployment

EPMAPS Quito MetropolitanArea Potable Water and SanitationCompany (Empresa Pública Metropolitana de Agua Potable y Saneamiento) – changed from EMAAP-Q in 2008

ETAPA Municipal Telecommunications, Drinking Water, Sewage and Environmental Sanitation Company of Cuenca (Empresa de Telecomunicaciones, Agua Potable, Alcantarrillado y Saneamiento de Cuenca)

EXA Ecuadorian Civilian Space Agency

FAN National Environmental Fund

FAO Food and Agriculture Organization of the United Nations

FEMSA Fomento Económico Mexicano, S.A.B. de C.V

FMPLPT Tungurahua Water Fund for High-grassland Management and Poverty Reduction

FONAG Fondo para la Proteccióndel Agua (Water Protection Fund) in Quito

FONAPA Fondopara la Conservación de la Cuenca de Paute [Water Fund for the Conservation of Paute Watershed]

FONES Fund for the Protection of Water in Espíndola, Loja (Fondo para la protección del Agua en Espíndola)

FOPAR Riobamba Water Fund for the Protection of the Chambo Sub-Basin

FORAGUA Fondo Regional del Agua (Regional Water Fund)

FTA Free Trade Agreement

FTAA Free Trade Area of the Americas

FUNAM Environment Defence Foundation (based in Argentina)

GAD Decentralized Autonomous Government (Gobiernos Autónomos Descentralizados)

GEF Global Environment Facility

IACHR Inter-American Commission on Human Rights

INAR National Irrigation Institute, Ministry of Agriculture (Instituto Nacional de Riego)

IEOS Ecuadorian Institute for Public Works and Sanitation (Instituto Ecuatoriano de Obras Sanitarias)

INEC Instituto Nacional de Estadística y Censos (National Statistics and Census Institute)

INERHI Ecuadorian Institute for Hydraulic Resources (Instituto Ecuatoriano de Recursos Hidráulicos)

INHAMI National Institute of Meteorology and Hydrology (Instituto Nacional de Meteorología e Hidrología)

MAE Ministry of the Environment (Ministerio del Ambiente)

MIDUVI Ministry for Urban Development and Housing (Ministerio de Desarrollo Urbano y Vivienda)

MSP Ministry of Public Health (Ministerio de Salud Pública)

NCI Nature And Culture International

OAS Organization of American States

PAHO Pan-American Health Organization

RIOS Resource Investment Optimization System

SENACYT Secretaria Nacional de Ciencia y Tecnologia (National Science and Technology Department)

SENAGUA Secretaría Nacional del Agua(National Water Secretariat)

UNASUR Union of South American Nations

UNDRIP United Nations Declaration on the Rights of Indigenous Peoples

USAID United States Agency for International Development

Executive Summary

Ecuador is located in the northwest part of South America fronting on the Pacific. To the north is Colombia and to the east and south is Peru. Ecuador's population was 15.22 million in 2012, with a population density of about 50 per km^2. Quito is the capital and Guayaquil is the largest city, with a population of 2.6 million. Almost 30% of the population is concentrated in the two biggest cities, Guayaquil and Quito, with an approximated growth of 1.3% per year.[1)]

Since the election of Rafael Correa to power in 2007, Ecuador has experienced significant political, economic and social changes. His rise to power coincided with the end of a decade of political and economic instability which saw a total of seven presidents; large migrations of peasant farmers to Europe and the United States; as well as the collapse of the national monetary system. Ecuador embarked on a process of democratic consolidation combined with social and economic change. Correa was able to promote his reform program through a referendum to rewrite the Constitution in 2008; the "Citizens´ Revolution" would modify the institutional framework of the country. Among the many innovations within the new Constitution, environmental governance became an issue tied to human development and civil rights. The Constitution includes the rights of nature and recognizes the territorial rights of indigenous communities. It also introduced a "fifth power" - the Council for Citizen Participation and Social Control. The country also adopted an indigenous paradigm known as "Sumak Kausay" (in English "*Good Living*"). This concept defines a new relationship for society with nature, with the country´s unique natural endowment defining environmental sustainability as fundamental to the well-being of the population. By the same token, the National Development Plan for Good Living promotes territorial approaches, incorporating provincial plans in the country´s overall development strategy.

In the seven years since Correa's election, Ecuador has seen strong economic growth and the adoption of populist economic policies that included social spending in public health and education. The government has been able to finance its social programs and to improve social indicators at a much faster rate than neighbouring Latin American countriesby increasing oil revenues through nationalization of production.

After the global economic crisis of 2009, the Ecuadorian economy began to recover and grew by 3.5% in 2010, reaching 7.8% in 2011. In 2012, the economy remained robust, with a GDP of US $84.04 billion and a growth rate of 5.1%.[2)]

The 24 provinces of Ecuador are divided into four distinctive regions.[3)] The coastal region consists of the provinces to the West of the Andean range, where the most fertile and productive land is located. Guayaquil is located on the coast and is the nation's main port. The highlands region, also known as La Sierra, lies between the western coastal lowlands and the eastern jungles. The largest Sierran city is Quito, capital of the country. The highlands are also culturally significant due to the many native Indian craft markets and the modern and thriving colonial cities.[4)]

1) INEC, Census 2010.
2) http://www.worldbank.org/en/country/ecuador
3) http://en.wikipedia.org/wiki/Regions_of_Ecuador

The oriente (east) consists of the Amazon jungle provinces and is primarily made up of the huge Amazon national parks and indigenous zones, which are large land areas set aside for the Amazon indigenous tribes to continue living traditionally. The insular region of Ecuador consists of the Galápagos Islands, about 966 km west of the South American mainland in the Pacific Ocean.

This case study examines the case of water fund mechanisms in Ecuador. The country has already developed five water funds for different municipal areas and is launching a sixth very soon. In Latin America there are now 17 funds that are established and operating. The first of these funds in Latin America was el Fondopara la Proteccióndel Agua or FONAG (the Water Protection Fund) in Quito. The concept of placing stakeholders, including public and private institutions, at the same table to map out strategies to conserve water was a foreign concept and, moreover, a new way to understand water management. For the first time, policy makers and farmers were speaking the same language regarding water quality and watershed protection. Since 2006, the Water Protection Fund has received 2% of the revenues from the municipal water company for the protection of water in the half dozen watersheds that supply Quito´s residents. Through long-term programs and initiatives, FONAG has been able to support communities in rural areas near watersheds and generate awareness about the benefits of water management. It has valuable experience in using these funds and can provide lessons for other countries wishing to establish such a mechanism. The case study reviews the different financial instruments for managing watershed and ecosystem services in the river basin context in Ecuador.

The case study on Ecuador Water Funds presents the innovative funding mechanisms developed to protect water supply in a small country with rich biodiversity and water resources. The country can provide a valuable laboratory for scientists throughout the world to study mountain, river and marine ecosystems and ways they can be protected. Even though Ecuador is endowed with abundant water resources, it is very unevenly distributed. In the coastal and highland regions, where 80% of the people live, they have the lowest availability of water (particularly along the Pacific coast). On the other hand, the Amazon region has only 20% of the population of Ecuador and much more available water.

The Water Funds are endowment trusts set up to compensate for environmental services, such as supplying clean freshwater and providing biodiversity-related benefits. The proceeds from the trust fund are invested in conservation projects that protect the healthy habitat from which environmental services derive. Each Water Fund has its own set of objectives and goals, but, in general, they invest in conservation of watersheds in order to meet water users' needs and biodiversity targets. The goals are in line with green growth goals of protecting the environment, reducing costs of water treatment and encouraging economic development.

Each project engages as many stakeholders as possible in the watershed, particularly the end users, such as public water utilities, major public hydroelectric facilities, irrigation systems and agricultural associations, and private companies such as beer companies and bottled water companies. The major funds and the constituents contributing to them in Ecuador are described in the case study.

4) http://yourescapetoecuador.com/destinations/andean-highlands-region/

The following are some lessons learned throughout the years:

- Water funds are a successful model for long-term financing for watershed conservation and an effective way to implement integrated watershed management.
- By using the water fund mechanism, stakeholders can: unite in a common vision; coordinate and enhance individual efforts; take advantage of the skills and capabilities of all players; ensure continuity and transparency in conservation activities; and expand public/private participation in conservation.
- Water funds can play an important role in development where local communities can benefit from investment in sustainable livelihoods.

Some of the valuable conclusions and lessons learned for future use of water funds are summarized below.

Baseline and socio-economic data are essential.

The areas where FONAG works are generally impoverished rural areas where basic needs are not fully satisfied, which makes them ideal for intervention from other NGOs and development agencies. Due to a lack of inter-institutional coordination, some of the initiatives tend to overlap. Baseline ecological and socio-economic data are critical to allow accurate measurements for a before-after, control-impact (BACI) approach.

Political leadership and support is essential.

A critical condition for implementing a mechanism such as the water funds is local political support. It cannot be overstated how much the support of leading decision-makers is essential for the implementation of new and innovative mechanisms for conservation.

The Technical Secretary or Manager must be an effective politician as much as a recognized professional in the environmental field.

An appropriate legal framework is needed to guarantee continuity.

There needs to be an appropriate legal framework to guarantee the mechanism's continuity, such as a municipal ordinance or other bodies that create the regulatory and legal framework. When FONAG was established there was no law under which such a mechanism could be established. The laws have progressively changed but until the Water Law is adopted, the fund mechanism has no basis within national public policy.

Decision-making regulations and procedures need to be established early.

In the case of FONAG, two water major stakeholders control its revenue, giving them a dominant role in FONAG's governance and decision-making processes. In turn, the arrangement has also affected investment decisions. It is important that a broad set of beneficiaries participate in governance of water funds so that they operate to the advantage of a wider cross-section of watershed inhabitants. The water fund needs to establish decision-making regulations and procedures early on to avoid excessive concentration of power and get the buy-in of more stakeholders.

Water funds mechanisms can improve scientific understanding.

FONAG's success in delivering watershed benefits is dependent on its understanding of local hydrological relationships and their importance to the urban areas they supply. Scientific information and research is essential to set investment priorities, promote initiatives and develop sustainable strategic planning. It is also important that a water fund strengthens its scientific understanding of local hydrology and monitors the impacts of its efforts to improve water flows. A water fund must also establish a clear system of measuring the impact of its activities on flow, sedimentation, biodiversity conservation, water quality and quantity. Investing in monitoring before a fund starts field activities enables the fund to tailor its activities to maximize water quality and quantity benefits and provides empirical evidence of the benefits that may help with continued political support for the fund.

Size and scope need to be appropriate for institutional capabilities.

Efforts to implement a water fund at the national level may be highly bureaucratic and far removed from local realities. A critical prerequisite for water funds has been the ability to maintain a reasonable size and scope in accordance to their institutional capabilities. The funds need to maintain flexibility in order to adjust to requirements of the individual case and learn from mistakes over the years. In the process of developing a fund, it is important to consult with and listen to the stakeholders in the watershed to determine what they will be able to contribute.

I. Introduction

1. Purpose of the Case Study

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of United Nations Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then the United Nations and the international community have considered water as essential to the attainment of sustainable development. Moreover, the concept of sustainable development was the cornerstone of UNCED. The Brundtland Commission defined that concept in 1987 and, ever since, it has been accepted that development must include not only economic growth, but also environmental and social dimensions.[5)]

In addition, international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991 and the triennial World Water Forums, convened by the World Water Council every three years since 1997. The Sixth World Water Forum was held in Marseille, France in 2012, where the Water and Green Growth project was introduced to a broad audience. The Water and Green Growth (WGG) project has been a joint undertaking of the World Water Council (WWC) and the Government of the Republic of Korea since November 2010.[6)] The project collected case studies demonstrating water and green growth and developed a policy framework. The first edition of the Water and Green Growth report was launched at the sixth World Water Forum in March 2012.[7)]

One of the case studies included in the first edition was on "Public-private fund mechanisms for watershed protection: Ecuador and Colombia", as these water funds were considered a good example of Water and Green Growth. The water trust fund concept in Latin America and the Caribbean was developed by The Nature Conservancy and its partners to protect biodiversity and conserve water sources for human consumption. The funds have been established in several Latin America and the Caribbean countries, including Ecuador, Colombia, and others.

The Water Funds are an endowment trust set up to compensate for environmental services, such as supplying clean freshwater and providing biodiversity-related benefits. The money is not paid directly to individuals in the watersheds who provide environmental services. Rather it is collectively reinvested in conservation projects that protect the healthy habitat from which these services derive. The Water Funds are based on Payment for Environmental Services (PES) principles, and are a means of mobilizing long-term trust funds. A public–private partnership of water users determines how to invest in conservation activities in priority areas. Each Water Fund has its own set of objectives and goals, but, in general, they invest in conservation of watersheds in order to meet water users' needs and biodiversity targets. The objectives are in line with green growth goals of protecting the environment, reducing costs of water

5) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced *Our Common Future* (1987, Oxford University Press), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

6) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

7) *Government of the Republic of Korea and World Water Council. 2012, March. Water and Green Growth Edition 1*. Marseille. Full text available at: www.waterandgreengrowth.org.

treatment, and encouraging economic development. This case study describes the evolution of the water fund mechanism in Ecuador. At present there are five water funds operating in the country with another one currently being established. This case study focuses on the Water Protection Fund (FONAG, el Fondopara la Protección del Agua) in Quito. It is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu, Republic of Korea in 2015. The World Water Council and the Government of the Republic of Korea, the organizers of the Forum, supported preparation of the case study.

2. Case Study Context

The Ecuador case study examines the water fund mechanisms for watershed protection, concentrating on the earliest one, FONAG (Water Protection Fund) in Quito. The others include: Pro-cuencas in Zamora, which is now part of FORAGUA (the Regional Water Fund); Espindola in Amaluza, which is applying to be part of FORAGUA; FONAPA (Fondopara la Conservación de la Cuenca de Paute) in Paute; FOPAR in Riobamba; and Tugurahua in Ambato. Another fund now in the initial stages of development is called Ayampe in Puerto Lopez. In the case of Quito's FONAG, about 80% of the water for Quito comes from three protected areas and their buffer zones. FONAG was created with the help of The Nature Conservancy in 2000 for a period of 80 years. It receives money from local government through the Quito Metropolitan Area Potable Water and Sanitation Company (EPMAPS),[8] electric companies, private companies, and NGOs. An independent financial manager invests the money, and the interest is used to fund activities for watershed protection. Local communities that live close to the water sources receive support from FONAG for environmental education and community-centered projects that invest in rural livelihoods.

Initial funding for the Quito Water Fund included grants from the water company, the Nature Conservancy, and the United States Agency for International Development (USAID). The Fund amounted to US $5.4 million at the end of December 2008 and is now almost US $11.4 million at the end of December 2013.[9] In 2008 alone, the endowment yielded US $800,000, which FONAG invested in conservation projects. In 2006 FONAG, with support from its board members, helped pass a municipal by-law that enabled the Quito water company to provide 2% of its revenue to the water fund (up from the initial 1% commitment). The water supply customers pay directly into the water fund, and the citizens of Quito provide their contributions through their water bills as determined in the municipal by-law. This and the other water funds in Ecuador will be described in the case study.

3. Case Study Methodology

This case study examines the case of water fund mechanisms in Ecuador. The country has already developed five water funds for different municipal areas and is launching a sixth very soon. In Latin America there are now 17 funds that are established and operating. The first of these funds in Latin America was FONAG in Ecuador; it has valuable experience in using these funds and can provide lessons for other countries wishing to establish such a mechanism.[10]

8) The leading contributor to the fund is the public water and sanitation authority EPMAPS (EmpresaPúblicaMetropolitana de Agua Potable y Saneamiento) of Quito. This company was until 2008 called EMAAP-Q (Empresa Metropolitana de Agua Potable y Alcantarillado de Quito)

9) Fonag.org.ec – Accountability report

10) Alianza Latinoamericana De Fondos De Agua, April, 2004. "Resultados e impactos" (in Spanish) http://www.fondosdeagua.org/resultados-e-impactos

The case study reviews the different financial instruments for managing watershed and ecosystem services in the river basin context in Ecuador. The present research explores the exogenous economic, social, political, environmental, and technical factors that have influenced the development of these fund mechanisms. It then examines the water institutions at the national, basin, and community levels that have had a major impact on watershed protection and environmental conservation, as well as on economic growth and social development. Water management is considered of crucial importance to economic growth, social development and environmental sustainability in Ecuador. The case study was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[11)] These case studies indicate how the institutional framework in the water and related sectors contribute to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in The *Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[12)] The questionnaires presented to representatives of the main water-related institutions and other stakeholders in Ecuador were developed to reflect that framework. Saleth and Dinar define a water institution to be an entity defined interactively by three main components: water law, water policy and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which Ecuador has implemented its integrated water resources management policy and practices that support green growth. The policies and institutions that have been responsible for the improvements in water management and availability, and thus economic growth and social development along the rivers and in urban areas are still evolving and are adapting to changing circumstances and lessons learned. The broad participation of stakeholders in consultations related to river basin planning has had a strong influence on this evolution. The case study describes the water management institutions and policies at national, basin, municipal and community levels, particularly in relation to the water fund mechanism. Their performance is analyzed and lessons and conclusions are drawn.

First, the external environment during the evolution of the water management system in Ecuador is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Then water resources governance, policy, law and institutions in Ecuador are reviewed, including local water governance structures. Information and statistics from international, national and basin sources, and from independent academic studies, provide an overview of the situation in the country and in selected river basins.

Finally, the case study analyses the impact and performance of the various elements of water management policies and practices related to water funds in Ecuador. Survey results and expert interviews are used to examine the current situation and performance of specific aspects of water funds in Ecuador.

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11) *K-water Institute (Research Center for Water Policy and Economy). 2013, September. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report*. Daejeon, Republic of Korea.

12) *Saleth, R. and Dinar. A. 2004. The Institutional Economics of Water: A Cross Country Analysis of Institutions and Performance*. Washington D.C.: The World Bank.

II. An Overview: Water Funds in Ecuador: A Brief Overview

1. About Ecuador

Ecuador is located in the northwest part of South America fronting on the Pacific. To the north is Colombia and to the east and south is Peru (see Figure 1). Ecuador's population was 15.22 million in 2012, with a population density of about 50 per km^2. Quito is the capital and Guayaquil is the largest city, with a population of 2.6 million. Almost 30% of the population is concentrated in the two biggest cities, Guayaquil and Quito, with an approximated growth of 1.3% per year.[13)]

Source: http://www.lib.utexas.edu/maps/americas/txu-pclmaps-oclc-754887586-ecuador_admin-2011.jpg

<Figure 1> Map of Ecuador Showing 24 Provinces

After the global economic crisis of 2009, the Ecuadorian economy began to recover and grew by 3.5% in 2010, reaching 7.8% in 2011. In 2012, the economy remained robust, with a GDP of US $84.04 billion and a growth rate of 5.1%.[14)]

The 24 provinces of Ecuador are divided into four distinctive regions.[15)] The coastal region consists of the provinces to the West of the Andean range, where the most fertile and productive land is located. Guayaquil is located on the coast and is the nation's main port. The highlands region, also known as La Sierra, lies between the western coastal lowlands and the eastern jungles. Two high and parallel ranges of the Andes traverse the country from north to south, and are topped by tall volcanic peaks. The largest Sierran city is Quito, capital of the country. The highlands are also culturally significant due to the many native Indian craft markets and the modern and thriving colonial cities.[16)]

The oriente (east) consists of the Amazon jungle provinces and is primarily made up of the huge Amazon national parks and indigenous zones, which are large land areas set aside for the Amazon indigenous tribes to continue living traditionally. The insular region of Ecuador consists of the Galápagos Islands (or Colón Archipelago, 7,845 km^2), about 966 km west of the South American mainland in the Pacific Ocean.

Throughout the 17th century Ecuador was a Spanish colony, and the first revolt against Spain occurred in 1809. In 1819, Ecuador joined Venezuela, Colombia, and Panama in a confederacy known as Greater Colombia. When Greater Colombia collapsed in 1830, Ecuador became independent.

13) INEC, Census 2010.

14) http://www.worldbank.org/en/country/ecuador

15) http://en.wikipedia.org/wiki/Regions_of_Ecuador

16) http://yourescapetoecuador.com/destinations/andean-highlands-region/

Although it was under military rule in the 1970s, the country did not experience the violence and repression characteristic of other Latin American military regimes. It has been a democratic republic for the last 30 years.

In 1998, Ecuador experienced one of its worst economic crises. El Niño caused $3 billion in damage; the price of its principal export, oil, plunged; and its inflation rate—43%—was the highest in Latin America. In 1999, the government was near bankruptcy, the currency lost 40% of its value against the dollar, and the poverty rate soared to 70%, doubling in five years. The president's economic austerity plan was protested with massive strikes in March 1999.[17] By the year 2000, Ecuador had suffered incessant political and economic crises which caused a 7% dip in GDP.

President Jamil Mahuad was overthrown in a military coup in January 2000, and the Vice President Gustavo Noboa, was given power. Faced with the worst economic crisis in Ecuador's history, Noboa restructured Ecuador's foreign debt, adopted the U.S. dollar as the national currency, and continued privatization of state-owned industries, generating enormous opposition. In February 2001, the government cut fuel prices after violent protests by indigenous people , who are among Ecuador's most disadvantaged people. Within two years, Ecuador's economy had rebounded from the brink of collapse. The economy grew by 5.4% for 2001, the highest rate in Latin America. Inflation was 22%, down from 91% in 2000, and the budget was balanced. But chronic corruption among senior government officials, as well as among the courts and the judiciary, has continued.

Colonel Lucio Gutiérrez was elected to the presidency in 2003 on an anticorruption platform. He became Ecuador's sixth president in seven years. His attempts to introduce austere fiscal reforms, however, quickly alienated his political base, and numerous national strikes took place throughout 2003. In April 2005, the Ecuadorian Congress ousted Gutiérrez. His deputy, Alfredo Palacio, took over as president. In 2006, huge nationwide protests took place concerning a potential free-trade agreement with the U.S. In the 2006 presidential runoff elections, Rafael Correa, a left-wing economist, won with 57% of the vote, defeating the conservative businessman Alvaro Noboa. Correa took office in January 2007.

Ecuador has experienced a structural transformation since 2007, in which the country has enjoyed democratic stability for the longest period in recent memory. Early in the process Ecuador regained its ability to standardize national planning and adopted policies designed to strengthen the State´s capacity for collecting internal revenue. These policies included nationalizing oil, strengthening public investment, and improving the efficiency of the internal revenue service.

President Correa´s landmark achievement was the passage of the 2008 Constitution. It was innovative in that it incorporated concepts that guaranteed rights (nature´s rights, collective and civil rights, economic, and cultural), in addition to promoting a social development model that advocated equity, social justice and multi-culturalism.

On May 24, 2013, President Rafael Correa began his third term. Correa's third term started with his popularity extremely high and with more than a two-thirds majority in Congress. Correa also had a stable economy to work with as well as a weak and divided opposition. According to Ecuador's current constitution, he would not be able to run for another term.[18]

17) http://www.infoplease.com/country/ecuador.html#ixzz300Si3gMf

18) http://www.infoplease.com/country/ecuador.html#ixzz300S8RGoJ

2. Timeline for Water Law and Water funds in Ecuador

The Ecuador study presents an overview of national water resources law and administration and focuses mainly on the innovative financial mechanisms the country has introduced as a means for protecting its watersheds and its water sources.

In accordance with Green Growth objectives, legislation and institutions that relate to water resources in Ecuadoraim to maximize environmental protection, economic growth, and social development. One of the instruments to achieve these goals is the Water Fund, which promotes economic and social development in remote rural areas. Water governance and institutions will be covered in detail in Chapter II. Box 1 outlines some of the major milestones in water law and water fund mechanisms in Ecuador.

<Box 1> Timeline for Water Law and Water Funds in Ecuador

Water Laws and Institutions

1960: Water Law of 1960 (Ley de Aguas 1972)

1966: Law creating the Ecuadorian Institute for Hydraulic Resources [(Creación del Instituto Ecuatoriano de Recursos Hidraulicos (INERHI)]. The institute lasted until 1996

1970: Creation of Ecuadorian Institute for Public Works and Sanitation [Instituto Ecuatoriano de Obras Sanitarias (IEOS)]. The institute lasted until 1992.

1970: Establishment of Instituto Nacional de Meteorología e Hidrología (INHAMI) [National Institute of Meteorology and Hydrology]

1972: Water Law of 1972 (Ley de Aguas 1972)

1992: Establishment of Undersecretary of Environmental Sanitation of the Ministry of Urban Development and Housing (Subsecretaria de SaneamientoAmbiental del MIDUVI)

1994: National Council for Water Resources [Consejo Nacional de Recursos Hídricos (CNRH)] established

1998: New Constitution of the Republic of Ecuador (1998) adopted

2008: New Constitution of the Republic of Ecuador (2008) adopted

2009: Codigo Organico de Organizacion Territorial, Autonomía y Descentralizacion – COOTAD (The Organic Code for Territorial Organization, Autonomy and Decentralization) adopted

2009: Plan Nacional del Buen Vivir (National Development Plan for Good Living) adopted

Water Funds

1995: Search for a financial mechanism for water protection between The Nature Conservancy (TNC) and FUNAM began

1999: The Quito Metropolitan Area Potable Water and Sewage Company(EMAAP-Q) created the trust "Fondo Ambiental para la Protección de las Cuencas y Agua (FONAG)"

2000: Establishment of FONAG. The constituents were: the Quito Metropolitan Area Potable Water and Sewage Company (EMAAP-Q)] and TNC

2001: The electric company [Empresa Eléctrica Quito (EEQ)] became a new constituent of FONAG

2001: The process of capitalization of the trust fund begins

2003: The national brewery became a new constituent

2004: Establishment of the technical secretariat and implementation of activities begins; first call for projects

2005: COSUDE and Tesalia Springs Company became news constituents of FONAG

2005: FONAG defined five programs to implement activities

2007: Ordinance 199 and 213 were adopted to support the creation of FONAG

2008: Creation of the National Water Secretariat (SENAGUA)

2008: Establishment of the "Water Fund for the Conservation of Paute Watershed (FONAPA)"

2008: Establishment of the Fund of Páramos for poverty reduction

2009: Establishment of FORAGUQ (Regional Water Fund) in Loja. FORAGUA now includes PRO-CUENCAS and FONES

III. The Case Study

The case study on Ecuador Water Funds presents the innovative funding mechanisms developed to protect water supply in a small country with rich biodiversity and water resources. The country can provide a valuable laboratory for scientists throughout the world to study mountain, river and marine ecosystems and ways they can be protected. Even though Ecuador is endowed with abundant water resources, it is very unevenly distributed. In the coastal and highland regions, where 80% of the people live, they have the lowest availability of water (particularly along the Pacific coast). On the other hand, the Amazon region has 20% of the population and much more available water.

The Nature Conservancy and its partners originally developed the Water Funds in Latin America and the Caribbean to protect biodiversity and conserve water sources for human consumption. The funds have been established in several Latin America and the Caribbean countries, including Ecuador, Colombia, and others.

The Water Funds are endowment trusts set up to compensate for environmental services, such as supplying clean freshwater and providing biodiversity-related benefits. The trust fund is collectively invested in conservation projects that protect the healthy habitat from which environmental services derive. The Water Funds are based on payment for environmental services (PES) principles, and are a means of mobilizing long-term trust funds. A public–private partnership of water users determines how to invest in conservation activities in priority areas. Each Water Fund has its own set of objectives and goals, but, in general, they invest in conservation of watersheds in order to meet water users' needs and biodiversity targets. The goals are in line with green growth goals of protecting the environment, reducing costs of water treatment and encouraging economic development.

The development of water funds in Ecuador has grown since the creation of FONAG. Since 2007, FONAG has provided technical assistance and encouraged the replication of the fund model in Ecuador. FONAG supported six[19)] water fund initiatives (see Box 2):

- Paute Water Fund (FONAPA),

<Box 2> Main Water Funds created since 2000 in Ecuador

Water Fund	FONAG	FONAPA	FOPAR	TUNGURAHUA	FORAGUA
Year Founded	2000	2008	2008	2008	2009
Members	EPMAAP-Q, EEQ, TNC, Tesalia, Cervecería Nacional, CAMAREN	ETAPA, ELECAUSTRO, CELEC-HIDROPAUTE, TNC, University of Cuenca, Fundación Cordillera Tropical, EMAPAL	Municipality of Riobamba, CESA, Federation of Organizations of Water Users of the Province of Chimborazo – INTERJUNTAS	Province of Tungurahua Council, Hidroagoyán, Hidropastaza, EMAPA, three indigenous groups from the province of Tungurahua	Municipalities of Celica, Loja, Macará, Pindal, Puyango, Chinchipe, Zamora, Nature and Culture International
Activities	-Vegetationrecovery -Communication -Environmentaleducation -Surveillance and monitoring of protected areas -Water management	1. Institutional strengthening 2. Dissemination/ communication 3. Training, education & environmental sensitization 4. Protection, conservation and recoveryof water resources and ecological environment 5. Monitoring and control	1. Environmental education 2. Productive projects 3. Surveillance of protected areas 4. Institutional strengthening	1. Communication 2. Environmental education 3. Protected areas 4. Strengthening of institutional capabilities	1. Institutional strengthening 2. Qualification, follow-up and assessment of municipal projects
Protected Areas and Related Basins	• Antisana Ecological Reserve • Cotopaxi National Park • Cayambe Coca National Park • Guayllabamba Basin	• El Cajas National Park • Sangay National Park • PauteRiverBasin	• Chimborazo Faunal Production Reserve • Sub-Basin of the Chambo River	• Llanganates National Park •Chimborazo Faunal Production Reserve • Ambato RiverBasin	• Podocarpus National Park • Yacuri National Park • Fragile and threatened ecosystems of the provinces of Loja, El Oro and Zamora Chinchipe
Number of peoplewho supplybasins*	2.5 millions	800.000	225.000	350.000	

Source: Coronel, Lorena and Zavala, P., (2014). Guia y Herramienta Practica Para Crear Un Fondo De Agua (Publication pending).
*Note: www.fondosdeagua.org

19) The Zamora (ProCuencas) and Espíndola (FONES) Funds became part of a regional effort in their territory FORAGUA.

- Tungurahua Water Fund for High-grassland Management and Poverty Reduction (FMPLPT),
- Riobamba Water Fund for the Protection of the Chambo Sub-Basin (FOPAR),
- Regional Water Fund for Loja, Zamora Chinchipe and El Oro (FORAGUA),
- Zamora Water Fund (PROCUENCAS), and
- Espíndola Water Fund (FONES).

The last two now are part of the Regional Water Fund for Loja, Zamora Chinchipe, and El Oro.

Each project engages as many stakeholders as possible in the watershed, particularly the end users, such as public water utilities, major public hydroelectric facilities, irrigation systems and agricultural associations, and private companies such as beer companies and bottled water companies. The case study describes the major funds and the constituents contributing to them.

1. Exogenous Factors

This section presents the exogenous factors that helped shape the context in which key water resources management decisions were made and implemented Ecuador and its river basins. It describes some of the economic, social, political, environmental, and technological elements that influenced those decisions and that contributed to the achievement of green growth.

1-1. Economic Factors

1-1-1. Recent Economic Trends

Ecuador has registered solid economic growth over the period 2000 to 2012 with an average annual growth in GDP (constant prices) of 4.5% over the period (calculated from Table 1). Per capita income in constant prices also rose at a good pace of 3.7% per year on average, even though it dipped following the global economic downturn in late 2008. Between 2000 and 2010, the poverty rate fell from 51% to 33%.[20]

<Table 1> Ecuador: GDP in US $ billion (Constant 2005 Prices), GDP Annual Growth, GDP per Capita (Constant 2005 US $) and Annual Growth, 2000-2012

	GDP (US $ 2005 prices)	Growth rate (%)	GDP per capita (US $ constant 2005 prices)	Growth (%)	GDP per capita PPP (current $)
2000	32.75	1.1	2613	-0.9	5504
2001	34.07	4.0	2666	2.0	5743
2002	35.46	4.1	2722	2.1	5954
2003	36.43	2.7	2743	0.8	6121
2004	39.42	8.2	2913	6.2	6680
2005	41.51	5.3	3012	3.4	7129
2006	43.33	4.4	3090	2.6	7537
2007	44.28	2.2	3106	0.4	7770
2008	47.10	6.4	3245	4.6	8284
2009	47.37	0.6	3209	-1.1	8256
2010	48.76	3.0	3251	1.3	8463
2011	52.59	7.8	3449	6.1	9155
2012	55.28	5.1	3568	3.5	9637

Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx

Ecuador adopted the dollar as its national currency in 2000, following a major banking crisis and recession in 1999. This change led to stability, which helped Ecuador achieve solid economic performance through 2006. In 2007, economic growth slowed, constrained by a reduction in petroleum production and private sector investment. The economy recovered in 2008 when oil prices were high.

In December 2008, the government defaulted on certain debt issuances (its 2012 and 2030 Global bonds, with a total face value of approximately U.S. $3.2 billion). In June 2009, Ecuador bought back 91% of its debt at just 35 cents on the dollar. Ecuador

20) World Bank. 2014. Ecuador Overview. http://www.worldbank.org/en/country/ecuador/overview

thus weathered the debt default crisis and came out surprisingly well, due to luck and good timing. The debt restructuring was successful and less fraught than other Latin American sovereign defaults.[21)]

As a result, however, limited access to international financing forced the government to reduce expenditure levels and cover a budgetary financing gap. It turned to loans from international financial institutions, from Ecuador's Social Security Institute, and financing from China, which has provided Ecuador with almost $7 billion worth of financing since 2009. Interest rates charged have generally been higher than those charged by international financial institutions, such as the World Bank.

Although oil prices rebounded in 2009, economic growth slowed due to a fall in internal demand. Remittances from foreign workers, Ecuador's second-largest source of external revenues (after petroleum), declined 12% due to the worsening economic conditions in the U.S. and Spain, the two most important origins for remittances.[22)] As seen in table 1, the annual GDP growth rate for Ecuador's economy in 2009 was 0.6%.

Although the economy was stagnant in 2009, it started to recover from the effects of the global crisis, with a 3.0% growth in constant prices in 2010, rising to an impressive 7.8% in 2011 (the third highest in the region). Ecuador's economic growth remained robust in 2012 at 5.1% and continued through the third quarter of 2013 at an annual rate of 4.9%.

President Rafael Correa Delgado was elected to a third four-year term in February 2013 by a wide margin. His administration has concentrated on the dual goals of strengthening the productive base and eradicating poverty. As a result, public investment has increased, from 21% of GDP in 2006 to nearly 41% in 2012. A large share of the public investment is allocated to infrastructure improvements and the social sector.[23)]

The President's economic priorities include higher social spending, increased government control over strategic sectors, and ensuring a greater share of natural resource revenues for the state. The business community has been uneasy because of uncertainty over changes in government economic policies. The World Economic Forum's Global Competitiveness Index rated Ecuador 101 out of 142 countries for 2011-2012.

1-1-2. Economic Sectors in Ecuador

Ecuador is a country of enormous economic potential. The Ecuadorian economy is based on petroleum production, agricultural production for domestic consumption and export, manufacturing primarily for the domestic market and services. Development has focused on agricultural, marine, and mineral resources, with industry playing a more limited role. The country has improved standards of living, but it is still characterized by inequalities of wealth and well-being.

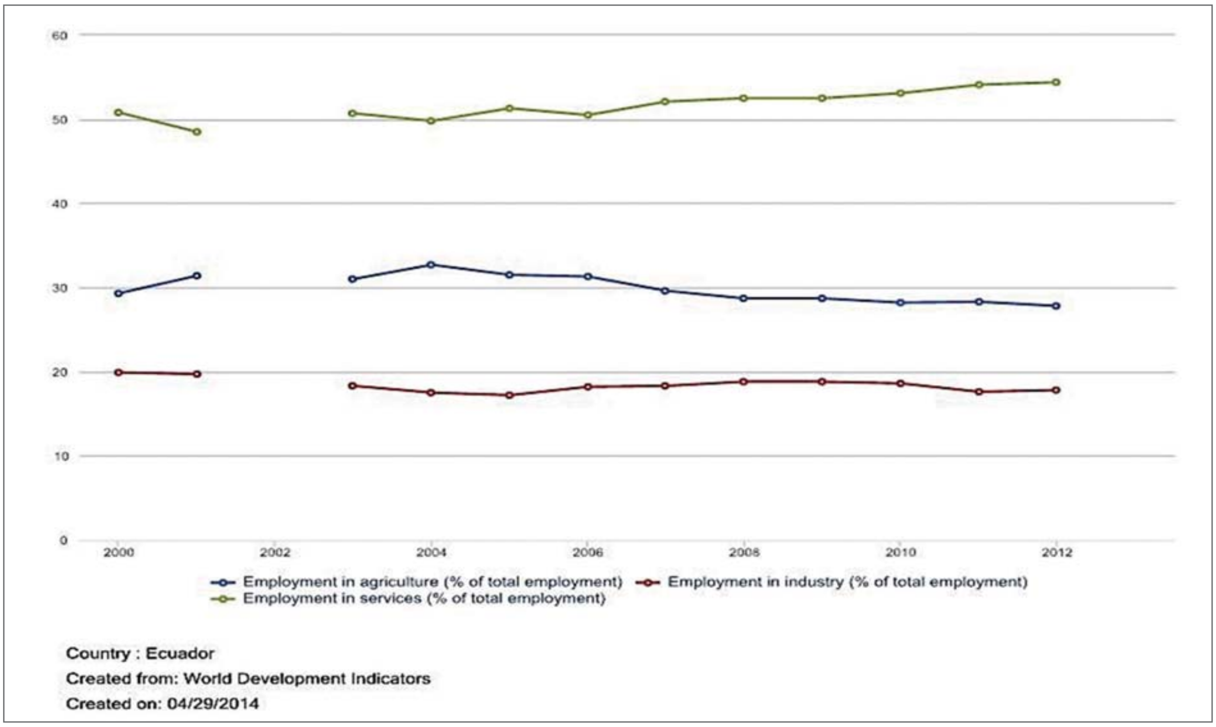
Agriculture. Agriculture has traditionally employed a large proportion of the population, and still employs around 28% of the workforce (see Figure 2). While the proportion of people engaged in agriculture remained rather steady over the period, the value added in agriculture as a percentage of GDP has fallen, from 16.3% of GDP in 2000 to 9.9% in 2012 (see Table 2).

Despite this disparity, many rural Ecuadorans feed their families with the produce from their own farms;

21) *Salmon, F. 2009, 29 May. Lessons from Ecuador's Bond Default. Reuters*. http://blogs.reuters.com/felix-salmon/2009/05/29/lessons-from-ecuadors-bond-default/

22) http://www.worldbank.org/en/country/ecuador/overview

23) http://www.worldbank.org/en/country/ecuador/overview



Source: World Bank, World Development Indicators

<Figure 2> Workforce Employed in Agriculture, Industry, and Services in Ecuador, 2000-2012

<Table 2> Ecuador: GDP Value Added by Sector (% of total GDP)

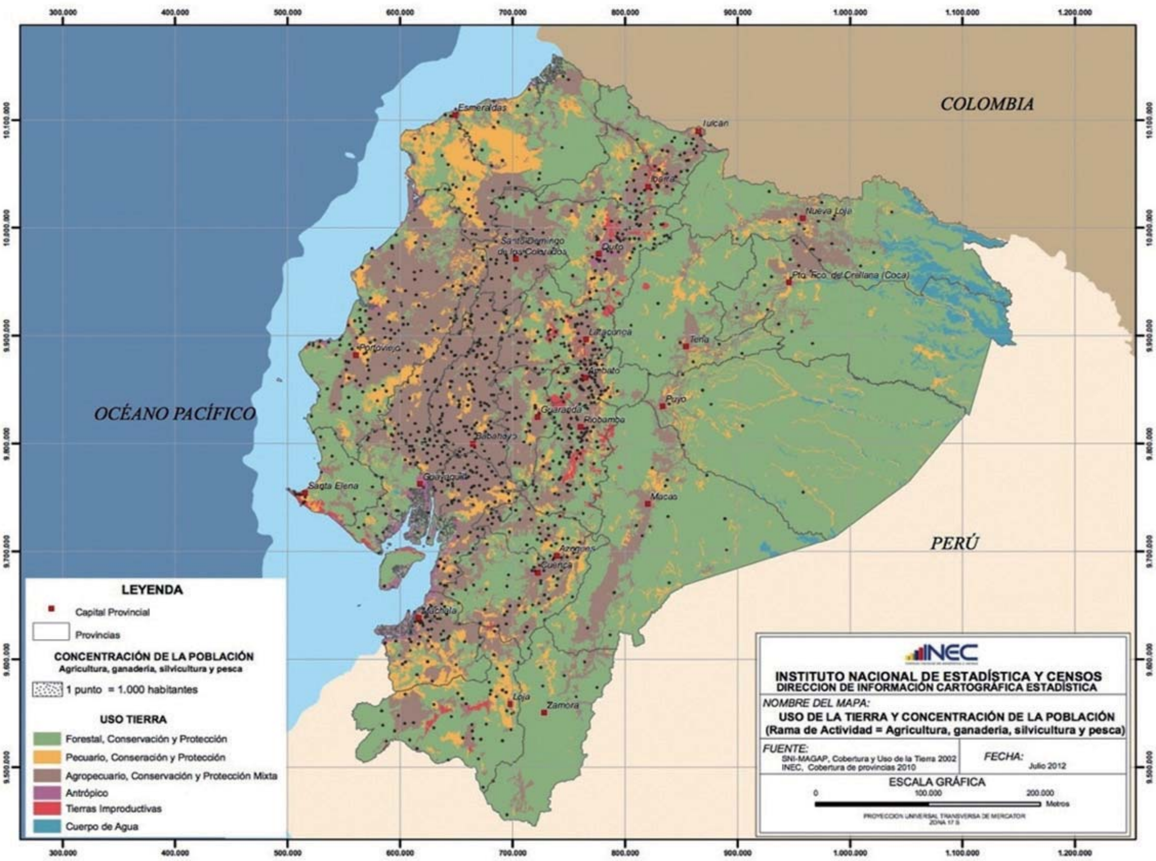
	Agriculture	Industry	Services
2000	16.3	35.7	48.0
2001	13.7	31.5	54.7
2002	12.2	31.3	56.4
2003	11.7	30.1	58.2
2004	10.4	31.8	57.8
2005	10.0	33.4	56.6
2006	9.9	35.6	54.5
2007	9.8	36.2	53.9
2008	9.3	39.3	51.4
2009	10.5	34.3	55.2
2010	10.7	34.9	54.4
2011	10.4	36.8	52.8
2012	9.9	36.8	53.3

Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx

production of subsistence crops, such as maize, potatoes, beans, and cassava, is crucial to the economy but not accurately reflected in official figures. Commercial production of grain crops has been falling as a result of cheaper grain imports from the U.S., which has also resulted in a shift in diet away from traditional corn consumption and toward rice and wheat. Production of specialty crops such as bananas, cacao, and coffee for export have provided much-needed foreign exchange. A land-use map is shown in Figure 3; agricultural land is mainly in the lowlands of the west and along the coast. The highlands and Amazon regions in the east are mainly covered in forest, although people in the highlands and rainforest continue to grow their traditional crops on small plots.

Livestock production is important to Ecuador's economy: beef cattle are bred in the lowlands, and dairy cattle and sheep are bred in the highlands. Chickens, pigs, goats, and guinea pigs are also raised for food.

Only a small proportion of Ecuadoran territory is used for cultivation, while large areas are reserved for forests and wildlife habitats. Chemical fertilizers are employed on commercial and specialized market crops, while traditional farmers employ animal manure. Traditional irrigation systems have been used in the highlands since ancient times, and most of the high-value crops, such as roses, tomatoes, and papayas, are cultivated in irrigated



Source: Instituto Nacional de Estadística y Censos (INEC)
Legend:green: forest, conservation and protection; yellow: pecuary (livestock), conservation and protection; brown: agricultural, conservation and medium protection; pink: anthropic; red: unproductive land; blue: water

<Figure 3> Land Use in Ecuador

fields and greenhouses in the highlands. Irrigation has been expanding rapidly on the coast and aids cultivation of rice paddy, banana, cacao, and oil palm. Currently such crops as tea, oil palm, and cassava are grown in the Amazon basin, but little is produced for export.[24]

Forest and marine resources are also important to the economy. Bamboo is used for traditional housing construction along the coast, and in the highlands pine and eucalyptus plantations provide fuel and construction material. A small-scale fishing industry operates mainly out of ports on the central and southern coasts. The major marine product is shrimp, produced in large ponds constructed in coastal areas and displacing mangrove swamps. Mangrove cutting, disease, severe flooding, and economic instability have hindered production in aquaculture.[25]

One of Ecuador's major resources is its soil, which, with the country's generally adequate rainfall and diverse climates, allows a wide variety of agricultural production. Particularly rich soils are found in the Guayas and other river floodplains on the coast and in the flats, floodplains, and volcanic slopes of the highlands.

Mining and Manufacturing. Growth in the industrial sector (Table 3) remained quite strong over the period 2000 to 2012. Despite volatility, the average annual growth in industry value added in constant prices was 4.9% per year over the period. Ecuador has great mineral

24) http://www.britannica.com/EBchecked/topic/178721/Ecuador/271891/Agriculture-forestry-and-fishing

25) Ibid.

potential, with large gold and oil deposits in many parts of the country. Exploration has discovered significant deposits of natural gas in the Gulf of Guayaquil, large deposits of low-grade copper ore west of Cuenca, and deposits of silver, molybdenum, iron ore, gypsum, zinc, and lead at various locations.

<Table 3> Rate of Industrial Growth in Ecuador

	Industry, value added (constant 2005 US $ in millions)	Industry, value added (annual % growth)
2000	9,544	10.96
2001	10,132	6.16
2002	10,593	4.55
2003	10,882	2.73
2004	12,538	15.21
2005	13,093	4.43
2006	13,696	4.61
2007	13,582	-0.83
2008	14,486	6.66
2009	14,461	-0.17
2010	14,583	0.85
2011	16,010	9.78
2012	16,912	5.63

Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx

Oil and gold are the country's most valuable extraction products. Gold has been produced in Ecuador for centuries, and much of the production comes from remote districts such as Nambija in southeastern Ecuador, where thousands of families live with minimal services and the miners face hazardous conditions in tunnels subject to collapse due to torrential rains.

The oil sector typically accounts for 50%-60% of the country's export earnings, 15%-20% of GDP, and 30%-40% of government revenues. Oil production is primarily carried out by the government, as well as by small domestic and several large foreign companies. Oil production declined between 2006 and 2009 due to insufficient investment, before levelling out in 2010 and increasing only slightly in 2011. In late 2010 and early 2011, the government renegotiated all oil concession contracts, moving from a production-sharing arrangement to service (fee) contracts. Several oil companies declined to renegotiate; those operations were devolved to the state oil company, increasing the state's share of national oil production from 62% in 2010 to roughly 72% in 2011. Despite oil contract renegotiations, public and private investments in the sector have remained relatively flat.

The mineral sector has been developing slowly. In early 2011, government negotiations commenced with major mining companies interested in moving from an exploratory phase into production. To foster diversification of Ecuador's economy, the Ecuadorian Government enacted a Production, Trade, and Investment Code in late 2010. The code is intended to promote production of higher value-added products, in particular by small and medium-sized businesses located in regions outside the major business centers of Quito and Guayaquil. Industrial development in Ecuador is still in the early stages. Industry accounts for about 36% of GDP value added and slightly less than 20% of the work force. These figures have remained steady since 2000. Some industry is associated with the processing of primary products, including cement, refined sugar, chocolate bars, beer, pasta, bread, meat, fruit, and instant coffee. Some import-substitution industries licensed by foreign corporations have been established, including those producing pharmaceuticals and tires and those assembling automobiles. Ecuador has had some success exporting processed foods, such as fruit drinks and canned meats to neighbouring countries.

Craft products also contribute to the economy: Ecuadoran woollen tapestries and sweaters; crafts in wood, straw, ceramics, leather, and tagua nut (used to make vegetable ivory); and Panama hats.

Services. The service sector currently accounts for 53% of value added in Ecuador's GDP (see Table 2), and around 54% of the workforce (see Figure 2). The service sector has increased in importance as the agriculture sector has declined. The service sector is dominated by tourism and transportation. Tourism has become an economic mainstay for Ecuador, particularly for visits to the Galápagos Islands (designated a UNESCO World Heritage Site in 1978). Improved tourist facilities have increased the number of visitors to the mainland as well. In particular, the Government expanded Quito's airport in the early 2000s and renovated Guayaquil's airport, adding an international terminal. Another big improvement was the extensive renovation of Guayaquil's waterfront, with pedestrian walkways, shops and public art. In Quito the Telefériqo (cable car) takes visitors to the top of a 4,000-metre mountain, and Ecuador's most-visited landmark, Mitad del Mundo ("Middle of the Earth"), with a monument and museum at the Equator, has undergone many renovations. Cities such as Baños and Puyo provide entry for excursions into the Amazon rainforest and offer opportunities for outdoor adventuring.[26)]

1-1-3. International Trade

International trade accounted for around one third of Ecuador's GDP in 2012 (Table 4). Its principal exports are petroleum, bananas, shrimp, flowers, and other primary agricultural products. In 2010, crude and refined petroleum products accounted for 56% of total export earnings. Oil is extracted in the northeast and sent over the Andes via pipeline.

Ecuador is the world's largest exporter of bananas and plantains (about $2 billion) and a major exporter of shrimp ($828 million) and cacao ($402 million). Exports of non-traditional products such as flowers ($598 million), canned fish ($601 million), and automobiles ($375 million) have become more important in recent years.

Ecuador's principal export destinations are the U.S., Colombia, Peru, Chile, and Italy. Imports include machines and primary industrial materials, motor vehicles, consumer goods, and food and chemical products. Imports come mainly from the United States, Colombia, Venezuela, Brazil, and Chile.

<Table 4> Ecuador: Imports and Exports of Goods and Services (Constant 2005 US $ billion), 2000-2012

	Imports (billion US $)	Growth (%)	% of GDP	Exports (billion US $)	Growth (%)	% of GDP
2000	6.49	12.8	27.3	8.48	2.5	25.9
2001	8.16	25.7	27.5	8.35	-1.6	23.2
2002	9.71	19.0	27.9	8.40	0.6	21.5
2003	9.32	-4.1	24.6	9.00	7.2	22.6
2004	10.33	10.9	26.1	10.55	17.2	24.6
2005	11.82	14.4	28.5	11.46	8.6	27.6
2006	12.98	-9.8	29.4	12.28	7.1	30.3
2007	13.89	7.1	30.7	12.28	0.0	31.9
2008	15.89	14.4	33.9	12.65	3.0	34.2
2009	14.32	-9.9	26.9	12.04	-4.8	25.2
2010	16.71	16.7	32.7	12.34	2.5	28.3
2011	17.40	4.1	33.7	12.98	5.1	32.2
2012	17.56	1.0	33.2	13.35	2.9	31.2

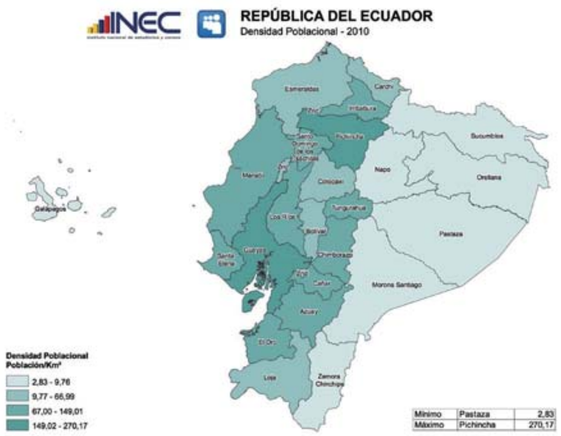
Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx

1-1-4. Demographic Trends

The population of Ecuador has risen from 12.5 million in 2000 to 15.5 million in 2012, for an average annual growth of 1.78% over the period. The growth rate has declined gradually, as detailed in table 5, from 1.98% in 2000 to 1.60% in 2012. Population density has increased from 50.46 persons/km^2 in 2000 to 62.38 persons/km^2 in 2012 (see Table 5 and Figure 4). The population density in 2012 ranged from 2.8 persons/km^2 in Pastaza province in the Amazon to 270 persons/km^2 in Pichincha province, where the capital is located. Population density is closely related to the location of the biggest cities, with the provinces of Pichincha and Guayas registering higher density because of the major cities of Quito and Guayaquil. Areas with lower population density are

26) http://www.britannica.com/EBchecked/topic/178721/Ecuador/271891/

found in the oriente (east). These contrasts are illustrated in the map in Figure 4.



Source: Instituto Nacional de Estadística y Censos (INEC)

<Figure 4> Population Density in Ecuador, 2010

<Table 5> Annual Population Growth Rate and Population Density in Ecuador 2000-2012

	Population Growth (annual %)	Population Density ($people/km^2$)
2000	1.98	50.46
2001	1.96	51.46
2002	1.93	52.46
2003	1.90	53.47
2004	1.86	54.47
2005	1.82	55.47
2006	1.78	56.46
2007	1.73	57.45
2008	1.70	58.43
2009	1.67	59.42
2010	1.64	60.40
2011	1.62	61.39
2012	1.60	62.38

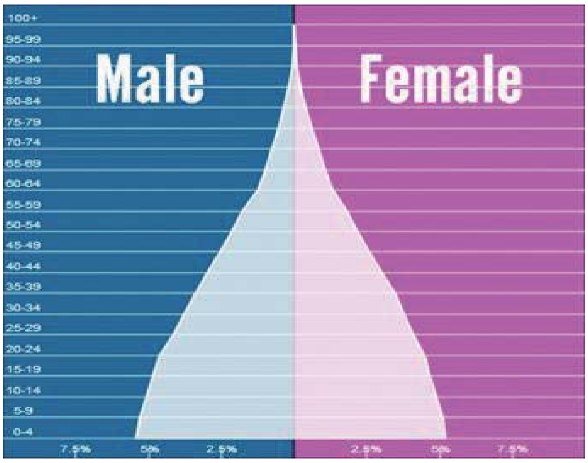
Source:World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx

The percentage of the population under the age of 15 has gradually declined, but was still high at 30% of the population in 2012 (see Table 6 and Figure 5). Persons between the ages of 15 and 64 now account for 63% of the population, and those over 64 account for a growing percentage (from 5.1 % in 2000 to 6.3% in 2012).

<Table 6> Population Distribution by Age in Ecuador

	Population Total (millions)	Population 0-14 (% of total)	Population Ages15-64 (% of total)	Population Ages →64 (% of total)
2000	12.53	35.54	60.36	5.10
2001	12.78	34.54	60.64	5.20
2002	13.03	33.78	60.91	5.30
2003	13.28	33.40	61.19	5.41
2004	13.53	33.02	61.72	5.63
2005	13.78	32.65	61.72	5.63
2006	14.02	32.30	61.97	5.73
2007	14.27	31.96	62.20	5.84
2008	14.51	31.62	62.43	5.95
2009	14.76	31.29	62.66	6.06
2010	15.00	30.95	62.88	6.17
2011	15.25	30.62	63.10	6.28
2012	15.49	30.29	63.32	6.34

Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx



Source: http://populationpyramid.net/ecuador/

<Figure 5> Ecuador Population Pyramid, 2010

The 30% figure for persons under the age of 15 is considerably higher than most OECD countries, which all seem to be in the range of 13 to 18% of the population being below the age of 15 (except for the U.S., which is at 20%). Most of the emerging market countries have more than 20% of their population below the age of 15 (i.e., Brazil 24%; Chile 23%; Egypt 32%; India 31%; South Africa 31%). The exception is China, with 16% of its population below 15 years of age, as a result of its one-child policy.[27]

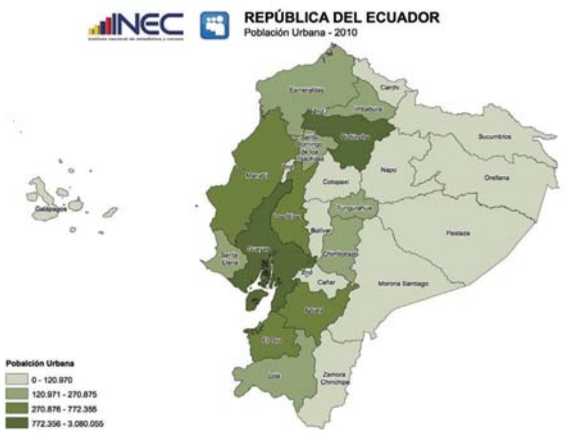
27) Population Reference Bureau. 2012. 2012 World Population Data Sheet.

Similar to the trends in population density, there has been rapid growth in the urban population along the coast and in the highlands province of Pichincha, where the capital is located. The country is now 68% urban and only 32% rural (see table 7 and figure 6). The growth in urban population has averaged 2.80% per year over the period, compared to an average growth in population as a whole of 1.78% per year. In 2012, 10.5 million people (67.98% of the total) were living in urban areas (Table 7).

<Table 7> Urbanization Trends in Ecuador: Urban Population, Percentage of Total Population, Annual Growth

	Urban Population (in millions)	Urban population (% of total)	Urban Population growth (annual %)
2000	7.56	60.30	2.83
2001	7.79	60.96	3.05
2002	8.03	61.62	3.01
2003	8.27	62.28	2.97
2004	8.51	62.95	2.92
2005	8.76	63.61	2.86
2006	9.01	64.26	2.79
2007	9.26	64.91	2.74
2008	9.51	65.56	2.69
2009	9.77	66.21	2.66
2010	10.03	66.86	2.62
2011	10.28	67.42	2.46
2012	10.53	67.98	2.43

Source: World Bank: http://databank.worldbank.org/data/views/reports/tableview.aspx



Source: Instituto Nacional de Estadística y Censos (INEC): http://www.ecuadorencifras.gob.ec/division-politico-administrativa

<Figure 6> Urban Population in Ecuador, 2010

While the urban population is concentrated along the coast and in the province of Pichincha, the areas with very low urban populations are in the Oriente (Figure 6), the Amazon region. Protected areas are mainly located in the low-density rural forested regions that provide environmental services to the rest of the country.

1-1-5. Effects of Economic Factors

Ecuador is a small country with rich natural resources, including petroleum and minerals, as well as rich biodiversity. The population is unevenly distributed, with most people living in areas with a low availability of water. This has created a situation where people in cities and water-short areas are expected to pay for protection of water sources and watersheds through their water tariffs.

There is still considerable poverty and income inequality facing the indigenous people in the highlands and the Amazon region. These are the people who can participate in protecting ecosystems and watersheds. However, the process for getting them involved in this visionary approach to conservation and climate change resiliency must be inclusive. Their concerns and needs must be understood, and their efforts should be fully compensated. In particular, when there are oil and mining concessions given to public and private companies in fragile protected areas, the people who live there must be consulted prior to the concession being offered.

1-2. Social Factors

1-2-1. Four Regions of Ecuador

The 24 provinces of Ecuador are divided into four distinctive regions of Ecuador (see Figure 7).[28] The

28) http://en.wikipedia.org/wiki/Regions_of_Ecuador

coastal region (La Costa) consists of the provinces to the West of the Andean range (Esmeraldas, Guayas, Manabí, El Oro, Santa Elena). It is the country's most fertile and productive land, where large banana plantations produce exports for huge U.S.-based companies Dole and Chiquita. This region is also where most of Ecuador's rice crop is grown. The truly coastal provinces have active fisheries. The largest coastal city is Guayaquil.

Source: http://www.virtualamericas.net/ecuador/maps/regions.shtml

<Figure 7> Map of Ecuador, Showing Four Geographical Regions: Galápagos Islands, the Pacific Coast, the Andes, and the Amazon

The highlands region of Ecuador, also known as La Sierra, lies between the western coastal lowlands and the eastern jungles. The sierra consists of the Andean and Inter-Andean highland provinces – Azuay, Bolívar, Cañar, Carchi, Catopaxi, Chimborazo, Imbabura, Loja, Los Ríos, Pichincha, Santo Domingo de los Tsáchilas, and Tungurahua. Traditional agricultural crops grown in the region are potatoes, maize, and quinoa. The major concentration of indigenous peoples is in the highlands, and the largest ethnic group is indigenous Kichwa [also Quichua or Quechua]. The largest Sierran city is Quito, capital of the country. The highlands are a naturally diverse area of active volcanoes, snow-capped peaks, hot springs (thermal baths), unique flora and fauna, serene landscapes, misty cloud forests, and barren páramo vistas. The highlands are also culturally significant due to the many native Indian craft markets and the modern and thriving colonial cities.[29)]

El Oriente (the east) consists of the Amazon jungle provinces – Morona Santiago, Napo, Orellana, Pastaza, Sucumbíos, and Zamora-Chinchipe. This region is primarily made up of the huge Amazon national parks and indigenous zones, which are large land areas set aside for the Amazon indigenous tribes to continue living traditionally. It is also the area with the largest petroleum reserves of in Ecuador, and parts of the upper Amazon here have been extensively exploited by petroleum companies. The population is primarily mixed indigenous Shuar, Huaorani, and Kichwa, although there are numerous tribes in the deep jungle that are quite isolated. The largest cities in the Oriente region are Lago Agrio in Sucumbíos and Macas in Morona Santiago.

The insular region of Ecuador consists of the Galápagos Islands, about 966 km west of the South American mainland in the Pacific Ocean.

1-2-2. History

The territory now known as Ecuador had a long history before the arrival of Europeans. Ecuador lacked cities and states until after the Inca conquest in the late 15^{th} century. The Inca spread the use of Kichwa as a lingua franca and ordered large forced migrations where resistance to their conquest was especially strong. With the arrival of a Spanish expedition led by Francisco

29) http://yourescapetoecuador.com/destinations/andean-highlands-region/

Pizarro in 1534, the Spaniards took over the country and were even welcomed as liberators by those who opposed the Inca rule. However, stiff resistance was encountered from other groups. During much of the colonial period, what is now Ecuador was under the direct jurisdiction and ultimately the rule of the Spanish crown.

In the tropical coastal region, much of the population died as a result of introduced diseases, and the area remained unhealthy until the advent of modern medicine. As a result, the coast was somewhat neglected during the colonial period, although there was some shipbuilding and export of cacao. The small coastal population of slaves, free blacks, and mixed ethnicities developed a culture very different from that of the Sierra. In the Oriente large populations of indigenous people successfully repelled European invaders; however, Jesuits and other missionaries were able to spread both Christianity and the Quichua[30)] [Kichwa] language.. The country's fourth major region, the Galápagos Islands, were little more than pirate nests during the colonial period.

Ecuador's early history as a country (1830) was a tormented one. For some eight years it formed, together with what are now the countries of Panama, Colombia, and Venezuela, the confederation of Gran Colombia. But after a period of protracted regional rivalries, Ecuador seceded in 1830 and became a separate independent republic. An increasing rivalry and ideological differences between the Sierra and the Costa usually focused on the two leading cities—Quito, the capital, in the Sierra, and Guayaquil, the country's principal port, in the Costa. The people of Guayaquil, the home of Ecuador's industry and trade, felt that a disproportionate part of the state's tax income was spent in Quito by government bureaucrats. Those in Quito complained that their exports had to pass through the bottleneck of Guayaquil, and reduced their competitiveness in the world market.

Religion became important during the last half of the 19th Century starting with the presidency of Gabriel García Moreno in 1860.The President strengthened the connection between the Roman Catholic Church and the state. Although many aspects of García Moreno's regime were dictatorial, it markeda period of economic and social progress for Ecuador. Roads, schools, and hospitals were built. A start was made on a Quito-Guayaquil railroad, to tie together the Sierra and the Costa. After he was assassinated in 1875, the administrative structure he built was dismantled, and the church was gradually removed from state education. The new president proclaimed freedom of religion, permitted divorce, and eased controls on the press. He was overthrown in 1911, and the real power continued to rest in the hands of the wealthy merchants and bankers of Guayaquil. Cacao was the dominant export crop, as in the colonial period, but sugar and rice became increasingly important.

World War II had a serious impact on the country. The large Amazonian territories claimed by Ecuador had never been effectively controlled by the government; much of the area was occupied by indigenous groups. Dating back to the 16th century, Peruvians had increasingly settled along the Amazon and its tributaries. In July 1941, after a series of border incidents, the Peruvian army invaded and seized much of the disputed Amazonian area. The Ecuadoran forces, poorly trained and equipped, were easily defeated, and the disgrace caused the overthrow of the President, Carlos Arroyo del Río.

30) The Kichwatribe of the Amazon are ethnically similar to the Quechua or Quichua of the Andes Mountains in Ecuador and Peru. They speak different dialects of the same language. http://www.ecuadorecovolunteer.org/tribes-of-the-amazon/

Ecuador enjoyed a long period of constitutional government and relatively free elections following World War II. While there were two interludes of military government (1963–66; 1972–79), the period was mainly dominated by José María Velasco Ibarra, who died in 1979. The country returned to an elected civilian government and a new constitution in 1979. The new president was a social democrat, who promised greater social equality and a more equitable distribution of oil industry profits, but he was unable to get these reforms through the legislature.

The political situation vacillated from conservative to liberal throughout the 1980s, and the economic situation deteriorated. There was a major national uprising in 1990, with indigenous groups demonstrating in favour of such issues as land reform. The uprising and subsequent protests pushed the Ecuadoran government to recognize the land rights of these indigenous groups and address their other concerns.

From the mid-1990s to the early 21st century, Ecuador experienced several years of political upheaval, during which time many individuals served as president. After several unsuccessful leaders, Rafael Correa gained favour with the voters and became Ecuador's president. He submitted a draft constitution that was approved by a special Constituent Assembly in July 2008, and was backed by more than 60% of Ecuadorian voters. The new constitution was the 20th since the country gained independence in 1830, and it reflected many of Correa's liberal ideals, including recognition of the importance of protecting the environment and greater national control over the oil and mining industries. His leadership was successful and he secured another term as president in February 2013.[31)]

1-2-3. Indigenous Communities

Ecuador is a patchwork of indigenous communities, including people of colonial Spanish origins and the descendants of African slaves. Around a third of Ecuadorians belong to indigenous communities (Figure 8). Among the indigenous ethnic groups are the highland and lowland Kichwa/Quichua, lowland Cofán, Secoya, Siona, Hauorani, Achuar and Shuar, Tsáchila and Chachí (see Picture 1).

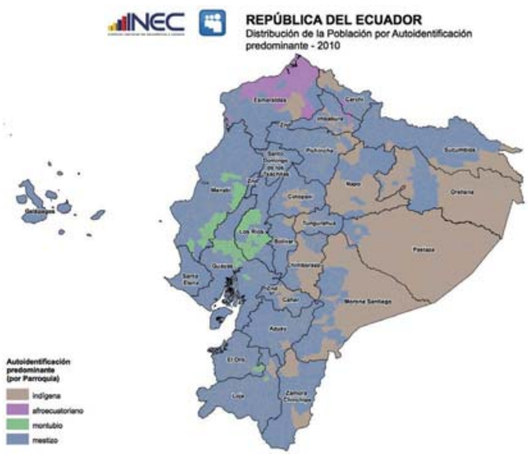
Photo: courtesy Lorena Coronel]

<Picture 1> Indigenous Children in the Highland Areas of Ecuador

The presidency of Rafael Correa (re-elected in 2009 and 2013) should represent an improved scenario for Ecuador's estimated 4 million indigenous people. Correa's campaign pledge was to foment a "people's revolution", and he emphasize his connection to indigenous people, having learned to speak Kichwa in his youth.[32)] The 1998 constitution recognized Ecuador as a pluri-ethnic nation and guarantees the rights of both indigenous peoples and Afro-Ecuadorians. These included the right to collective territory, the use of natural resources, cultural patrimony, and bilingual education.

31) Edited and adapted from http://www.britannica.com/EBchecked/topic/178721/Ecuador/25834/Ecuador-from-the-late-20th-century

32) Amazon Watch. Advancing Indigenous Peoples Rights in Ecuador:http://amazonwatch.org/work/advancing-indigenous-peoples-rights-in-ecuador



Source: Instituto Nacional de Estadística y Censos (INEC):http://www.ecuadorencifras.gob.ec/division-politico-administrativa
Legend: tan: Indigenous; pink: Afro-Ecuadorian; green: Montubio; blue: Mixed

<Figure 8> Distribution of Ethnic Groups in Ecuador

Correa had promised a new Constitution that would include empowerment for Ecuador's indigenous peoples. Work on drafting the new constitution began in November 2007. As agreed between the government and indigenous organizations, among the key inclusions is the establishment of Ecuador as a united "plurinational" state. The "plurinational" concept includes the need to reflect indigenous concerns in all public policies, such as education, health, housing, and local government. Collective rights have been included in all relevant instruments establishing forms of administration, functions and self-government for nations and peoples in their own territories, without implying they have property rights over non-renewable subsoil resources. Institutionalizing the concept of "Plurinationalism" was an important long-held initiative of The Confederation of Indigenous Nationalities of Ecuador (CONAIE). The concept was tied to the struggle for land and structural reform of Ecuadorean agriculture, which implies access to water, markets, and credit.

Many of the indigenous communities in Ecuador have continued to live according to their traditional values, including a system of sharing and exchanging, which frequently clashes with the individualism of modern western influenced society. One of these is the highly valued tradition of the "minga" – working together to harvest crops or build roads and homes. The elimination of the communal aspect of their societies would threaten solidarity and reciprocity, without which indigenous societies would risk disintegration.

Internationally, new rights recognitions for indigenous peoples enshrined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) have set a new standard for indigenous rights. Though UNDRIP is non-binding, it has given indigenous groups in Ecuador and beyond a new instrument to defend their lives, land, and culture. Guaranteed throughout the Declaration is the right to a process of "Free, Prior and Informed Consent" for indigenous peoples when faced with decisions or legislation that may affect their people and/or territory. Article 57 of Ecuador's Constitution recognizes the right to "Free, Prior and Informed Consultation", which does not give indigenous peoples the right to oppose projects slated for their lands or policies that may affect them.

Ecuador's indigenous movement is considered one of the strongest in South America, if not the hemisphere. Both indigenous and Afro-Ecuadorian groups have been effective in mobilizing international support and resources in order to improve their living conditions. Despite growing political influence, indigenous and Afro-descendant minorities in Ecuador continue to suffer discrimination at many levels of society. Around 70% of the estimated 600,000 Afro-Ecuadorian citizens continued to suffer widespread poverty and very pervasive educational and societal discrimination in 2007.

The CONAIE, comprised of regional and local indigenous federations from the Amazon, Andes, and Coast, is a major player in Ecuador's political history, having toppled several governments and led uprisings that have paralyzed the country in response to legislation, international trade agreements, and extractive projects that threaten their rights. One powerful uprising occurred due to the negotiated Free Trade Agreement (FTA) between Ecuador and the U.S. government in 2008. To Ecuadorians, this meant that the U.S. would have inundated Ecuador with inexpensive goods, potentially destroying the agricultural sector and indigenous culture along with it. Countrywide protests expressed outrage over these negotiations. When former President Palacio repudiated indigenous demands to stop negotiations, CONAIE promised to shut down the city of Quito. The government ultimately backed away from the FTA. CONAIE and its leaders stress the ever-growing danger that indigenous cultures face with increased resource development and FTAs.[33)]

CONAIE has long sought an instrument that would better reflect the reality in the country and replace the colonial-era structures which stressed homogeneity within a single culture. The organization argues that this approach has resulted in 500 years of discrimination against Ecuador's indigenous people, their lifestyles and worldviews. Indigenous activists, environmentalists and rights defenders report frequent threats and violence against them by police, soldiers, and private security forces. This includes the legal team representing Indigenous communities suing a multinational oil company for pollution caused by drilling in Sucumbíos province between 1964 and 1992.[34)]

Predictions about the improvement of indigenous relations with the Ecuadorian state under President Correa have been overly optimistic. The government has promoted widespread natural resource extraction, while at the same time requesting funds for the innovative Yasuni-ITT Trust Fund proposal. Government efforts to expand extractive industries in indigenous territories have led to protests and a government crackdown on indigenous organizations and their supporters. For example, in June 2010, the Correa Administration charged indigenous leaders with sabotage after a protest outside of the ALBA summit (Alianza Bolivariana para los Pueblos de Nuestra América or the Bolivarian Alliance for the Peoples of Our America). The government has also accused NGOs that work with indigenous people of manipulating them rejecting oil and mineral extraction on their lands.[35)]

Ecuador is a country of great ethnic diversity and great contrasts of wealth and poverty. People identify more with their region or village than with the country as a whole, although the government has attempted to nourish a sense of pan-Ecuadoran national identity.

Although there has been some recent indigenous migration from rural areas to cities, it is fairly clear that the indigenous population in rural areas continues to be significantly higher than those in urban areas. According to the 2001 census, 82% of the indigenous population is rural and only 18% is urban.[36)]

An estimated 2 to 3 million Ecuadorians live abroad, but increased unemployment in key receiving countries - Spain, the United States, and Italy - is slowing emigration and increasing the likelihood of returnees to Ecuador.

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33) Amazon Watch. Advancing Indigenous Peoples rights in Ecuador: http://amazonwatch.org/work/advancing-indigenous-peoples-rights-in-ecuador

34) Edited and adapted from *Knapp, G.W. 2014. Ecuador. Encyclopedia Britanncia.* http://www.britannica.com/EBchecked/topic/178721/Ecuador/25834/Ecuador-from-the-late-20th-century

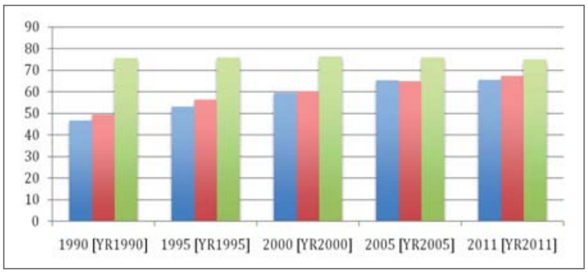
35) Amazon Watch http://amazonwatch.org/work/advancing-indigenous-peoples-rights-in-ecuador

36) Political Database of Americas: Indigenous Peoples, Democracy and Political Participation. 2006, October. School of the Foreign Service, Georgetown University. http://pdba.georgetown.edu/indigenouspeoples/demographics.html. Statistics from INEC, Censo 2001.

Large-scale migrations away from Ecuador occurred between 1980 and 2000, caused by economic downturns, political instability, and a currency crisis. Ecuador has a small but growing immigrant population and is Latin America's top recipient of refugees; 98% are neighbouring Colombians fleeing violence in their country.[37]

1-2-4. Employment

Ecuador had one of the lowest unemployment rates in the world in 2011 at around 4.2%; the rate had been steadily falling since 2005, when it reached 11.5%.[38] Participation of women in the labor force is comparable to the other developing countries in Latin America and the Caribbean, as can be seen in Figure 9. Participation of women was around 65% of the male participation rate in 2011. This rose from about 45% in 1990, so it can be seen that women are taking a much larger role in the economy of the country now. Ecuador is still slightly behind the average for all Upper Middle Income Countries, at around 73%. The economically active population is concentrated in Guayaquil and along the coast and in Quito and Pichincha province.



Source: http://datatopics.worldbank.org/gender/country/ecuador
Legend: Blue: ratio of female to male labor force participation in Ecuador;
Red: Ratio of female to male labor force in developing Latin America and Caribbean countries;
Green: Ratio of female to male labor force in Upper Middle Income countries

<Figure 9> Participation of Men and Women in the Labor Force in Ecuador, Latin America and the Caribbean Region, and Upper Middle Income Countries

1-2-5. Human Development Index

Ecuador's HDI value for 2012 is 0.724—in the high human development category—positioning the country at 89 out of 187 countries and territories. Between 1980 and 2012, Ecuador's HDI value increased from 0.596 to 0.724, an increase of 21% or average annual increase of about 0.6% (Table 8).[39]

<Table 8> Human Development Indicators for Ecuador

	Expected Years of Schooling (of children) (years)	Mean years of schooling (of adults) (years)	Life expectancy at birth, total (years)	GNI per capita (constant 2005 US $)	Human Development Index (HDI) value
1980	11.8	5.4	62.92	2547	0.596
1985	12.3	6.0	66.06	2433	n.a.
1990	11.5	6.6	68.84	2434	0.635
1995	11.4	6.9	71.23	2635	n.a.
2000	11.4	7.0	73.36	2419	0.659
2001	11.4	n.a.	73.70	2527	n.a.
2002	11.4	n.a.	73.99	2604	n.a.
2003	11.4	n.a.	74.24	2618	n.a.
2004	11.4	n.a.	74.45	2771	n.a.
2005	11.4	7.3	74.63	2881	0.682
2006	11.4	7.3	74.80	2966	0.686
2007	11.4	7.4	74.98	2977	0.688
2008	13.7	7.5	75.18	3161	0.715
2009	13.7	7.5	75.40	3138	0.716
2010	13.7	7.6	75.65	3194	0.719
2011	13.7	7.6	75.92	3385	0.722
2012	13.7	7.6	76.19	3504	0.724

Source: Human Development Report 2013 and http://databank.worldbank.org/data/views/reports/tableview.aspx#

37) U.S. Central Intelligence Agency https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html

38) http://www.indexmundi.com/g/g.aspx?c=ec&v=74

39) *UNDP. 2013. Ecuador: HDI Values and Rank Changes in The Rise of the South: Human Progress in a Diverse World. Human Development Report 2013*. http://hdr.undp.org/sites/default/files/Country-Profiles/ECU.pdf

As presented in Table 8, it is clear that the country has shown major improvements in life expectancy and income over the period. There is a gap, however, between the high level of expected years of schooling,[40) at 13.7 years, and the actual years of schooling measured as a mean, at only 7.6 years. This large gap has not changed very much since 1995.

Ecuador's 2012 HDI of 0.724 is below the average of 0.758 for countries in the high human development group and below the average of 0.741 for countries in Latin America and the Caribbean. From Latin America and the Caribbean, countries that are close to Ecuador in 2012 HDI rank and population size are Venezuela (Bolivarian, Republic of) and Peru, which have HDIs ranked 71 and 77 respectively.[41)]

1-2-6. Poverty and Income Inequality

Prior to 2004, poverty affected mostly rural and indigenous households in Ecuador. In 1998, the indigenous population had a poverty rate of 87% for all indigenous groups and 96% for those in the rural highlands group, as compared with 61% for non-indigenous people. In 2004, extreme poverty was in the range of 56% to 71% for indigenous people in the rural highlands, as compared to 25% of the non-indigenous population.[42)]

Despite the lingering problems with ethnic minorities, economic growth in Ecuador has been inclusive, which has directly reduced poverty and inequality levels and increased the middle class. Between 2006 and 2013, income poverty (using the national poverty line) fell from 37.6% to 25.5% whereas extreme poverty declined from 16.9% to 8.6%. Poverty in rural areas had been reduced from 71.3% in 2003 to 50.9% in 2011, while poverty in urban areas fell from 38.7% in 2003 to 17.4% in 2011.[43)]

Moreover, inequality in Ecuador decreased faster than the average for the region: the GINI coefficient fell from 56.6 to 49.3 between 2000 and 2010 (Table 9). This is because income growth most benefitted the poorest citizens: between 2000 and 2011, the highest growth in income occurred in the poorest two quintiles of the population. Income of the poorest 40% of the population rose 8.8% compared with 5.8% for the average for the total population.[44)]

<Table 9> Gini Index in Ecuador, 2000-2010

2000	56.59
2001	NA
2002	NA
2003	55.06
2004	NA
2005	54.14
2006	53.20
2007	54.31
2008	50.62
2009	49.43
2010	49.26

Source: World Bank

There are still significant challenges in terms of sustaining the achievements in reducing poverty and inequality. More than half of the Ecuadorian population continues to live in poverty or is vulnerable to again falling below the poverty line, particularly in rural areas.

40) Expected years of schooling: the total number of years of schooling a child of school-entrance age can expect to receive if prevailing patterns of age-specific enrolment rates stay the same throughout the child's life.

41) http://hdr.undp.org/sites/default/files/Country-Profiles/ECU.pdf

42) World Bank http://go.worldbank.org/D0JD6D8U40

43) INEC. various years. National Survey on Employment, Unemployment and Underemployment (ENEMDU).

44) World Bank. 2014. Ecuador Overview. http://www.worldbank.org/en/country/ecuador/overview (last updated April 10).

Many of the improvements in social indicators are a reflection of increased social and public investment in infrastructure (schools, hospitals, roads) and policies that expanded access to social services such as primary education and public health. Targeted public investments still largely depend on the oil sector.[45)]

Ecuador's poverty and income inequality most affect indigenous, mixed race, and rural populations. The government has increased its social spending to ameliorate these problems, but critics question the efficiency and implementation of its national development plan. Nevertheless, the conditional cash transfer program, which requires participants' children to attend school and have medical check-ups, has helped improve educational attainment and healthcare among poor children.

1-2-7. Education

The network of public education has been greatly expanded to promote the goal of universal literacy. Primary education is free and compulsory for six years beginning at age six. Ecuador has made progress in making education available to disadvantaged classes and ethnic groups and to women. Religious and nondenominational private schools also play a significant role. Population growth and limited funding have placed great strains on the educational system, however, efforts are under way to adapt the curriculum to Ecuador’s cultural diversity.

Secondary education varies from seriously overcrowded public institutions to elite private institutions emphasizing bilingualism in English, French, or German. Very few school teachers have any degree or higher education.

The National System of Higher Education in Ecuador has experienced significant growth over the last 20 years. The Constitution passed in 2008 eliminated tuition fees for the public universities, in a step to make education more accessible to all. Ecuador's higher education system consists of over 75 universities educating some 625,000 students, of which about half are public, and over 300 institutions that provide higher technical or vocational training. Most universities provide a wide range of subject areas while polytechnics and some other schools specialize. Graduate level education is relatively immature in Ecuador, having only started in 2000. Not all University professors have a Master's degree, and only some University presidents and research professors have doctoral degrees. The premier university is the Pontifical Catholic University in Quito, noted for its research programs in fields such as botany, archaeology, linguistics, and anthropology. It (along with other universities in Quito) attracts numerous students from the U.S. and Europe who participate in study abroad programs.

The Ecuadorean congress in August 2010 approved a new higher-education law that seeks to increase regulation of universities while bringing their programs in line with the country's development needs. President Correa stated that universities needed to be held more accountable and to play a more active role in promoting development in Ecuador. The law seeks to bring higher education in line with the needs of Ecuador's indigenous minority, and requires private institutions of higher education to reserve 5% of their places for full scholarships, with 10% receiving partial scholarships.[46)]

Although controversial, Correa's proposal seeks to improve the quality of teaching. By 2017, all professors

45) http://www.worldbank.org/en/country/ecuador/overview

46) *Lloyd, M. 2010, 4 Aug. Ecuador Approves Higher Education Law with Some Concessions to Universities. The Chronicle of Higher Education*. http://chronicle.com/article/Ecuador-Approves/123770#sthash.soNaGL8L.dpuf

must have at least a master's degree, and many will now be required to have a doctoral degree. Currently, Ecuador only has 250 full-time professors with doctorates, all from foreign institutions.

In order to increase the pool of qualified professors, the government has embarked on an ambitious scholarship program that provides scholarships for postgraduate study abroad. In 2011 1,070 students received the scholarships. In 2012 they expect over 3,000 students. The program requires the students studying abroad to return to Ecuador for twice the amount of time the government sponsored their education abroad.[47)]

As of 2009 the education system had 19 medical schools, all of which offer the required education needed to obtain the title of Physician, but only 12 of which offer postgraduate clinical training. Nine of these universities are public, five are private and self-financed, and five are private and co-financed. The rapid growth of Ecuador's system of medical education has led to inevitable gaps that threaten its ability to sustain itself, such as the lack of well-trained faculty to supply its medical schools.[48)]

1-2-8. Religion

Ecuador is overwhelmingly Roman Catholic. The Roman Catholic Church plays a significant role in education and social services and influences the selection of significant places for festivals and pilgrimage sites, such as Quinche in the north and Biblián in the south. Protestantism continues to grow rapidly, particularly among the disadvantaged; the largest groups are the non-Pentecostal Evangelicals and the Pentecostals. There is also a sizable Mormon congregation. Quito, Ambato, and Guayaquil have been urban centers of Protestant activity, and many of the Indians of the Sierra and Oriente have also converted. Many highlanders are practicing Catholics, and religion plays an important part in daily life.[49)]

1-2-9. Health

Some of the greatest health problems in Ecuador today include malnutrition, diabetes, and heart disease, which is the leading cause of death. Other common problems include acute respiratory infections and diarrheic diseases, which have risen dramatically since 1990. With the country's large agribusiness industry, the Pan-American Health Organization (PAHO) has found a profound increase in the number of illnesses caused by the use of pesticides and other agricultural chemicals.

Ecuador has improved its healthcare over the past decade by centralizing and attempting to organize its system into regional units. Ecuador's Ministry of Public Health is said to cover approximately 30% of the population, and in total, there are more than 17,000 physicians and 5,200 nurses working in the public system. Since the Free Maternal Child Health Law was passed in September 1994, free reproductive health services have been guaranteed for all.

Many factors have made across-the-board medical service nearly impossible. Although Ecuador's rural population has dropped from around 70% in 1950 to 33% by 2012, the combination of 40-plus indigenous groups, numerous languages, and populations in remote areas, all contribute to the difficulty in setting up an equitable healthcare system.

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47) Millard, B. and Millard. D. 2012. Higher Education in Ecuador. Pachamama Spectrum of Treasures, June 27. http://www.pachamama-spectrum-of-treasures.com/2012/06/higher-education-in-ecuador.html

48) *Joffre, C.P. et al. 2013. Medical Education in Ecuador. Med Teach*, 35(12): 979-84. http://www.ncbi.nlm.nih.gov/pubmed/24003833

49) Edited and adapted from http://www.britannica.com/EBchecked/topic/178721/Ecuador/25834/Ecuador-from-the-late-20th-century

Many of Ecuador's poorest, who live in the central provinces, Amazonia and urban shantytowns, receive no medical treatment from the two main public sources - the Public Health Ministry and the Social Security Institute. Estimates suggest that as much as 20% to 30% of Ecuador's population lack immediate access to health services, and 70% are without health insurance and do not have the means to pay for care. These marginalized groups often rely on traditional medicine and aid from volunteers and NGOs.[50)]

1-2-10. Effects of Social Factors

Ecuador has made great strides in recent years to improve health and education indicators and to improve the well-being of the population as a whole. Income inequality is decreasing, although it is still very high. Ethnic minorities, especially those in remote rural areas, still suffer from lack of services and are vulnerable to falling below the poverty line. With the right incentives, communities could be more engaged in eco-tourism, traditional crafts, indigenous medicines and other forest products to protect the country's megadiversity and improve their own lives. Water Funds are a first step to providing such an incentive. Indigenous communities, particularly women, need to be consulted and trained in how to best protect the watershed and how the funds can best be used.

1-3. Political Factors

Ecuador has a relatively long experience with democracy, but it has been marked by frequent cycles of instability. Since its independence in 1830, regionalism and individual personalities have defined Ecuador's political culture. Following a return to democracy in 1979 after nine years of military rule, party splits, bureaucratic ineptitude, and corruption proliferated. Voters have periodically blamed incumbent governments for their problems, and often have turned to populist, anti-traditional party candidates to govern. Between the years 1996 and 2006 Ecuador had seven different presidents. Political instability and lack of governance were the norm during that period.

Ecuador is active in many multilateral and international organizations and regional groups such as the Union of South American Nations (UNASUR), which has Secretariat Headquarters located in Quito. UNASUR promotes political, economic, and security coordination. Ecuador is also in the 33-member Community of Latin American and Caribbean States (CELAC) to boost regional integration and cooperation; it does not include Canada and the United States. It held its first summit in early 2013. Ecuador is also a part of the Organization of American States (OAS) and many of its associated bodies as well as the United Nations and its Economic Commission for Latin America and the Caribbean (ECLAC).

1-3-1. Election of President Rafael Correa Delgado

Ecuador ended a decade of political and economic instability with the election of Rafael Correa, a left-leaning U.S.-trained economist, in late 2006. His first term was cut short by a new constitution that he had supported during the campaign. The new constitution, written by an elected Constituent Assembly, was approved with 64% of the vote in September 2008 and went into effect in October 2008. The 2008 constitution increased the power of the president and allowed the president to run for two consecutive terms. As required under the new constitution, new elections were then organized for President, Vice President, Members of the unicameral National Assembly, and provincial and local offices. In April 2009, Correa won the presidency in the first round, and his party, Alianza País (AP), won the most seats in Congress, although not a majority.

50) http://www.pbs.org/frontlineworld/rough/2007/06/ecuador_healthlinks.html

President Correa describes his ideology as a "Citizens' Revolution," but maintains that it responds to conditions in Ecuador and is not a replication of the policies of now-deceased Venezuelan President Hugo Chávez. President Correa's populist approach weaves together themes of economic justice and Andean pride with a critique of the traditional partisanship of Ecuadorian politics. President Correa clashed repeatedly with the police and with the press from 2010-11.

Correa's first full term (2009-13) was supported by a few years of strong economic growth and the adoption of populist economic policies that included significant public investment including cash transfer programs to those living in poverty. Since coming to office, President Correa has increased social spending, expanded government control over strategic sectors, and attempted to ensure that a greater share of natural resource revenues go to the state. He has financed ambitious social spending using revenues generated by the energy sector (mainly oil) and through loans from China based on forward oil sales. According to the World Bank, today Ecuador is an upper middle income country. The poverty rate in urban areas declined from 49% in 2002 to roughly 32% in 2011, with a similar notable decline in extreme poverty from 19% to 10% respectively.

Correa won a landside re-election on February 17, 2013, with 57% of the vote. In addition to the presidency, Correa's AP movement won a strong congressional majority, gaining two-thirds of the seats in the 137-seat National Assembly. President Correa began his new four-year term on May 20, 2013.

1-3-2. Controversial Legal Decisions

Human Rights Watch maintains, however, that President Correa has used his power to "undercut freedom of the press in Ecuador" and has weakened judicial independence. Recently, President Correa through the OAS has supported a reduction in the budget of the Inter-American Commission on Human Rights (IACHR) and its Special Rapporteur on Freedom of Expression through a series of proposed reforms that were ultimately tabled in March 2013. Although countries such as Ecuador, Bolivia, and Venezuela tried to weaken the IACHR's influence and power at a special session of the OAS General Assembly on March 22, 2013, the vast majority of OAS member states rejected the effort.

In June 2013, Ecuador's National Assembly passed a new mining law by a large margin. The law attempts to regulate mining, as the country wants to reduce the economy's dependence on revenues from oil exports. The new law eases terms for small-and medium-size mining projects in Ecuador by delaying the windfall tax until miners have recovered their initial investment and clarifies guidelines and regulations for mining operations. Many large mining companies, however, remain concerned about the large tax burden placed on them by the government. In advance of the bill's passage, a Canadian company pulled out of the enormous Fruta del Norte gold mine project because of concerns about the government's high taxation on project profits.

The new law was also controversial and opposed by the umbrella indigenous organization, CONAIE, because it did not make binding a requirement for prior consultation with indigenous groups. Ecuador's large indigenous population has become increasingly active politically. While support from indigenous groups was important when Correa came to power, many including CONAIE have become vocal critics of his approach to the development of natural resources.[51)]

51) http://www.fas.org/sgp/crs/row/R43135.pdf

1-3-3. Effects of Political Factors

President Rafael Correa is a strong leader who has led his country on a solid economic path since he was elected in 2006. He won election to a third term by a wide majority in 2013. He has introduced economic and social measures that have improved the economic situation and lifted large numbers of people out of poverty. Much of the increased government spending has depended on oil export revenues and loans from China. The President has promoted both economic development and social inclusion; these policies have often been contradictory. While the president still remains popular, such actions as his rejection of the Yasuni-ITT initiative (see Section 1-4 below) and his efforts to expand petroleum and mining concessions have made some indigenous groups distrustful of his promises. The Water Funds so far continue to support environmental protection, improved water quality and remote communities in upstream areas. Efforts such as Water Funds may be a means to gain the support of some of the neglected minorities.

1-4. Environmental Factors

The Republic of Ecuador is one of the most biodiverse countries in the world, with almost 20,000 species of plants, over 1,500 species of birds and more than 840 species of reptiles and amphibians, and 341 species of mammals[52] Ecuador also has one of the highest deforestation rates and the worst environmental record in South America. It is on a path of destruction, as it claims copious amounts of raw materials.[53]

Photo: courtesy Jaime Umaquinga, FONAG

<Picture 2> Quito Watershed in Protected Area

At the same time, the national environmental policy (2011) is attempting to reverse the process. The policy proposes to: increase protected areas for conservation by 5%; reduce the deforestation rate by 30%; remediate 60% of environmental liabilities; and reduce the threat of climate change from the ecosystem vulnerability index.[54] Picture 2 shows one of the protected watersheds that provides water to Quito.

1-4-1. Threats to Ecuador's Environment

According to the Food and Agriculture Organization of the United Nations (FAO), Ecuador has the highest deforestation rate in South America (1.8% annually between 2000 and 2008), losing about 198,000 ha per year. Oil exploration, logging, and road building have had a disastrous impact on Ecuador's primary rainforests, which now cover less than 15% of the country's land mass. The country's annual deforestation rate in the early 2000s neared -2%, which equates to about 197,600 hectares (ha) per year.[55]

52) *Butler, R.A. 2006, 9 Jan. Ecuador: Environmental Profile. Mongabay.com/A Place Out of Time: Tropical Rainforests and the Perils They Face*. http://rainforests.mongabay.com/20ecuador.htm (Accessed 9 May 2014).

53) Osborn, B.E. 2014. Nature the Rights-Bearer: A Struggle of Acceptance and Application in Ecuador. BA Thesis, Middlebury College, 1.

54) Ministry of Environment. 2011. National Environmental Policy.

55) Ibid.

In order to mitigate the impact of deforestation, the Ministry of Environment has implemented the Social Forestry "Socio–Bosque" Program and the "National Afforestation and Reforestation Program" which plans to reforest 1 million ha in a 20-year period, or an average of 50,000 ha per year.[56)] While the rate of deforestation has decreased in recent years, over the first three months of 2013 Ecuador lost 9,075 ha of mostly tropical lowland forests, which is a 300% spike in deforestation from the same timeframe in 2012.[57)] After an area has been logged and abandoned, settlers follow logging roads and set up homesteads, slashing, and burning the surrounding forest for agriculture, and cattle pasture.

Small and large-scale metal mining is also a problem, which can cause disastrous impactson the environment. This type of mining requires toxic chemicals, such as mercury and cyanide, to separate the precious metals from other poisonous substances, like cadmium and arsenic. The chemicals contaminate the entire biosphere of air, land and water, and can kill animals and pose a health hazard for miners and nearby villagers. Mining also creates enormous holes in the earth that stretch for many kilometres as well as millions of tons of solid and liquid waste from dynamite explosions and deforestation.[58)]

The impact of oil exploitation in Eastern Ecuador is now notorious as a result of a long-running $6 billion lawsuit involving 30,000 Amazon forest dwellers and Texaco, once one of the world's largest energy companies (now part of Chevron). It is estimated that during the 25 years that Texaco operated in the Oriente region of the Western Amazon, the oil company spilled 17 million gallons of crude oil into the local river systems, dumped more than 20 billion gallons of toxic drilling by-products, and cleared forest for access roads, exploration, and production activities. As of the mid-1990s, lands once used for farming lay bare and hundreds of waste pits remained. In August 1992, a pipeline rupture caused a 275,000-gallon (1,040m^3) spill that caused the Rio Napo to run black for days and forced downstream Peru and Brazil to declare national states of emergency for the affected regions.

Originally, it appeared that Texaco might pull out of the Oriente without reparations to the people whose environment was so seriously degraded, but widespread protests by indigenous peoples, environmentalists, and human-rights organizations forced Texaco into negotiations. In response to the insufficient clean-up gesture payment of $5-10 million dollars that Texaco offered, along with widespread environmental degradation and serious health problems among local peoples, a class-action lawsuit was filed against Texaco in the U.S. on behalf of 30,000 people affected by the oil company's operations.

In accordance with the United Nations Framework Convention on Climate Change, the Ecuadorian government has developed a National Strategy on Climate Change which contains three Plans (Adaptation, Mitigation, Creation, and Strengthening of Conditions). This instrument and its respective plans were designed to mitigate the impacts of climate change and risk management that are already being felt in the agricultural sectors.

56) Forest Governance in Ecuador 2011. ITTO/MAE

57) *Butler, R.A. 2006, 4 Sept. Deforestation Surges as Ecuador Kills Amazon Protection Plan. Mongabay.com/A Place Out of Time: Tropical Rainforests and the Perils They Face*. http://rainforests.mogabay.com/20ecuador.htm (Accessed 9 May 2014)

58) *Zorrilla, C. 2012, 12 May. La Mineria De Cobre y Sus Impactos en El Ecuador. Lalineadefuego*.

1-4-2. Introduction of Water Trust Funds

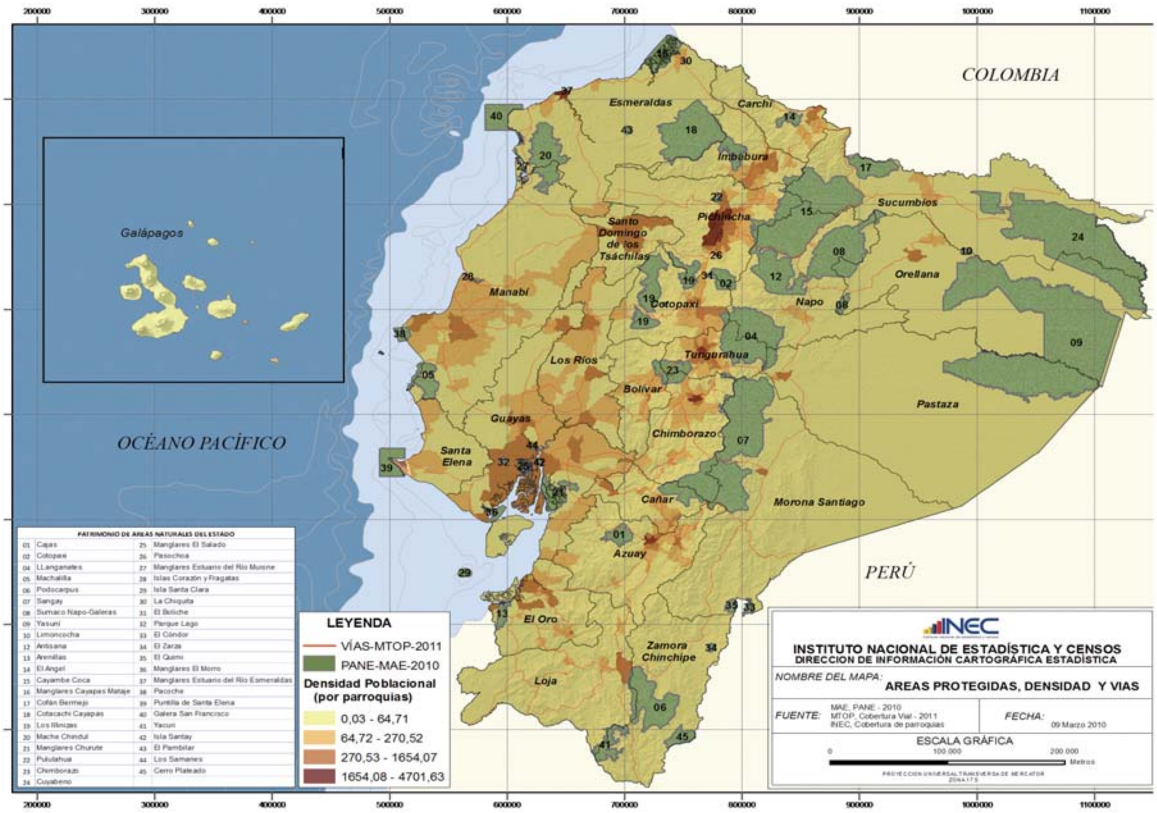
In Quito, threats to water resources led to the creation of the water trust fund FONAG in early 2000 to finance management and conservation of surrounding watersheds. Water users, whether they are city dwellers, farmers, or electricity consumers, are frequently not even aware of the source of their water. Drinking water is provided by a municipal public company, the Quito Metropolitan Area Potable Water and Sewage Company [Empresa Metropolitana de Alcantarillado y Agua Potable de Quito (EMAAP-Q)], supplying over 260,000 homes. Consumption is expected to increase by about 50% by the year 2025, increasing pressure on water resources. At the same time, financing for expanding supply is tight.

About 80% of Quito's drinking water comes from two protected areas, the Cayambe Coca Ecological Reserve and the Antisana Ecological Reserve. The two Reserves cover over 520,000 ha and are part of the country's national park system, managed by the Ministry of the Environment (Picture 3).

Photo: courtesy FONAG

<Picture 3> Cuyuja River in Protected Area of Napo Province

Their natural ecosystems are characterized by páramos, high-altitude Andean grasslands, and cloud forests recognized for their capacity to retain humidity and regulate water flows. See the map of Ecuador's protected areas in Figure 10.



Source: Instituto Nacional de Estadística y Censos

<Figure 10> Protected Areas in Ecuador

Although the Cayambe Coca and Antisana Ecological Reserves are formally protected for conservation, they face a number of threats. Over 20,000 people live in communities and agricultural cooperatives in the areas surrounding the Reserves. Their principal activity is dairy production and the sale of timber. Communities with more than 7,000 people are found within Cayambe Coca. They require water for their crops and have ancestral rights to use the grasslands for extensive cattle raising. Picture 4 shows women working in the FONAG program in Cuyuja, Napo.

Photo: courtesy Lorena Coronel]

<Picture 4> FONAG Program in Cuyuja, Napo in the Andean Highlands outside Quito

Unsustainable agricultural practices, such as overgrazing and burning of the grasslands, affect the viability of the páramos. The páramos consist of mostly glacier formed valleys and plains with a large variety of lakes, peat bogs and grass wetlands provide environmental services including water resources to more than 100 million people.

The drainage of wetlands has negative impacts on water retention, and the combination of grazing and burning of the páramo reduces soil moisture content (see Picture 5). The loss of vegetative cover can lead to erosion processes, and the subsequent sediment load could affect water quality, particularly for drinking purposes. To control these threats, the Ministry of Environment hired a local environmental NGO, Fundación Antisana, to design management plans for the two Reserves. Fundación Antisana's analysis singled out a number of actions for improving information and protecting the local hydrology.

Photo: courtesy FONAG

<Picture 5> Natural Paramos Are Threatened by Unsustainable Agricultural Practices in Highland Areas

Although the land within the reserves is technically patrimony of the government, the original landowners were never compensated for their loss of land title. Continuing land conflicts have meant that land may need to be bought or compensation paid (for example, conservation easements or payments for environmental services designed to encourage more appropriate land uses) to ensure the protection of water sources.

In order to protect these water sources in the upper watershed areas, effective systems are needed to control illegal logging, hunting, fishing, burning, overgrazing and trash disposal. To improve or protect hydrological functions, special measures may be needed to protect waterholes, prevent erosion, and stabilize stream banks and slopes. To reduce the human pressures in critical watershed areas, it is necessary to promote sustainable resource use by local communities, such as sustainable agricultural practices.

The Ecuadorian park service, Sistema Nacional de Areas Protegidas, lacks sufficient resources to implement these measures, so it developed with others. For example, as FONAG is dedicated to financing watershed protection around Quito, it complements other conservation efforts underway.

As discussed in chapter III-2 below, the aim of the fund is to collect payments from water users and channel these funds towards watershed protection activities. The fund is managed by an independent financial manager. FONAG staff estimate that their programs and projects have benefited approximately 500,000 ha of land and 2,500 people in the watersheds.[59)]

1-4-3. Protection vs. Exploitation of Resources

Much of Ecuador's wealth lies in the Amazon rainforest region where some indigenous populations still live in voluntary isolation. Ecuador produces 400,000 barrels (47,000 MT) of oil per day, and an estimated additional 900 million barrels (106 million MT) of oil reserve has been identified in the heart of the bio-diverse rainforest. In light of ecological concerns – including the future of indigenous populations – in June 2007 Ecuadorian officials indicated to the UN that Ecuador would ban exploitation of huge oil reserves if compensated by the international community for its effort to save the Amazon region and its indigenous inhabitants from ecological collapse. The hope was to raise some $350 million per year, which is equivalent to 50% of what the state would earn from petroleum extraction. In the spirit of co-responsibility, the people of Ecuador would make an in-kind contribution of the balance in global environmental goods.

Moreover, in September 2007, the Ecuadorian government for the fourth time ordered the suspension of all activities at the controversial Junin open pit copper mining project located in the ecologically diverse Tropical Andes of Ecuador. The National Coordinator for the Defence of Life and Sovereignty, an umbrella body of social organizations formed by local residents in communities affected by mining, wants Ecuador to be declared a "country free of large-scale mining" and is calling for all foreign mining corporations to pull out of the country. Monoculture oil-palm expansion is also affecting Afro-descendants and indigenous populations in Ecuador, particularly in the biologically diverse Cayapas-Mataje Ecological Reserve in Esmeraldas. Local activists report oil palm companies are increasingly moving into the northern coastal province of Esmeraldas, which is a traditional Afro-Ecuadorian zone. This is having a direct social and environmental impact on indigenous Awá and Chachi villages, including land appropriation.[60)]

These initiatives led to the creation of the Yasuni Ishpingo Tambococha Tiputini Trust Fund (Yasuni-ITT Trust Fund) for receipt of contributions from supporters of Ecuador's historical decision to forego the extraction of the Yasuni-ITT oil fields (about 846 million barrels or 100 million MT, about 20% of Ecuador's total reserves). The contributions were to finance renewable energy and sustainable development investments such as avoidance of deforestation and conservation of ecosystems. The United Nations Development Program (UNDP)'s Multi-partner Trust Fund Office administers the fund.[61)]

Through this initiative, Ecuador was planning to gradually change its energy matrix from fossil fuel to renewable energy sources. The Yasuni initiative was expected to avoid the emission of 407 million MT of carbon dioxide (CO_2) by foregoing extraction and burning of fossil fuels, protecting one of the most bio-diverse regions of the world and maintaining the livelihoods of the area's indigenous people. In addition, it would reduce deforestation and promote reforestation nationally.

59) Marta Echavarria and Paulina Arroyo, 2002. Financing Watershed Conservation: The FONAG Water Fund in Quito, Ecuador. Prepared by Marta Echavarria, Ecodecisión in collaboration with Paulina Arroyo, The Nature Conservancy.

60) Minority Rights Group International. 2008. World Directory of Minorities and Indigenous Peoples - Ecuador: Overview. http://www.refworld.org/docid/49544cc3223.html (Accessed 30 April 2014)

61) UNDP Multi-partner Trust Fund Office http://mptf.undp.org/yasuni

Ecuador's fight to save Yasuni National Park has attracted support from conservationists around the world, including such eminent figures as the scientists Jane Goodall and Edward O Wilson, the Hollywood actors Leonardo DiCaprio and Edward Norton, the former US vice-president Al Gore and the Secretary General of the United Nations, Ban Ki-moon.[62)]

The Yasuni National Park is one of the most biodiverse locations in the world: home to 596 species of birds, 2,274 species of trees and bushes, more than 382 species of freshwater fish, at least 169 species of mammals, 141 species of amphibians, and 121 species of reptiles. There are also more than 100,000 species of insects per hectare, the highest number in the world.

Ivonne Baki, the Secretary of State for the Yasuni-ITT Initiative, explained in May 2013 that the Initiative is the emblematic project of the Ecuadorian government. To avoid the environmental destruction caused by oil exploration in one of the areas with the greatest biological and cultural diversity of the Amazon, the government has committed itself to a permanent ban on oil production in the Ishpingo-Tambococha-Tiputini (ITT) oil fields, located in Yasuni.

Despite all the efforts to save the Yasuni forest and its indigenous people and species, however, economic considerations trumped protection of the environment in Yasuni, and the human-induced degradation of Ecuador's environment continues. In August 2013 President Correa terminated the historic Yasuni-ITT proposal, which aimed to prevent petroleum and mining activities in the Amazon through monetary contributions from rich nations as compensation for leaving the oil in the ground.[63)] He announced that Petro Amazonas, the state-run oil company, would initiate plans to exploit the Ishpingo, Tambococha, and Tiputini oil fields that lie beneath the eastern part of Yasuni National Park within weeks.[64)] Along with Correa's executive decision to tap into the estimated 800 million barrels (95 million metric tons) of crude oil in the Yasuni Basin, the forthcoming surge in mineral mining threatens to devastate the country's environment and natural resources.

The decision by President Correa came at a time of conflict and recent violence in the Park. In March 2013, members of the isolated Tagaeri-Taromenane group killed two Waorani, and a retaliatory attack by the Waorani led to several deaths. It is expected that increased drilling, road building, and industrial activity in the park will exacerbate an already tense situation, as the Tagaeri-Taromenane find themselves encroached upon.[65)]

The origin of the Yasuni-ITT proposal has its roots in civil society. It began as a call by CONAIE in 1995 for a moratorium on drilling in Yasuni national park, which then became a central component of later efforts by civil society groups and academics to put forth a vision for a post-petroleum economy in Ecuador. Many people in Ecuador are still fighting against petroleum and mining interests, and they intend to protect the Yasuni National Park for the future.

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62) *Johnson, S. 2013, 10 May. Saving Yasuni: Can a Revolutionary Plan Protect the Rainforest from Commercial Exploitation?. The Independent*. http://www.independent.co.uk/environment/green-living/saving-yasuni-can-a-revolutionary-plan-protect-the-rainforest-from-commercial-exploitation-8523192.html

63) *Valencia, A. 2013, 16 Aug. Ecuador to Open Amazon's Yasuni Basin to Oil Drilling. Reuters*. (Accessed 10 May 2014)

64) *Indigenous Groups and Civil Society Vow Resistance. 2014, 16 Aug. Amazon Watch*. http://amazonwatch.org/news/2013/0816-ecuador-president-pulls-plug-on-innovative-yasuni-itt-initiative

65) Ibid.

1-4-4. Effects of Environmental Factors

The contradictory policies of the government with regard to the environment have caused unrest and some instability. The internationally-acclaimed effort to protect an area of the Amazon (Yasuni-ITT reserve) was suddenly rejected in August 2013, because the international community had not come up with sufficient funds. This may have undermined President Correa's credibility in working for protection of this fragile ecosystem. Perhaps the proposal was ahead of its time. The Water Funds, on the other hand, have now been operating on similar principles for 14 years, paid for by users of the water source that is protected. The Funds could provide an economically-sound model for protection of large ecosystems, such as the Amazon rainforest. However, concessions to large oil and mining companies are not easily compatible with environmental protection. Prior consultation with communities living in the watershed and compensation to them from royalties is essential, as well as enforcement of environmental regulations. The views of the local communities on how best to preserve the forest would be a valuable input to such a program.

1-5. Technical Factors

1-5-1. Research & Development

Gross expenditures on research and development (GERD) as a percentage of GDP in Ecuador were very small in 2008 (the latest available) at 0.26%; it was even lower in earlier years at 0.15% in 2007 and 0.14% in 2006.[66] Expenditures on Information and Communication Technology (ICT) as a percentage of GDP were much higher at 5.26% in 2008. These expenditures include computer hardware, software and services; computer and network systems integration; Web hosting, data processing, other services and communications services (voice and data communications services); and wired and wireless communications equipment. High-technology exports amounted to only 2.5% of total exports. These include aerospace equipment, computers, pharmaceuticals, scientific instruments, and electrical machinery. This level is the lowest it has been since 1991. Throughout the period 1992 to 2011, the percentage had stayed above 3.2%.[67]

Ecuador has taken a number of actions to promote the development of science and technology infrastructure. The National Innovation System of Ecuador was developed by the SecretariaNacional de Ciencia y Tecnologia (SENACYT or National Science and Technology Department). The system invests in science and technology as a contribution to economic and social development, and promotes collaboration among government, academic institutions, and the private sector. Its activities include:

- Promotion of human, social, and productive development;
- Diffusion of science, technology, and innovation;
- Synthesis and convergence;
- Strengthening of the network; and
- Sustainable funding.

66) UN Data: A World of Information http://data.un.org/Data.aspx?q=Research+and+development+expenditure&d=UNESCO&f=series%3AST_SCGERDGDP

67) Masson, G. and Luis, J. 2008. Measures of Science and Technology in Ecuador. http://works.bepress.com/cgi/viewcontent.cgi?article=1002&context=jose_luis_masson_guerra

<Table 10> Institutions Participating in Science and Technology Activities

Universities	Subjects
- Autonomous National Institute of Livestock (Pecuary) Research - National Polytechnic School: - Army Polytechnic School: - Superior Polytechnic School of Chimborazo: - Superior Polytechnic School of Coastal Areas: - University of Cuenca: - Technical University of Machala: - University of Azuay: - International University of Ecuador: - Equinoccial Technological University - Private Technical University of Loja: - Catholic University of Santiago Guayaquil:	- Agro-forestry, Agro-livestock and Agro-industrial sectors - Engineering - Physics, Chemistry, Microbiology, Environment, and Geophysics - Electronics and Mechanical Sciences - Anthropology, Economics, Coastal studies, Informatics and Robotics - Microbiology and Hydraulics - Agro-livestock - Environmental Studies, Economics - Mechanics - Technology transfer - Research and Technology Transfer, Extension, and Services Center - Research and Development System (SINDE)
Government Institutions	
- Latin American Faculty of Social Sciences, Ecuador: - Ecuadorian Forest, Natural and Wildlife Areas Institute: - National Institute of Energy: - National Institute of Meteorology and Hydrology: - National Fishing Institute: - National Center of Aquaculture and Marine Research: - Ecuadorian Institute of Standardization:	Technological Impact Studies - Local biodiversity - Energy - "Charles Darwin" Research Station Research and Marine Conservation - Economic, technological, and biological research on fisheries - Aquaculture - Metrology and Standardization

Source: Red Iberoamericana de Indicadores de Ciencia y Tecnología (RICYT):www.ricyt.org

Priority economic sectors in the system are: sustainable agriculture; environment and sustainable development; renewable energy alternatives; information and communication technologies; biotechnology; and other scientific research areas. The main contributors to the process have been universities and government.

Table 10 shows the institutions with science and technology progammes and their specializations. It is clear that research and development in agro-industry, livestock, fisheries and aquaculture, environment, water, forests, biodiversity and coastal zone and marine research are important focus areas.

Much research takes place outside the universities. The Pan American Center for Geographical Studies and Research at the Military Geographical Institute in Quito conducts geographic and environmental research and postgraduate training. The same building houses other environmental institutes, libraries, and laboratories. Agricultural research is concentrated in the laboratories of the National Institute of Agricultural Research. Major research establishments are maintained by French and U.S. foreign assistance organizations.[68)]

1-5-2. Incentives for Scientists[69)]

President Correa introduced in 2010 a program that would provide incentives to attract senior Ecuadorian scientists living abroad and senior scientists from the developed world, active or retired, to come and work in Ecuador. Under the plan, 48 scientists are to be invited to come to Ecuador for up to a year to teach at universities, or collaborate in research centers or state-owned companies. The government has allocated $1.7 million to the program. It is hoped to improve the research on science and technology at local universities.

68) Ecuador Education. http://www.britannica.com/EBchecked/topic/440562/Panamerican-Center-for-Geographic-Studies-and-Investigation

69) *Hirschfeld, D. 2010, 16 Aug. Ecuador Opens its Doors to Senior Scientists. SciDevNet*. http://www.scidev.net/global/migration/news/ecuador-ope-Local biodiversity ns-its-doors-to-senior-scientists.html

Ecuador is also attracting scientists and researchers to develop new medicines, petrochemical and solar technology near the remarkably biodiverse Amazon rain forest. The planned "City of Knowledge" is proposed for Yachay,[70] in the northern fringes of Ecuador's highlands. The Correa administration hopes the high-tech center at Yachay will one day compete and collaborate with Silicon Valley in the U.S., the Republic of Korea, Japan, and the other great innovation centers of the world.

The city is planned around a university and a special economic development zone. Within the city there will be public research institutions and technological parks of knowledge as incubators for innovation. The government has purchased a 44 km^2 plot of land in Yachayon which a number of abandoned buildings stand, in various states of disrepair. These are now being preserved, rehabilitated, and integrated into the university section of the development. It could take decades for the full vision of Yachay to be realized. The Correa government hopes to rapidly transform the country into a global powerhouse. In fact, Ecuador's government has partnered with and plans to model Yachay on the Republic of Korea's Incheon Free Economic Zone.[71]

1-5-3. Research and Development in Biological Diversity

The Yasuni Scientific Research Station (YRS) was created in 1994 and is operated the School of Biology of the Pontificia Universidad Católica del Ecuador (PUCE).[72]

The Tiputini Biodiversity Station (TBS), also founded in 1994, is a biological field station established in Amazonian Ecuador by the Universidad San Francisco de Quito in collaboration with Boston University. It is the steward of 638 hectares of primary lowland rainforest approximately 300 km from Quito. TBS is situated on the north bank of the Tiputini River, a southern tributary of the Napo River within the Yasuní Biosphere Reserve. Its primary activities are associated with research and education. Located within one of the world's last wilderness areas, the main goal is to better understand nature so that appropriate and effective conservation strategies may be implemented. Scientists come to TBS to conduct research on a wide array of topics ranging from cataloguing the regional megadiversity to animal behaviour to global climate change.[73]

Much of the effort in TBS is dedicated to environmental education. About 85% of visitors to the station are students in organized groups that come for relatively short visits. TBS hopes to raise awareness about the wonders of the rainforest, pressures upon it, and the justification for maintaining it. The rest of our visitors are essentially scientific investigators who make efforts to learn more about sustainable management of this complex ecosystem in order to share the knowledge with the world.

1-5-4. Technology in Major Industries

In Ecuador, the oil sector accounts for a sizeable portion of all export earnings and represents one-third of all tax revenues. The smallest producer in the Organization of the Petroleum Exporting Countries (OPEC), Ecuador produced 505,000 barrels per day (bbl/d) of crude oil in 2012 and exported more than one-third of it to the U.S. Ecuador imports refined products, limiting net oil revenue.

70) *Mack, E. 2013, 16 March. Plotting the Next Silicon Valley -- You'll Never Guess Where. CNET.* http://www.cnet.com/news/plotting-the-next-silicon-valley-youll-never-guess-where/

71) Ibid.

72) http://www.yasuni.ec/ENyasuni.php?c=1272

73) Tiputini Biodiversity Station: A Biological Treasure. Universidad San Fransciso de Quito. http://www.usfq.edu.ec/programas_academicos/Tiputini/Paginas/About-us.aspx (Accessed 17 May 2014)

Despite a challenging investment environment prompted by government initiatives to increase the share of oil revenue for the state, 2012 oil production in Ecuador returned to the 2008 annual level. Ecuador's energy mix is largely dependent on oil, which represented 76% of the country's total energy consumption in 2012, according to the British Petroleum's Statistical Review of World Energy 2013. Hydroelectric power was the second largest energy source. Natural gas and non-hydro renewable fuels are also important to Ecuador's energy mix.[74)]

According to Oil and Gas Journal, Ecuador has three commercial oil refineries, with a combined capacity of 176,000 barrels per day (bbl/d). Operated by Petroindustrial, a subsidiary of Petroecuador, the Esmeraldas refinery (110,000 bbl/d) is in Esmeraldas, La Libertad (46,000 bbl/d) is in Santa Elena Peninsula, and Shushufindi (20,000 bbl/d) is located in Sucumbíos. Esmeraldas operates below capacity and Petroindustrial plans to upgrade it to process heavier Ecuador Oriente crude. In addition, Ecuador and Venezuela have been in discussions to construct a new refinery with a crude distillation capacity of 300,000 bbl/d in the Manabí province of Ecuador. According to recent industry reports, China's Sinopec and/or the China National Petroleum Corporation (CNPC) might fund a portion of the project.[75)]

Research on space and planetary science is conducted by the Ecuadorian Civilian Space Agency (EXA), a private Ecuadorian organization founded in 2007. It is a non-profit, non-governmental organization with civilian oversight. EXA had tested microgravity via parabolic flight with the Ecuadorian Air Force and Space Adventures. It also launched Ecuador's first two satellites, CubeSat NEE-01 Pegaso (April 2013) and CubeSat NEE-02 Krysaor (November 2013), abroad Chinese and Russian rockets, respectively.

1-5-5. Effects of Technical Factors

Although Ecuador has lagged in spending on science and technology, and has very few post-graduate programs in its higher education institutions, the country is making an effort to improve higher level education with new laws and incentives for scientists and scholars (Ecuadorian and international) to come to Ecuador and teach and conduct research to upgrade the training available in the country.

It is also positioning itself to become a high-tech center in certain areas in which it has natural advantages – research in biological diversity for sustainable development in the rainforest; development of pharmaceuticals; and research on livestock, animal behaviour and climate change. It is currently setting up a knowledge hub in the highlands on the border with the Amazon.

The natural laboratory for scientists and students around the world to study mountain, rainforest and marine systems in one small country is extremely valuable. The work on ecosystems and biodiversity could be crucial to climate change adaptation and mitigation, if Ecuador's ecosystems themselves are not undermined by petroleum drilling and mining in the megadiverse areas of the country.

1-6. Concluding Remarks

In general, Ecuador has been moving on a path towards green growth, but contradictory policies have sometimes set the country back. Economic growth has been inclusive, and education and health indicators show significant improvement. While there have been many good efforts to protect the environment in this country, more direct consultation with and involvement of people and communities living in protected areas will bring

74) U.S. Energy Information Administration. Ecuador Overview (Last updated 16 Jan 2014). http://www.eia.gov/countries/cab.cfm?fips=ec

75) Ibid.

greater benefits to all. Technical education and a large knowledge hub are being promoted, but expenditures on science and technology are still a very small part of the nation's GDP.

The Water Funds programs, which will be presented in more detail in the next chapter, are one proven means to improve water quality and environmental protection, promote economic development and improve quality of life. They are a good example of Water and Green Growth principles.

2. Water Resources Governance and Institutions

2-1. State-driven Institutions

In 2008, the Republic of Ecuador passed a new constitution after a heavily confrontational national assembly. The new constitution was approved by public referendum and became effective in October 2008, replacing the constitution of 1998. Among its many innovations was the inclusion of a concept that nature has inalienable rights, and the recognition of ecosystem rights. By including this landmark concept, the Ecuadorian government sought to shift the balance among the State, the free market, society and nature by reducing the prominent place of the market as the definitive driving force for development. In contrast with the constitution of 1998, this new document broke with the notion that water is a resource that can be exchanged, appropriated, and transformed as if it were a commodity. The control over water resources by big landowners was to be a thing of the past. It also broke with the notion that the main use of water is for agricultural development, discounting all other uses for this resource. Nature's rights within the Constitution in a way are a part of a broader system of rights linked to: the right to life, to health, to education, to a healthy environment, collective rights, and cultural rights.

2-1-1. Water in the Constitution

The Constitution in general includes mandates to protect biodiversity (Art. 400 – 403), mitigate climate change (Art. 414) and regulate environmental services (Art. 74). By establishing these mandates, the government is "obligated" to guarantee a sustainable model of development for its citizens. In all, 21 articles of the new Constitution mention water explicitly and more than 50 mention aspects related to water.

The Constitution's main principles on water management establish that: water is a fundamental and inalienable human right;[76] water is considered a national heritage; and its main purpose is for public use and human consumption.[77] Water resources, therefore, can only be publicly or community held, and the water source is not to be privatized. Water for domestic use is given the number one priority, followed by: irrigation for food security; ecological low flows; and other productive uses.[78] Civil society, by extension, has a right to be a part of the design, monitoring, and evaluation of public policy related to water through citizen participation mechanisms. As the Constitution considers water a human right, the government is obliged to guarantee sufficient and safe water and services related to sanitation, health and irrigation. How this was to be implemented in terms of proper regulations remained to be seen. It must be noted that many of the innovative aspects of the Constitution of 2008 were based upon international recommendations

76) The concept was heavily debated during the national assembly as to whether it was "access to water" vs. water as a human right in itself.

77) Article I of the Constitution of The Republic of Ecuador 2008.

78) Article 318 of the Constitution of The Republic of Ecuador 2008.

and accords such as the Millennium Development Goals (MDGs), UN General Assembly Resolution 64/292 of 28 July 2010 (which establishes the human right to water and sanitation),[79] as opposed to recommendations of the World Bank and other multilateral agencies of the 1990s and early 2000s.[80]

The Constitution set a time frame of two years from the approval of the Constitution for creating new institutions (i.e., The National Water Secretariat) and adoption of a Water Law. By June 2009, the Ecuadorian government issued a decree for the "Reorganization of the National Council of Water Resources through the creation of the National Water Secretariat."

The decree provided a legal framework for integrated water resource management, from the national level to the water basin and watershed levels. National workshops were held throughout 2009 with local as well as international organizations and stakeholders to develop a roadmap towards a national Integrated Water Resource Management (IWRM) Plan. Emphasis was placed on the criteria for the preservation, conservation, and sustainable and efficient water use. It also supported the conservation of native forests and páramo ecosystems, which are key ecosystems for water regulation in the Andean watersheds. The páramos consist of mostly glacier-formed valleys and plains with a large variety of lakes, peat bogs and grass wetlands that provide environmental services, including water resources, to more than 100 million people. Other government agencies such as the Ministry for Urban Development (MIDUVI), the Ministry of the Environment (MAE), the Public Health Ministry (MSP), and the National Irrigation Institute (INAR) in the Ministry of Agriculture, all had (and still have) jurisdiction over one or more aspects of water management in Ecuador.

2-1-2. National Water Law

The Constitution provided the framework for the National Water Law, which has not yet been approved (as of May 2014), despite the set time frame of two years from the signing of the Constitution. The deadline for the approval of the Law had to be postponed several times as a result of social unrest and the lack of consensus among stakeholders, indigenous organizations, and government agencies, including congressmen from the government's own party in the national assembly. Because of many suspensions of the Law´s approval since 2009, the water management principles stated in the Constitution have been in a state of limbo. Therefore, the uneven distribution of water has not been resolved and the people who lack access to drinking water remain in potentially vulnerable degrees of poverty. One of the main issues related to the delay in passage of the Law has been the fact that civil society and local NGOs have not been able to fully participate in the debate. There is a need to establish new strategies for public participation if the Law is to be successfully implemented and considered legitimate with the required stakeholders. This has affected the overall consensus that was to be reached with stakeholders, and in fact reflects a certain level of political instability. Equally important has been the influence of powerful economic and political groups that have lobbied the national assembly in favour of industry and big business. The lack of regulation has benefited these groups the most.

The governing principle of the Water Law is to be the creation of an institution capable of streamlining and organizing all the previously existing institutions related to water and to articulate an integrated system to be technically regulated and directed. The current legislation on water is from 1972 with many changes

79) United Nations. 2010, 28 July. Human Right to Water and Sanitation. UN General Assembly Resolution 64/292.
80) See Drinking and Sanitation Water Program for Small Municipalities and Rural Communities (PRAGUAS-WB), Water and Sanitation Program for Intermediate Cities (PRASCI-IDB), among others.

and addendums that it is incomprehensible and extremely difficult to apply. The new Water Law was to establish the legal, administrative, and institutional conditions that would guarantee access to water. It was meant to restrict illegal appropriation of water, its sources and related ecosystems, thus enforcing a strong policy of redistribution and avoiding the control over the resource in a few powerful hands.

The main issue has not been water supply in and of itself. Ecuador is a country with potentially enough water, in national terms, and four times more water than the world median per capita level. The problem is that it has been unevenly distributed[81] and contaminated. The country's water sources are being destroyed at an alarming rate. The concentration of water in a few hands is evident; many of the bigger industries, such as banana plantations pay small fees for water use, monopolize the resource, and ignore existing laws. At the same time, rural, especially indigenous communities with communal irrigation systems hold small portions of the concessions.

Many obstacles have arisen from the lack of a national-level policy. Difficulties in implementing central government decisions at local and regional levels have created tensions between ministries with conflicting interests at a sub-national level. Since the creation of the Water Secretariat in 2009 until the present, the absence of strategic planning has been tied to a lack of institutional incentives for cooperation. Many of the overlapping policies have not been cleared or thoroughly implemented; this has in turn weakened the Secretariat's presence at all levels. There has been an evident accountability gap, limited citizens´ participation and an absence of monitoring and evaluation of the existing initiatives that have been implemented. Moreover, the lack of public concern and the limited involvement of water users in policy making reflects the growing perception that many of the grand declarations within the Constitution have no plausible way of been adapted to reality. At the same time, policy-making processes and implementation have suffered greatly due to the lack of expertise and staff competent in public policy and water management. In terms of the hierarchical and institutional structure of the sector, the institutions generating public policy and plans are the same as the institutions responsible for the operational planning, design and construction of water infrastructure. This situation has brought criticism from stakeholders that the Secretariat is both judge and jury; it may sway policy to favour the rich and powerful or, in the worst case, it does nothing.

2-1-3. National Development Plan

Among the other legislative bodies and national planning instruments, the National Development Plan for Good Living[82] is the most important after the Constitution. It establishes in its objectives that it is the State's obligation "to guarantee the rights of nature and promote a healthy sustainable environment." Other objectives within the National Development Plan are related to social and economic development based on the provision of water resources and basic sanitation for the whole country. Either directly or indirectly, a number of the objectives in the National Development Plan focus on water management.[83]

2-1-4. National Water Secretariat (SENAGUA)

The institutional framework for water management has evolved since the creation of the Ecuadorian Institute for Hydraulic Resources in 1966. In the

81) Areas along the coast with higher population density suffer from water shortages, while water is abundant in the Amazon Region and the Andes, where population density is significantly lower.

82) Plan Nacional del BuenVivir 2009-2013 (National Plan for Good Living of the National Secretariat for Planning and Development)

83) See Objective 1 Goals 1,2,3,4; Objective 3 Goals 1,2; Objective 4 Goals 1,2,3.

year 1994, the National Council for Water Resources replaced the Institute. The Council's function was very limited, however, and did not include conservation, pollution control, infrastructure construction or maintenance. In May 2008, the Ecuadorian government issued a decree for the "Reorganization of the National Council for Water Resources through the creation of the National Water Secretariat." The decree provided a legal framework for moving towards integrated water resources management from the national level to the water basin, watershed, and catchment levels. It considered sustainability its main concept, and promoted ecosystem integrity, and citizen participation.[84)]

In a sense, it consolidated existing policies that were dispersed among different legal bodies and put in place certain innovations related to natural resources management that until then had only been mentioned in the constitution: environmental protection; people´s right to water; and oversight of economic and social activities that use these resources. Emphasis was placed on: preservation; conservation of natural forests and páramo ecosystems; and sustainable and efficient water use.

In its initial years, the National Water Secretariat had difficulties reorganizing and restructuring the institutional framework for water. The reason for this was that it was placed in charge of functions that were scattered throughout many institutions, sometimes with overlapping roles. The shift was met with resistance, lack of organization, and proper planning. At the same time, the institutional archive had disappeared, making a historic overview impossible, in addition to political, social, and environmental factors that the new Secretary and teams had not foreseen.

The Water Secretariat has not played a predominant role in managing water funds, mainly because it is not within its mandate to do so. The existing legal framework is ample enough so that water funds and the Secretariat have related guidelines but are not required to work in tandem with each other, at least not until a Water Law is passed.

In the case of FONAG, a concerted effort to support national initiatives was undertaken in 2009. FONAG was able to assist the Secretariat in developing an information system for water concessions and promoting citizen participation mechanisms with regards to proper usage of watersheds. This used FONAG areas of intervention (such as the Guayllabamba River Basin) as an example, which later led to the creation of a watershed council.

2-1-5. Basin-level Institutions

Ecuador's 2008 constitution provided that an integrated approach should be taken with watershed management and further provided that the Decentralized Autonomous Governments(GADs) should have more expertise in the subject. Under the Constitution[85)] the GADs are to be integrated into regions that, among other things, will be in charge of integrated watershed management. The COOTAD points out that regional GADs should manage the watersheds and create watershed councils.

Additionally, Article 411 of the Constitution guarantees the conservation, restoration and integrated management of water resources, watersheds, and ecological flows. Thus, the Regional GAD, in coordination with all levels of government, is expected to implement the watershed management plans, including sub-basins and micro-basins in their respective territorial jurisdictions.

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84) IUCN http://www.iucn.org/news_homepage/all_news_by_theme/water_news/?1058/The-Ecuadorian-National-Water-Secretariat-is-Created

85) Article 244

This new context of national governance required that the regional GAD define regional integration in its territory. However, as the regional GADs are not yet operational, it is difficult to give detailed information on the state- and basin-level institutions that govern the watershed area. It is expected that the water law, which is in the approval process, will clarify and specify the role of the different actors in water management.

Under the decree that created SENAGUA (May 2008), water was identified as a "strategic national resource." The decree provided the tools for integrated water resources management and decentralization to the river basin level. River basin management committees are expected to be responsible for coordination of the operation and maintenance of irrigation and water supply systems in rural areas. The decree provided that water resources management would be decentralized, through river basin management committees. It included many modern principles of water management, putting emphasis on ecosystem needs and the human right to water; it recognized nature's need to be included in water allocation decisions.

It also included a mechanism to decentralize water management by the creation of river basin committees. This decree was the first of its kind, and it clearly supports an IWRM and ecosystem approach. This was a radical change for Ecuador.

2-1-6. Municipal Water and Sanitation Institutions

Municipal governments, in turn, have the exclusive responsibility to provide safe, public drinking water within their territories. The parish (or district) level has the obligation to promote activities for conservation of biodiversity and environmental protection in its communities.

By handing over many of the responsibilities for water management to local governments in a decentralized process, the central government ceased to be the sole entity in charge of water management. It also transferred fiscal responsibility to local governments in that the share of the expenses and many of the conflicts become a local burden instead of a national one.

The creation of water funds for watershed protection was originally through a municipal ordinance that authorizes a water company to create a trust fund from a small percentage of its water fees. The water funds relevant for this case study are described below.

2-2. Market-oriented Mechanisms

2-2-1. Water Funds Administration and Institutions[86)]

Water Funds have proven to be the most efficient financial mechanisms when considering long term, permanent and transparent financing. They serve as a trust fund that is permanently capitalized by public and private stakeholders to finance upstream land management in order to guarantee clean water supply, as well as conservation initiatives. A multi-institutional body that determines how to allocate revenue administers the funds. Generally, revenue is invested in watershed conservation, to improve or maintain water-related benefits and regulate water related risks. The location of the six water funds in Ecuador is shown in Figure 11.

Watershed management projects are financed through the interest generated from the trust fund, as well as additional investments from water users or external donors, and a portion of the trust itself. In the cases of Colombia and Ecuador, a portion of the revenue is destined to a reserve fund that is used to cover

86) This section is summarized from Coronel, L. and Zavala, P. 2014. Guia y Herramienta Practica Para Crear Un Fondo De Agua (publication pending).

Source: Coronel, Lorena and Zavala, P. (2014). Guia y Herramienta Practica Para Crear Un Fondo De Agua (publication pending).

<Figure 11> Location of Water Fund Watershed Areas in Ecuador

some operational costs, and to pay for transactional costs associated with conservation agreements with communities that live in or near the watersheds.

The financial mechanism of a water fund must be flexible and able to adapt to local realities, which means that each Water Fund has a different institutional structure depending on what its needs are. In the case of FONAG in Quito, four administrative units exist within the Fund.The Board of Trustees is the superior body where the decision-making process takes place. It is made up of representatives of all the member institutions: EPMAPS (Quito Metropolitan Area Potable Water and Sanitation Company), EEQ (The Electric Company of Quito), The Nature Conservancy, Swiss Agency for International Cooperation and Development (COSUDE), the Consortium for Training in Renewable Natural Resource Management (CAMAREN), and two companies, The Andean Brewing Company and the Tesalia Springs Bottled Water Company.

The Technical Secretariat is in charge of executing the operational activities, developing work plans, strategies, regulations and conservation initiatives for the protection of watersheds and water through its programs and projects. The Secretariat has 30 personnel on its staff. An independent private asset manager for the Trust Fund, Enlace Fondos, serves as legal representative and is in charge of all capital assets. Finally, the Technical Committee serves as an advisory board made up of delegates of the stakeholder institutions.

Public sector stakeholder involvement has been fundamental to Water Funds, given that in many cases their contribution, in financial terms, is significant and permanent. Public stakeholders represent, in many cases, a large number of water users and are represented by local authorities, public water companies, and electric companies, among others. This is the case for Quito, where the Water and Sewer Company is the largest contributor.

FONAG - The Water Fund for Quito

The regulatory framework for the creation of FONAG was a municipal ordinance[87] in which the water company authorizes the creation of a trust “Fondo Ambiental para la Proteccion de las Cuencas y Agua (FONAG)” which would finance itself from a monthly transfer of 1% of all water fees from the city of Quito. The Quito Metropolitan Area Potable Water and Sanitation Company (EPMAPS), along with international agencies, promoted the establishment of the fund as a privately-held endowment fund. The Water Company until 2008 was called EMAAP-Q.

The funds allocated to this entity would be destined to programs and projects for the protection, conservation, and recovery of watersheds and water resources

87) See Art. II.383.7(Section III on Contributions and Incentives) Metropolitan Ordinance 213 from September 2007.

that supply the Metropolitan District of Quito. The Ordinance also states that from the second year on, "… this contribution will rise 0.25% annually for four years until it reaches 2%, an amount which will stay and contribute to the permanent quest for provision of water under adequate conditions for its consumption." Among its main objectives, FONAG is designed to guarantee sufficient and good quality water through co-financing actions aimed at protecting watersheds to achieve the natural regeneration of water. The specific programs FONAG is involved with include: the Restoration of Natural Vegetation Program, the Environmental Education and Outreach Program, the Surveillance and Monitoring of Protected Areas Program, the Water Management Program and the Training Program.

The board of trustees, comprised of stakeholders who contribute to the fund, approves the operational plans and selects a Technical Secretary who serves as "Executive Director of the Water Fund." Among the trustees are the Electric Company, CerveceriaNacional (The National Brewing Company), Tesalia Springs Company (a water bottling company) and the Swiss Agency For International Cooperation and Development (COSUDE).

FONAPA – Fondo para la Conservacion de la Cuenca del Paute

Based on the experience of FONAG, the Municipal Telecommunications, Drinking Water, Sewage, and Environmental Sanitation Company of Cuenca (ETAPA) proposed a similar initiative through public and private financing schemes. ETAPA invited several Paute River watershed stakeholders to participate. Among them were the Electric Company (ELECAUSTRO), HidroPaute (now CELEC), the University of Cuenca, the Tropical Mountain Range Foundation and the Municipal Drinking Water, Sewage and Watershed Management Company of Azogues (EMAPAL). The fund started off as a public-private collaboration to "ensure the conservation, protection, preservation and restoration of water resources and the environment in the Paute River watershed through the investment of returns from the trust's autonomous capital and from external contributions in projects and programs designed to this end." The board of trustees is composed of all its constituents; they in turn appoint a board of directors (composed of the three major contributors and two additional members who are elected within the board). The board of trustees approves annual reports and contractual details. The board of directors dictates regulations for the fund's operations, appoints a technical secretary, approves work plans and budgets, and lobbies possible contributors.

FORAGUA – Fondo Regional del Agua (Regional Water Fund)

In the year 2007, the city of Loja approved a municipal ordinance that put in place a special consumption tax on water in order to help finance the conservation of water resources. The tax varied between US $0.03 to 0.07/m^3 of water for residential use and $0.10/m^3 for industrial uses; the collected amount is to be deposited in a special account and to generate approximately $300,000 annually, all destined to fund conservation initiatives, environmental awareness programs and reserve management. This "surcharge" was to be known as the "environmental charge" on household water bills. The ordinance also allows municipalities to declare areas of strategic importance as municipal reserves designed to protect biodiversity and water sources. The declaration of land as a municipal reserve limits the uses that can be made of natural resources within those properties. By the same token, the ordinance also allows for the municipalities to purchase land in or near watersheds from private landowners.

FORAGUA was created under the initiative of five Municipalities in the southern part of the country:

Celica, Loja, Macará, Puyango and Pindal, and with the support of the Nature and Culture International Corporation. The Fund was created in 2009 in order to conserve, protect and restore environmental assets, especially those that are most fragile and threatened. The mechanism of contribution to the Fund is regulated by the municipal ordinances that each Decentralized Autonomous Government (GAD) maintains in its territory when they enter as part of FORAGUA. Collections are made through environmental rates from each one of the municipalities. The Fund's resources are used in the programs of integrated management of water resources of the municipal adherents.[88)]

Until 2014, eleven municipalities have joined FORAGUA as a means to finance and sustain their environmental activities, especially aimed at the protection of water.

FORAGUA is a sponsor fund that provides technical assistance to the constituent municipalities so that they in turn implement the activities. The FORAGUA is responsible for evaluating and financing the projects submitted by the municipalities, and giving adequate follow-up.

Slowly, other municipalities within the southern region of Ecuador became interested in the mechanism and put in place similar ordinances. Soon, local governments proposed an initiative to aggregate these ordinances into one functioning system. This is how the Regional Water Fund (FORAGUA) came to be. In its objectives, FORAGUA states that its main goal is "the conservation of intact and the restoration of degraded ecosystems through reforestation and natural regeneration in areas important for hydrological services in watersheds in Southern Ecuador." FORAGUA was established in 2009 with the participation of five municipalities and an NGO, Nature And Culture International (NCI). Two more joined the fund in 2011, and by December 2013 a total of 39 municipalities were constituents or were in the process of being included.

By mandate, the municipalities that constitute the fund devote the resources exclusively to water conservation for a period of 80 years. This allows the undertaking of long-term conservation programs and forest regeneration initiatives. Of the total of funds raised through the environmental tax, 90% of the revenues are reinvested in the municipality proportionally to the amount collected, and 10% is used for the operations of the technical secretariat of the fund.

PRO-CUENCAS – Fund for the Protection of Watersheds in Zamora

PRO-CUENCAS is a financial mechanism for managing and administering financial resources to implement initiatives that promote the sustainability of natural resources and biodiversity in the watershed basins that supply water to the Zamora Canton. The Fund seeks to link users of the water with the conservation of natural resources of the watershed basins. Their lines of action focus on environmental education activities, monitoring, communication, productive projects and institution building. Activities implemented are carried out directly.

The Fund was set up with the participation of the Municipal Decentralized Autonomous Government of Zamora, the Arcoiris Ecological Foundation, the Ministry of the Environment, the National Environmental Fund, the Nature Conservancy (TNC), and Conservation International Ecuador (CI), through Incorporation Agreement signed on March 22, 2006[89)]

88) http://www.foragua.org/?q=node/44

89) The Nature Conservancy (TNC). 2009. Reportes del avance del proyecto de fondos réplica Proyecto FONAG-USAID.

contributions received by PRO-CUENCAS are voluntary; there is no legal mechanism for fundraising.

PRO-CUENCAS also sought to formalize itself as an institution through a commercial trust, which could not be achieved due to high maintenance costs. So far, it is handled as an account within the National Environmental Fund (FAN). In 2012, Zamora joined the Regional Fund for Water (FORAGUA), mentioned above.

FONES - Fund for the Protection of Water in Espíndola, Loja

FONES was born from a seed input of the Pro-Water Project, through the Municipality of Espíndola, province of Loja. Initially it was thought to formalize the Fund through a commercial trust; however it could not be constituted due to the high maintenance costs involved, compared to the capital and the financial potential of the Fund. Thus, it was formalized through the creation of a sub-account at the National Environmental Fund (FAN).

FONES started its first activities in 2008, focused on environmental education, support to productive projects, communication, monitoring, and institutional strengthening of the Fund. There is no legal document that formalizes the contributions of the Fund, reason why contributions are voluntary.

Initially, FONES worked for the care of the water sources at the Espíndola Canton exclusively, but expanded its vision by leading the creation of a Fund of the Commonwealth in the Basin of the Catamayo River, which includes five Municipalities around this basin: Espíndola, Quilanga, Sozoranga, Gonzanamá and Calvas. However, given the scale of this potential Fund and with USAID's support, it was recommended that these local governments join in one greater effort that works in the area, FORAGUA. Currently, they are in the process of entering to it.

2-2-2. Private Sector and Water Funds

The objectives of the water funds are related to protection and conservation of ecosystem services such as water quality, consistent flow, and reduction of sedimentation in reservoirs. In many cases, the private sector, represented by water bottling companies, brewing companies and agricultural cooperatives, has found that supporting these types of initiatives is a way to lower production and operational costs.

TNC has developed the following "Stepwise Process for Companies Considering and Making Water Fund Investments":[90)]

- Understand the status of and stress on the watershed(s) and its relationship with the broader region;
- Assess your company's impacts and dependencies on watershed ecosystems;
- Identify priority water-related benefits and risks—those most relevant to business performance;
- Research and evaluate conditions and trends in the priority ecosystem services, as well as the drivers of these trends;
- Select the scope within which to establish or participate in a water fund (e.g. a specific product, facility, market, landholdings, major customer, supplier, etc.);
- Initiate or join the water fund and contribute to joint priority setting and strategy assessment for managing risks and opportunities;
- Support the fund in designing the best possible investments in strategic conservation and restoration programs, using Resource Investment Optimization

90) Tallis, H. 2012.Water Funds Business Case. Conservation as a Source of Competitive Advantage

System (RIOS) and other tools;

- Invest on the capitalization needs and/or conservation activities previewed by the water fund; and
- Monitor outcomes to ensure efficient return on investment.

Private investment in water funds has increased in recent years and promises steady growth. In Latin America, the following companies are investing in Water Funds: Anheuser-Busch Inbev, ASOCAÑA, Brasilia Water Supply Company, Backus (SabMiller Perú), Bavaria Brewery (SabMiller Bogotá), Caterpillar Foundation, Dow Chemical Foundation, Empresas Publicas de Medellin (EPM), FEMSA Foundation, Johnson & Johnson, Kimberly-Clark, National Brewery (SabMiller Ecuador), PROCAÑA. Specifically for FONAG the local brewery, Cerveceria National, and the bottled water company, Tesalia Springs, are private sector investors.

The private sector has different levels of participation in water funds. In some cases private corporations have been constituents of water funds since their creation, while in other cases, companies have made specific contributions support the implementation of activities of the fund. For example, FONAG has included as a constituent the Tesalia water bottling company, and has also received funding for specific actions from other private companies like Coca Cola. This indicates a sense of corporate social responsibility in protecting the watershed and the water source by beverage companies.

2-3. Community-centered Institutions

The Código Orgánico de Organización Territorial (COOTAD, Organic Code for Territorial Organization), passed in October 2010, established the responsibilities and obligations of local government, following Art. 261 of the Constitution. This article sets the framework for shared responsibilities between each level of local government and the central government. In essence, this legislation mandates coordination among the different levels and establishes parameters for citizens' participation and stakeholders' involvement in planning and implementation of public policy related to (among other things) water. In Ecuador, the political sub-divisions of local government go from the regional to the provincial to the municipal to the parish levels. Each level has a certain responsibility regarding water resources and its management according to the COOTAD. The regional levels are still in development, and no further legislation has been passed to specify their functions. Yet, the provincial level has watershed management among its responsibilities.[91] It has the authority to establish taxes destined to the conservation of watersheds and environmental management and ecosystem recovery as well as irrigation, related to existing water sources.

Water Funds represent an incentive for private business and public stakeholders. But for water trust funds to work, the communities most affected by deficiencies in water management or quality must be involved. Farmers, indigenous communities and landowners upstream are most responsible for protecting the land and its water quality and must sign on as well. In the case of FONAG, this meant adopting an approach whereby the technical team held workshops with indigenous farmers and ranchers, whose farming practices, though passed on from generations, were obsolete and detrimental to their immediate environment. Generations of indigenous farmers had allowed their cattle to wander freely. Farmland and forests, as a result, became overgrazed and denuded of vegetation. During the rainy season, cow dung and water waste poured downhill, contaminating

91) See Art. 32, 55, 132, 136, 137 of the COOTAD.

water sources downstream and costing exorbitant amounts of money for water utilities that depend on clean water. The process involved discussing with the farmer communities the benefits of certain conservation practices that would be beneficial to all. It was important to give the upstream farmers support for watershed protection with programs and projects that could help them optimize their farming practices and do so in an environmentally conscious way and respectful of their ancient traditions. Through FONAG´s outreach efforts, farmers are taught how to improve grazing methods. They receive training in crop and cattle rotation to prevent overgrazing.

Although the land within natural reserves is technically government property, the original landowners were never compensated for their loss of land through expropriation. This led to continuous conflicts over land, which has called for a new strategy that may include compensation rather than expropriation. For example, payment for environmental services designed to encourage more appropriate land uses can be expected to better protect water sources.

Possible activities that could be financed through this mechanism include: land acquisition in critical areas, alternative income initiatives for local residents, supervision, implementation of improved agricultural practices, environmental education, and training.

2-4. Concluding Remarks

Ecuador has not yet been able to get its water law approved by the National Assembly since 2009, partly because of the lack of consensus among stakeholders, indigenous organizations, and government agencies, including congressmen from the government's own party. Because of many suspensions of the Law´s approval since 2009, the water management principles stated in the Constitution have not been implemented.

The National Water Secretariat (SENAGUA) was created in May 2008, and that was to oversee a system of integrated water resources management and decentralization to the river basin level. River basin management committees were supposed to be responsible for coordination of the operation and maintenance of irrigation and water supply systems in rural areas. The decree included many modern principles of water management, putting emphasis on ecosystem needs and the human right to water; it recognized nature's need to be included in water allocation decisions. However, SENAGUA has not been very effective, few river basin committees were established, and the IWRM principles have not been systematically introduced in Ecuador.

What has happened is that the Water Funds mechanisms have become the means to manage water resources and protect the environment in some major river basins in Ecuador. The funds have also become a means of drawing in the private sector and public stakeholders. In order for them to work, the communities most affected by deficiencies in water management or quality must be involved. Farmers, indigenous communities and landowners upstream are most responsible for protecting the land and its water quality and must sign on as well.

IV. Performance of Water Funds in Ecuador

Transparency and accountability are fundamental parts of a Water Fund. That is why technical secretariats issue periodic technical and financial reports to their constituents.

It has also been important to analyze the impact of the initiatives to see whether they are reaching the objectives they were designed for in environmental and social terms.

The following is a brief summary of the main results achieved from the impact analysis reports for FONAG, the accountability reports and general results from other Funds in Ecuador as well as interviews and a survey of stakeholders.

1. Generic Performance

According to the respondents to the questionnaires for this survey, the degree of achievement of the objectives outlined the Water Funds is evaluated as good.

Some factors contributing to the successes of the water management plan were listed as follows:

- Various water stakeholders (public and private) united under one common objective;
- Long term financing that allows for strategic planning for extended initiatives;
- A mechanism that generates confidence from its contributors;
- Full transparency in the management of the funds and activities with thorough accountability processes and stakeholder involvement;
- Strong political backing from local governments and technical support from International Cooperation Agencies and NGOs;
- Continuous training for staff members of the Secretariat and personnel;
- Agile mechanisms for management and participation;
- Direct contact with indigenous communities in the highlands;
- Close work with the most ecologically compromised areas with water availability and quality;
- Mechanism that is flexible and adapts to local conditions and has been widely replicated;
- Generation of environmental awareness in the general population;
- Inter-institutional coordination; and
- Local capacity building.

Some factors that may have caused unexpected consequences in the plan's implementation were mentioned as follows:

- Failure to meet obligations by some of the constituents;
- A change in political climate and institutional instability with local authorities has on occasion affected the continuity of financing for the funds;
- Disparity in the decision-making processes among the constituents of a Fund.
- Inadequate communication of the results achieved of a Fund;
- Small financing from NGOs that does not guarantee long-term activity development or program sustainability;
- Sudden changes in national policy and regulatory framework in regards to the use of public funds;
- Lack of coordination between different State institutions;
- Central government policies have weakened NGO presence and local governments; and
- Institutional and regulatory instability for water resource management inhibits the capacity for long-term planning.

The efficiency of the project administration system and the implementation timely are qualified as good (8.06 and 7.75 out of 10 respectively). The input cost was rated good and transparency was rated high.

The performance indicators are shown below:

i. Economic performance (EP)

a) Increasing gross regional domestic product (GRDP) brought by the case;

b) Creating jobs in the local economy thanks to the case;

c) Local development to national standards caused by the water fund; and

d) Technological performance and technological advancement, and

ii. Social Performance (SP)

a) Improvement of people's health by the case;

b) Improvement in quality of life by the case;
c) Increased citizen participation in decision making in or by the case; and
d) Increased gender equality in or by the case; and

iii. Environmental Performance (ENP)
a) Improvement in water quality by case;
b) Maintaining or restoring biodiversity by case;
c) Improvement in disaster safety by case; and
d) Increased environmental awareness by case; and

iv. Overall performance (generic, economic, social, and environmental performance) of the case.

2. Economic Performance

The progressiveness of water institutions based on factors such as effectiveness, flexibility, adaptability, technological applications, innovation, and openness to change has been evaluated by some of the respondents:

- Water funds have demonstrated great efficiency in project development yet have had issues when it comes to flexibility and adaptability due to a rigid institutional structure. In some cases they have implemented new technologies supposedly to promote innovation, but these have not been shared or properly communicated to the general population.
- These are dynamic processes in which all the users and stakeholders must participate in order to reach the established institutional goals. Stakeholders must also be aware of the particular poverty alleviation needs of the communities where the initiatives are implemented.
- It is important for these mechanisms to focus on closing the gap in the equitable distribution of benefits among the users of the lower and upper watersheds, taking advantage of scientific and technological knowledge generated from these initiatives.
- In the case of Ecuador, many of the Water Funds, with the exception of the Tungurahua Water Fund, have suffered huge setbacks due to the fact that many of their activities respond to political requirements rather than technically sound, environmentally, and socially conscious requirements. It can still be an important and flexible mechanism if the roles are clear and user participation is guaranteed and established in the decision- making process.

The mechanism's main objective is to bring together stakeholders to pay for conservation efforts. It also promotes partnerships between the public and private sectors, involving them in all stages, from design through to implementation.

The funds are managed by a financial institution and can only be spent on activities and purposes stipulated in the trust fund contract. In some cases only the financial returns from the endowment is spent on conservation initiatives. This allows the money flowing in to the endowment to be saved in order to ensure sustainability of financial resources in the long term. In other cases, part of the endowment and the financial returns is spent.

It is important to point out that water funds are a financial mechanism that need to be profitable in order to function properly.

Table 11 shows the main contributions to FONAG's endowment since 2000.

<Table 11> Contributions to FONAG Endowment (US $ thousand)

CONSTITUENT	2013	2008	2000
EPMAPS-QUITO	10,681	4,886	19
TNC	81	81	2
EEQ	585	360	0
CERVECERIA NACIONAL	66	36	0
THE TESALIA SPRINGS COMPANY	21	7	0
CAMAREN/COSUDE	35	30	0
	11,449	5,400	21

Starting with US $21,000 seed capital in the year 2000, by 2008 the endowment reached US $5.4 million and in 2013 the endowment was US $11.4 million (see table 11). FONAG only used the financial returns from the endowment, which have generated interest and gains of up to US $6.3 million by 2013.

FONAG has raised funds from other institutions and projects, be they through donations or as counterpart funds. One of the more significant contributions, in terms of scope and project size was the project "Protecting Water Sources for biodiversity Conservation" financed by USAID.

By 2008, for each dollar FONAG put in a project, itwas able to an additional $3 as matching funds. FONAG has proven to be profitable which has allowed it to implement initiatives to reach its objectives through the following programs: (a) Recovery of vegetation cover; (b) Communication; (c) "Guardians of the Water" Environmental Education Program; (d) Surveillance and monitoring of protected areas; and (e) Management of water.[92] FONAG allocates 20% of the resources to the co-financing of diverse projects and 80% to the implementation of permanent programs.[93]

3. Social Performance

The water fund dedicates 80% of its funding to long-term 'programs' and 20% to short-term 'projects'. Within the long-term programs, the two largest are the Rehabilitation of Vegetative Coverage (Recuperación de Cubierta Vegetal) and the Surveillance and Monitoring of Protected Areas (Vigilancia y Monitorea de ÁreasProtegidas). Each of these programs supports activities usually identified by the communities themselves. Additionally, FONAG has embarked on programs that focus on changing cultural perceptions and raising awareness through environmental programs for children and a strong focus on integrated management of water resources from the higher watershed of the Guayllabamba River (see Picture 6).

photo courtesy The Nature Conservancy

<Picture 6> Children Participating in the FONAG Conservation Program

3-1. Environmental Education

Among the most important activities that FONAG has been involved with, the Environmental Education Program is one of its most beloved. The objective of the Program is to generate a change in attitude with regards to the environment and especially water. To do so FONAG implemented a program for children who live near watersheds that supply Quito with water. The program focuses on two areas: promotion of environmental awareness and education. The main participants are children from fifth and sixth grade from rural and urban schools. Around 6,000 children participate annually which involves not only the children but educators and parents as well.

92) FONAG, 2006. Fondo para la Protección del Agua: Invirtiendo en el futuro. Rispergraf, Documento de divulgación. Quito, Ecuador.

93) Since 2012 FONAG reorganized its activities and eliminated the Training Program.

3-2. Work with Communities

Poverty is severe in the high watersheds of the Andes where FONAG works. The thin soil, cold climate, and limited livelihood options make for low standards of living where basic needs are not satisfied. Growing populations, increasing subdivisions of land, and more extensive monoculture to supply urban markets represent underlying challenges for the future. Many villagers subsist by keeping cattle (dairy and beef), often in the páramo grasslands that supply much of Quito's water.

The Rehabilitation of Vegetative Coverage (Recuperación de Cubierta Vegetal) and the Surveillance and Monitoring of Protected Areas (Vigilancia y Monitorea de ÁreasProtegidas) Programs support community activities such as organic gardens, guinea pig farming, and sewing cooperatives for women in the communities. The activities are aimed at offsetting the local costs of land-management changes and generating goodwill toward the water fund. A community capacitation meeting is shown in Picture 7.

The socio-economic impact of the fund had not been studied until the evaluation by The Nature Conservancy mentioned above, which was done in only four of the 80+ communities in the affected watersheds. There were three selection criteria for assessment villages: FONAG projects had run for at least three years; FONAG's work included support for economically productive activities; and there were communities in the relative vicinity in which FONAG had not worked that were likely to be fairly similar and could thus act as control communities.

Photo: courtesy Lorena Coronel

<Picture 7> Community Capacitation with the Ranger of the Antisana National Park

For the assessment communities, Water Fund projects were found to have benefited 2,500 people in rural parts of the water supply area. The study also mentioned that trying to measure impact was extremely difficult due to the fact that activities of the Fund could not be distinguished from activities from other institutions working in the same areas. Yet, households that were willing to reply to surveys claim they have seen improvements in their own farming practices, reductions in household expenses and healthier diets.

4. Environmental Performance

At least 70% of the water that Quito's 2 million inhabitants consume comes from the highland páramos near the city, specifically from three protected areas: Cotopaxi National Park (Picture 8), Cayambe–Coca Ecological Reserve, and the Antisana Ecological Reserve (see Figure 12). The highland páramo acts as a natural sponge that absorbs vast amounts of rainwater and cloud mist that is slowly released, acting as a natural water tower. When kept intact, it is one of the more botanically diverse habitats on earth with approximately 4,700 plant species—all adapted to the intense ultraviolet radiation, cold, and wind of high elevations.

By the year 2005 Quito's water demand was 7 m^3/s and is expected to rise to 15 m^3/s in 2050. For this reason, conserving the ecosystems is essential in order to guarantee sufficient water for the inhabitants of the city. Indigenous farmers in the region regularly burn sections of páramo in order to stimulate new growth for good cattle pasture. This has been a tradition passed for generations. Yet in recent years the burning has caused wildfires and greatly reduced local water retention. Grazing negatively impacts local water quality as well. This is why the water fund has focused the bulk of its

Photo: courtesy FONAG

<Picture 8> Cotopaxi National Park

Source:The Nature Conservancy (TNC), 2012. Report on the Ecological and Socioeconomic Assessments of the Quito Water Fund.

<Figure 12> Map Showing Three Protected Areas that Comprise the Watershed Area Covered by FONAG

resources on protecting sensitive páramo areas from fire and cattle grazing as well as restoring degraded páramo and nearby forests. This is achieved through the environmental education programs with upstream landowners and training them on ways to improve their livelihoods while, at the same time, protecting Quito's watershed. The Fund has implemented five programs that include strengthening control of protected areas and restoring vegetation in degraded areas.

The ecological benefits generated by water funds have been questioned, because accurate information that proves their impact in terms of quality and quantity of waterdoes not exist. The following is a summary of the main results from the Socio-economic and Ecological Assessment by the Nature Conservancy from November 2010 to January 2012.[94] The study explored whether the water fund was delivering measurable benefits to nature and people. The results found are an approximation of the environmental impact the fund has had during its existence.

The main ecological results of the evaluation show:

- Two of the three water fund sites had similar levels of photosynthetic activity to an intact páramo reference site protected for more than 40 years.
- Two of the water fund sites showed before and after improvements.
- The third water fund site did not show increased photosynthetic activity, as it was already intact when the water fund assumed responsibility for protecting it. Here the water fund activities appear to have prevented a decline, as páramo grasslands directly to the north and

<Table 12> The Parameters of Analysis for the Study

Photosynthetic activity of páramo areas using remote sensing imagery	Three sample sites including one that currently provides 50% of Quito's water
Páramo plant diversity using botanical transects	Three sample sites including one that currently provides 50% of Quito's water
Water-quality parameters using water samples	8 river segments covering 3 of 6 water fund watersheds
Aquatic invertebrate diversity and rareness using samples	8 river segments covering 3 of 6 water fund watersheds
Riverbank erosion hazard, fluvial habitat, and vegetation quality using local measurements and indexes	

94) The Nature Conservancy (TNC). 2012. Central Science and Northern Andes & Southern Central American Conservation Programs. Report on the Ecological and Socioeconomic Assessments of the Quito Water Fund.

west have been altered, with burning of the grasslands and heavy grazing by cattle. This confirms the pressure on the site is real and that it has been halted.

- All three of the conservation sample sites had greater plant species richness than the control sites. Two of the three conservation sites also had an equal or greater number of plant species than the intact reference site.
- Based on several indicators, water quality in water fund river segments was found to be, on average, slightly higher than in matched control segments of nearby rivers, but there were few significant differences. Water quality in water fund segments was within national standards except for Total Coliforms, Faecal Coliform, and Escherichia coli indicating that there is faecal contamination in the water.
- Aquatic invertebrate species richness and number of rare species were significantly greater in the water fund river segments than in the control segments. Without time-series data, however, it is difficult to infer causality or to pinpoint effects of water fund projects.
- The riverbank erosion hazard, fluvial habitat, and riparian vegetation quality indexes all showed that water fund segments of rivers were more intact than control segments but of lower quality than the intact reference site.

The study reached interesting conclusions, and recommended developing a stronger design for monitoring and measuring the effects of water fund activities on water quality and quantity. Without baseline data, it is not possible to definitively measure FONAG's impacts.

FONAG´s technicians point out that the activities have benefited approximately 500,000 ha and 2,500 people from the highlands.

5. Overall Performance

5-1. Water Resource Management

Water Funds require reliable information on the state of the resource in order to support the strategic planning of integrated resource management.

FONAG has achieved important advances through certain initiatives:

- Hydro-meteorological monitoring network; and
- Information System and Monitoring: this provides dependable and timely data for management and planning of water resources from the Guayllabamba river, its area of influence and the Oyacachi, Papllacta and Antisana micro-watersheds. The system also includes a climate change variable.

The research and data generated are one of the most important results of the Fund and have been used as baseline data for further initiatives to be implemented by SENAGUA.

5-2. Performance outside Ecuador

With the creation of replica funds in and outside of Ecuador, the mechanism has proven to be flexible and adaptable to diverse contexts and contribute to green growth. The concept is innovative and its application is paramount to integrated resource management in the region.

The FONAG model has been successfully replicated throughout Latin America. At least 17 new water funds have been created and are operational, and 32 water funds are expected to be completed by 2015[95].

This is one of the most important results of the original Water Funds, which shows their capacity for being replicated in different contexts and situations and being able to adapt to particular conditions in the places where they have been implemented.

The Latin American Water Funds Partnership states that 14 countries in Latin America have accepted the water funds concept, and up to 44 funds are in different stages of development and implementation. Brazil, Colombia and Ecuador are the countries with the most functioning water funds. There are 17 operational funds in six countries at present (see Table 13).

<Table 13> Status of Water Funds in Latin America and the Caribbean

Water Funds	Phase			
	Evaluation	Design	Created and operational	Total
Argentina	1			1
Bolivia		1		1
Brazil	1	3	5	9
Chile	1	1		2
Colombia	2	2	3	7
Costa Rica		1		1
DominicanRepublic			2	2
Ecuador	1	2	4	7
Guatemala		1		1
Honduras	2			2
Mexico	1	1	2	4
Panama		2		2
Peru	1	2	1	4
Venezuela		2		1
Total	10	17	17	44

Source: Genevieve Bennett et al.(2013)

V. Lessons Learned and Conclusion

Conservation of water and related ecosystem resources has become a priority for users and stakeholders alike in great part due to Water Fund intervention. Water Funds in Ecuador have proven time and again that they are mechanisms that are capable of consolidating diverse actors with a common goal and shared responsibility. This is why it has been important to raise awareness of their activities and the overall benefits achieved. In Quito, people are generally not fully aware that the quantity and quality of their water depends to a large extent on the conservation of protected areas upstream. As much as 80% of the city's drinking water comes from just two ecological reserves: Antisana and Cayambe-Coca. Raising public awareness has been a central goal of all water fund initiatives.

An important lesson learned from the initial water funds was that the key users of water need to be identified, prioritized, and well informed.

For example, the largest water user in Quito was the Metropolitan Area Potable Water and Sewage Company, a public entity. For this reason, city government (and the city's residents) became a key target audience for FONAG. One of the first things that FONAG did was to produce a short and attractive publication detailing, among other things, FONAG's goal which was simple: to protect watershed reserves and their ability to provide clean water for the nearly two million people living in Quito. Its method, however, was novel. Instead of spending money to restore reserves and water quality after they were damaged, it relied on a financial mechanism to value nature's environmental services. This communications tool was instrumental in swaying the mayor as well as the boards of directors of the water utility company, the electric utility company and all other participants in the fund.

The following are some lessons learned throughout the years:

95) Genevieve, B., Carroll, N. and Hamilton, K. 2013. Charting New Waters: State of Watershed Payments 2012. Washington, D.C> Forest Trends. http://www.ecosystemmarketplace.com/reports/sowp2012.

- Water funds are a successful model for long-term financing for watershed conservation and an effective way to implement integrated watershed management.
- By using the water fund mechanism, stakeholders can: unite in a common vision; coordinate and enhance individual efforts; take advantage of the skills and capabilities of all players; ensure continuity and transparency in conservation activities; and expand public/private participation in conservation.
- Water funds can play an important role in development where local communities can benefit from investment in sustainable livelihoods.

Some of the valuable conclusions and lessons learned for future use of water funds are summarized below.

Baseline and socio-economic data are essential.

The areas where FONAG works are generally impoverished rural areas where basic needs are not fully satisfied, which makes them ideal for intervention from other NGOs and development agencies. Due to a lack of inter-institutional coordination, some of the initiatives tend to overlap. Baseline ecological and socio-economic data are critical to allow accurate measurements for a before-after, control-impact (BACI) approach.

Political leadership and support is essential.

A critical condition for implementing a mechanism such as the water funds is local political support. It cannot be overstated how much the support of leading decision-makers is essential for the implementation of new and innovative mechanisms for conservation.

The Technical Secretary or Manager must be an effective politician as much as a recognized professional in the environmental field.

As the environmental issues gain traction in the public agenda and citizens increasingly demand solutions to their environmental problems, local organizations in collaboration with FONAG have served as watchdogs in watershed conservation. A huge part of the effort in creating awareness requires lobbying and promotion of public policy.

An appropriate legal framework is needed to guarantee continuity.

There needs to be an appropriate legal framework to guarantee the mechanism's continuity, such as a municipal ordinance or other bodies that create the regulatory and legal framework. One of the major issues FONAG had when it began was that the laws for such mechanisms did not exist or were too vague to establish the institutional groundwork required. The laws have progressively changed but until the Water Law is adopted, the mechanism and its activities have no basis within national public policy.

Decision-making regulations and procedures need to be established early.

In the case of FONAG, two water major stakeholders control its revenue, giving those institutions a dominant role in FONAG's governance and decision-making processes. In turn, the arrangement has also affected investment decisions. It is important that a broad set of beneficiaries participate in the governance of a water fund such as FONAG, so that it operates to the advantage of a wider cross-section of watershed inhabitants. A Water Fund needs to establish decision-making regulations and procedures early on to avoid excessive concentration of power and get the buy-in of more stakeholders.

Water funds mechanisms can improve scientific understanding.

FONAG's success in delivering watershed benefits is dependent on its understanding of local hydrological relationships and their importance to the urban areas they supply. Scientific information and research is essential to set investment priorities, promote initiatives and develop sustainable strategic planning. It is also important that a water fund strengthens its scientific understanding of local hydrology and monitors the impacts of its efforts to improve water flows.

A water fund must establish a clear system of measuring the impact of its activities on the objectives of the fund (e.g. flow regulation, sedimentation control, biodiversity conservation). Long-term water quality and quantity data are essential for measuring the benefits many water funds are created to provide. Water quantity in particular requires a longer time period of data collection to identify changes, given the high variability inherent in freshwater systems. Investing in monitoring before a fund starts field activities enables the fund to tailor its activities to maximize water quality and quantity benefits and provides empirical evidence of the benefits that may help with continued political support for the fund.

Size and scope need to be appropriate for institutional capabilities.

Efforts to implement a water fund at the national level are likely to be highly bureaucratic, involve higher transaction costs and be far removed from local realities. A critical prerequisite for FONAG and other water funds has been the ability to maintain a reasonable size and scope in accordance with its institutional capabilities. The funds need to maintain flexibility in order to adjust to requirements of the individual case and learn from mistakes over the years. In the process of developing a fund, it is important to consult with and listen to the stakeholders in the watershed to determine what they will be able to contribute.

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Sources are indicated with each photo.

Interview 1

Specifically for FONAG, the very creation of the water fund mechanism, although controversial, already implied an impact on green growth. One problem is associated with the requirement to have fast results from these funds in watershed protection, but water management does not show quick results. There are increasing demands to present quick results and impacts, but It is not possible to prove positive results in the short term; what can be obtained are certain approximate indicators. The social and economic impacts are a result of the concerted actions for administration and watershed management. To achieve the fund objectives, it is necessary to work with the people in the highlands; several communities have benefited from projects promoted by FONAG. The funds have definitely helped reduce the deterioration of ecosystems that provide water to Quito.

First, you have to understand that this is not a super mechanism and the idea should not become idealistic; every fund has its problems. Water Funds depend greatly on the economic health of the country. If there is no expectation that the funds are going to be profitable, it is best to seek other alternatives. The funds must produce revenue for proper operation, in FONAG's case they achieve between 7 and 8.9% of their investments. This is at least 3 or 4 points more than what is generated in any banking institution. Political backing is important. In Ecuador, in addition to considering laws and statutes, it is necessary to count on support from local authorities. The National Water Secretariat, called SENAGUA, has been detrimental and has affected the funds directly, because water is mentioned in many laws and legislative bodies. It is difficult to coordinate the fragmented regulations, and this makes procedures unclear.

Water Funds are an additional mechanism that alone cannot achieve the objective of water protection. The FONAG does not consider the capacity of people or prevalence of projects, and it is not large enough to cover the entire watershed area. The deterioration of watershed areas that supply the city has accelerated. In order to address the situation, collaborative work among municipalities, government, the private sector and NGOs is required.

In terms of national institutions, the approval of the water law in the near future could have an effect on water funds. Indigenous organizations are requesting a National Water Fund, but it is still unclear how it would be implemented.

Interview 2

Water Funds have invested at least US $17 million, which did not exist before and are all focused on water conservation. Funds have managed to address these water resources with a watershed approach, as with management plans for the highlands in Tungurahua. The results of actions undertaken in terms of the quality and quantity of water are still unclear. The FONAG applies an annual operation plan that directs investment to achieve the goals set for the Fund. It has also embarked on a process to develop the Strategic Plan. One of the proposed actions is that the technical secretariat should be carbon neutral.

One of the most important achievements has been to be able to integrate a large spectrum of actors who are now directly involved, especially from academia and multiple local participants. The inclusion of private sector stakeholders from a corporate social responsibility angle, which is not necessarily programmatic but rather specific, often implies large transaction costs. In relation to local planning, FONAG´s strategic plan will be aligned with priorities set by the Municipality's Department of Environment and will consider strong institutional coordination between the Department and FONAG.

There have been improvements in the attitudes of the people, knowledge and practices as a result of environmental education. With regard to revenue, the impact is not easily quantifiable and specific because the investment was fragmented and revenue was not one of the objectives established. It is still unknown how effective the initiatives have been in terms of quality and quantity of water, these are long-term impacts. The cases of reforestation have been isolated, and thus have not been effective, but the impact of change exists in the attitudes of the people. There are current studies being done, but they have not yet resulted in robust statistics. The greatest impact has been the increase of protected areas under surveillance. In addition, there will be ongoing support to new areas purchased by the Quito Metropolitan Area Potable Water and Sanitation Company (EPMAPS). An evident change in attitude and new awareness about conservation practices has been achieved among the people.

Interview 3

Water Funds are a simple and proven option, whereby payment for conservation of ecosystems is established. This has helped influence users to be aware of the value of water and its conservation. The initiative has been replicated extensively which also proves there has been an important impact at the regional level in Latin America. It is an excellent mechanism for linking public and private sectors. The mechanism allows the urban areas to work together with nature. "Nature supports the human." Water Funds are not a "recipe" to be strictly followed and must be able to adapt to local legal frameworks. A fund's success reflects the capability of the mechanism to adapt to each location in which it is implemented. In Ecuador, the water funds have not invested in green infrastructure; however, in other countries there has been investment in green infrastructure from water funds. In addition there is a tendency to involve users linked to sanitation in water funds, which would ensure that the whole cycle of the water resource is involved in the water fund. This is the case of the Water Fund in Piura- Perú.

Ecuador is the country with the most replications of water funds. Some examples that have incorporated new elements of local law and municipal powers to implement water funds are FORAPA and FORAGUA. However, approval of the proposed water law could affect water funds. While there is not yet an official law adopted, it is difficult to know to what extent the law will affect the funds. In its relations to the local authorities, SENAGUA is not an effective institution, because, instead of contributing to the water funds, they have used water funds to strengthen themselves. In practice SENAGUA collaborates with local authorities, but they do not have a key role. Initiatives such as "neutral" water, water footprint, etc. will be on the rise and this is an opportunity for greater involvement of private companies. Expectations are high that bottling companies, for example, will channel their work with watersheds through water funds; this is an excellent way to promote conservation from the private sector. One case is Coca Cola's goal for 2020 to return the water to the people and nature. The Nature Conservancy proposed a platform using water funds that was accepted by Coca Cola. The investment will be focused on projects for watershed management.

The network of funds has worked well for those that receive direct support from the Alliance and for the creation of new water funds. The principal lines of action are to strengthen technical capabilities, to support financing and to exchange experiences. Another issue that is being analyzed is how to involve the Inter-American Development Bank (IDB) and the Development Bank of Latin America (CAF) to include water funds in their lending systems. The idea is to incorporate the benefits of ecosystem services and green infrastructure into the lending package. More information related to the Alliance of Water Funds is available at www.fondosdeagua.org

In Colombia, many municipalities are linked to the water company and the funds are not always used for land planning. However, water funds are linked with regional authorities in Medellin and Antoquia. Each location is different. Each location has different degrees of institutional capacity, and the Technical Secretariat must be able to articulate processes clearly. For example, when the fund was initiated in Lima (Peru), it did not involve public actors; in Ecuador there is a tendency to include public users. Brazil has a mixture of both public and private actors as the law allows, encourages and demands. In Colombia, it is more balanced, with only private funds and the sugarcane growers. Experience has shown that the more a country is industrialized, has a solid institutional structure and legal framework, the more options are available for private actors to participate.

Interview 4

Water Funds have promoted protection actions and have channeled efforts from various actors into one consolidated initiative. It has been important to include public and private actors as well as NGOs in the search for solutions to guarantee water provision in the long term. Conservation has been one of the main objectives of water funds, and the funds have been able to demonstrate the relationship between ecosystems and the services they can provide to large cities.Water funds have been able to adapt to the current legal framework by creating a platform for contributions for the conservation of water.

At the local level the national authority (SENAGUA) has applied to some extent certain measures that could be considered green growth. But there is no current law or policy that promotes green growth directly. The local planning part of the mechanism has evolved over time, so that the newer water funds clearly demonstrate their willingness to align themselves with local planning. In the case of FORAGUA for example, all investment plans are developed based on territorial management plans.

Within the program financed by USAID for the strengthening of Water Funds in Ecuador, we were able to calculate the exact number of hectares that were conserved. To do this a methodology was applied that placed emphasis on management activities undertaken within the area to be protected. The results were positive and the capacity for replication in various scenarios was highly valued. Impacts on the environment depend on the individual fund, particularly the component on working directly with communities in the upper reaches of the basin. The impacts have been positive.

Interview 5

Water Funds seek to guarantee the availability of water through non–invasive actions, which is to say not infrastructure but rather through specific conservation activities. The FONAG engages water users in the city of Quito in conservation measures in areas far away, as water is increasingly brought from more distant places to meet the city's needs.

At the moment there are no legal, administrative or political reform that influenced green growth. But Water Funds have been able to consolidate some sort of integrated management that can and has been replicated. This has allowed the funds to focus on specific actions. The Authority (SENAGUA) in general believes it has mastered all the concepts, yet here there is a wide misconception of what green growth actually implies.

This is to say, there may be certain specific actions being implemented but may not be considered within the concept of green growth.

In the early years of water funds the relationship with the local planning was not evident, as local planning was not as structured as it is now. The Law obliges local authorities to develop basin management plans, in addition to the National Strategic Plan which water funds must be aligned with. All activities of the Funds will soon be aligned with national and local planning. This has been evident in the case of the Water Fund of Tungurahua, which generated a management plan in response to the request of the provincial assembly. In other cases, it is not so obvious but it is a trend. All the funds will have to be in compliance with national and local planning.

Economically, the mechanism has had high impact. High performance has been achieved through constant and continuous contributions from the fund's constituents. In addition, the mechanism is protected by the ordinance and the contract that created the trust. One of the major weaknesses has been the inability to include new constituents into a fund. But the most important issue has been to promote integrated water resources management in which the environmental issues are key.

Water and Green Growth Case Study Report 6

Egypt

Desalination for Agricultural Development

About the Report

This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

Disclaimer

The findings, interpretations, arguments, and conclusions expressed in this report areresponsibility of the authors and do not necessarily reflect the views of K-water and World Water Council.

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Abbreviations and Acronyms

CAPMAS Central Agency for Public Mobilization and Statistics

CD Central Directorates

CDWD Central Directorate for Water Distribution

CPI Corruption Perceptions Index

IWRP Egypt's Integrated Water Resources Plan

ED Electrodialysis

EDR Electrodialysis Reversal

EDM Electrodialysis Metathesis

GD General Directorates of Irrigation

GDP Gross Domestic Product

ID Irrigation Department

MED Mechanical and Electrical Department

MALR Ministry of Agriculture and Land Reclamation

MoHP Ministry of Health and Population

MHUNC Ministry of Housing, Utilities and New Communities

MoLD Ministry of Local Development

MSEA Ministry of State for Environmental Affairs

MWRI Ministry of Water and Irrigation of Egypt

MED Multi-Effect Distillation

MSF Multi-Stage Flash

NF Nano Filtration

NWRC National Water Research Centre

NWRP National Water Resources Plan for Egypt

R&D Research and Development

RO Reverse Osmosis

TDS Total Dissolved Solids

WFP UN World Food Program

VCD Vapour Compression Distillation

WHO World Health Organisation

WWC World Water Council

ZLD Zero Liquid Discharge Desalination

ZDT Zero Discharge Technology

Executive Summary

This case study report analyses the impact of the Zero Liquid Discharge Desalination for Agricultural Development on Egypt's "green growth", defined by the World Water Council as a "strategy that fosters economic growth and development, protects natural ecosystems and the resources and environmental services they provide, and enhances socially-inclusive development strategy." The purpose of the water project was to use desalination of brackish groundwater for agricultural development. It started its operation in 2005 and its total cost by 2014 was US $1,400,000, and it was financed by private funds. It perfected its operation in 2013, producing 1000 m^3/day of water for irrigation. This report follows a New Institutionalist approach, exploring the economic, social, political, environmental, and technical "exogenous" factors which, together with Egypt's water-related institutional framework and relevant policy mix, shaped the implementation of this water-related project. Water scarcity is one of the major environmental issues that Egypt has to face. Egypt is located in the northern coast by the Mediterranean Sea, a semi-arid to arid region, where rainfall is a rare weather phenomenon, especially in Cairo. Egypt has reached the water poverty limit and it is considered a water-scarce country. As far as its renewable fresh water resources are concerned, the river Nile is the main supplier of water. Egypt has a claim on water of 55.5 billion m^3/year by the 1959 agreement with Sudan. Furthermore, non-renewable aquifers and non-traditional water resources, such as reuse of drainage and wastewater, and the desalination of seawater and brackish groundwater supplement the quantity of its freshwater resources. In total, 82.6% of the water available in Egypt is used in the agricultural sector, which employs 31% of the total labor force and covers its water demand almost entirely from irrigation from the Nile.

The issue of water supply has been the subject of Egypt's Integrated Water Resources Plan 2017 that identifies the use of desalination technologies as a means to increase the water resources in Egypt. In particular, Egypt planned to increase its official reuse of marginal-quality water from 10% in 2000 to about 17% by 2017. In harmony with this, the Desalination Technology Roadmap 2030 was developed to outline how different desalination technologies can contribute to meet these needs and objectives. One of the critical objectives identified was the provision of water for supplementary irrigation coupled with greenhouse irrigation. Nevertheless, the desalination of seawater has remained constant from 2002 to 2010 at 0.06 billion m^3/year. On the other hand, the recycling of sewage water increased slowly from 1.10 billion m^3/year in 2005 to 1.30 billion m^3/year in 2010. Similarly, the increase of recycling of agriculture water was from 5.1 billion m^3/year in 2005 to 5.8 billion m^3/year in 2010. In 2010, less than 11% of marginal-quality water reuse was achieved. Thus, so far, it seems that attaining the 17% objective by 2017 will be very difficult unless, more investment is done in this area.

The report underlines that the project is subject to many challenges, due to the fact that it is not particularly well documented and is not yet complete. Thus, there is not enough information available to assess in depth its performance and impacts on the local population, the environment and the economy. In consequence, efforts were made to assess the potential performance of the project as well as its possible impacts on the population, the environment, and the economy using information available in the literature from research conducted in other places. Accordingly, increased access to water resources for irrigation secured through the water desalination project is seen to have a positive impact agriculture productivity, and thus also on agricultural output and employment. The project does not seem to have had an adverse impact on the environment, largely due to the minimization of the discharge of by-products of the desalination process. In particular, the Zero Liquid Discharge technologies used in the project convert liquid concentrates into dry solid by using evaporators. These processes are energy-intensive and thus expensive, but appropriate in cases where other methods cannot be applied due to the existence of groundwater aquifers or the existence of surface water in the vicinity.

The report attributes the relatively low performance of the project to Egypt's weak institutional structure and water institutions. In particular, the top-down approach to technological innovation and development that was adopted had as a consequence the very limited involvement of the local community from the beginning of the project and throughout its operation. The views of the local community were not solicited and taken into account, and the potential benefits of the project were not explained to all relevant stakeholders. As a consequence, neither the company nor the local community were mobilised to ensure synergies of the project with more employment and training opportunities, more inclusion of women, and more participation of local authorities and social groups.

Thus a key recommendation emerging from the report is that community involvement be integrated in the design and implementation of a water project as a means of maximizing the project's economic, social and environmental impact and its overall efficiency. In addition, it is important to keep a detailed record of the different stages of the design, operation and management of the project in order to properly assess the progress of the project, identify weaknesses in its implementation and undertake corrective measures, and ultimately evaluate its efficiency for green growth by properly considering its environmental and social aspects in addition to its economic ones.

I. Introduction

1. Purpose of the Case Study

In this report, we investigate the potential of Zero Liquid Discharge Desalination for Agricultural Development to contribute on Egypt's green growth strategy from an institutional perspective. This report highlights the importance of the consideration of the environmental and social aspects in addition to economic ones in the efficient management of water resources for green growth.

2. Case Study Methodology

2-1. New Institutionalist Approach

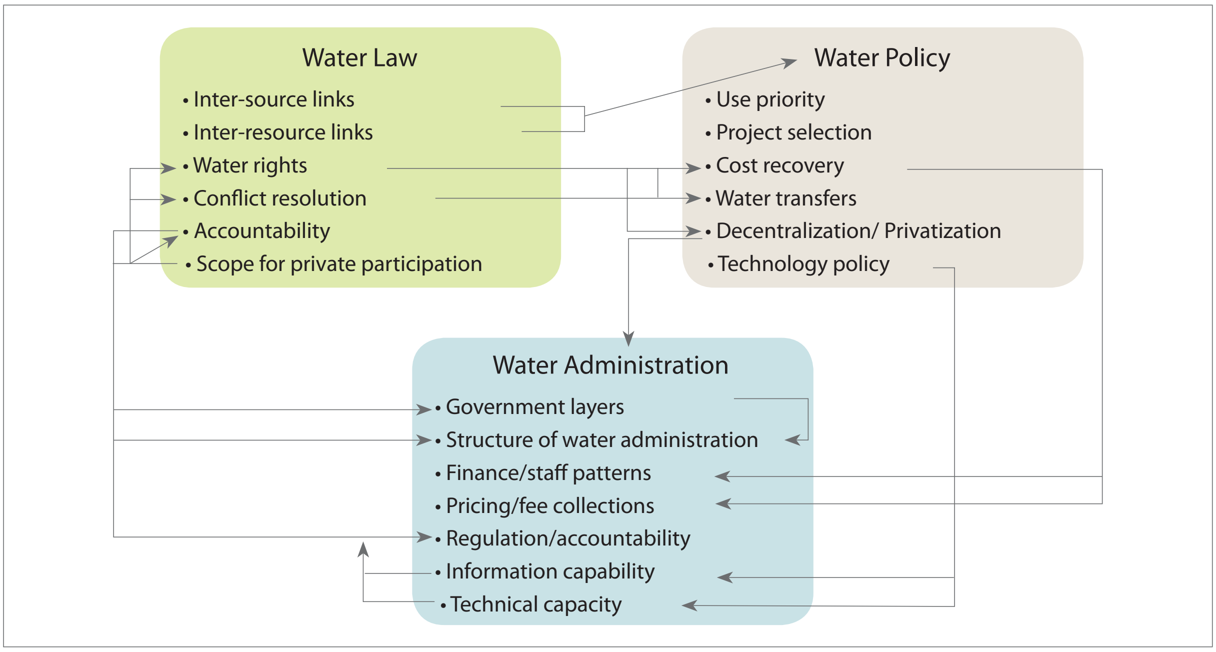
A New Institutionalist Approach is used in this document in order to analyze how Zero Liquid Discharge Desalination for Agricultural Development can potentially contribute to Egypt's green growth.

The emergence of the theories of ownership and transaction costs in Economics was possible because of the recent research on institutions. These theories comprise what it is known as New Institutionalism. The analysis of the establishment and evolution of institutions is useful to understand social change (North, 2005).

Institutions are behavioural rules that establish the boundaries between permitted and prohibited. This theoretical approach is used in the analysis of the impact of institutions and policies that shape the project for Zero Liquid Discharge Desalination for Agricultural Development. This report explores how the economic, social, political, environmental, and technical exogenous factors together with the Egypt's water-related institutional framework and relevant policy mix can led to the success or failure of this water-related green growth project.

2-2. Analytical Framework

The report follows the analytical framework developed by Saleth and Dinar (2004) *The Institutional Economics of Water* (see Figure 1). In order to analyze

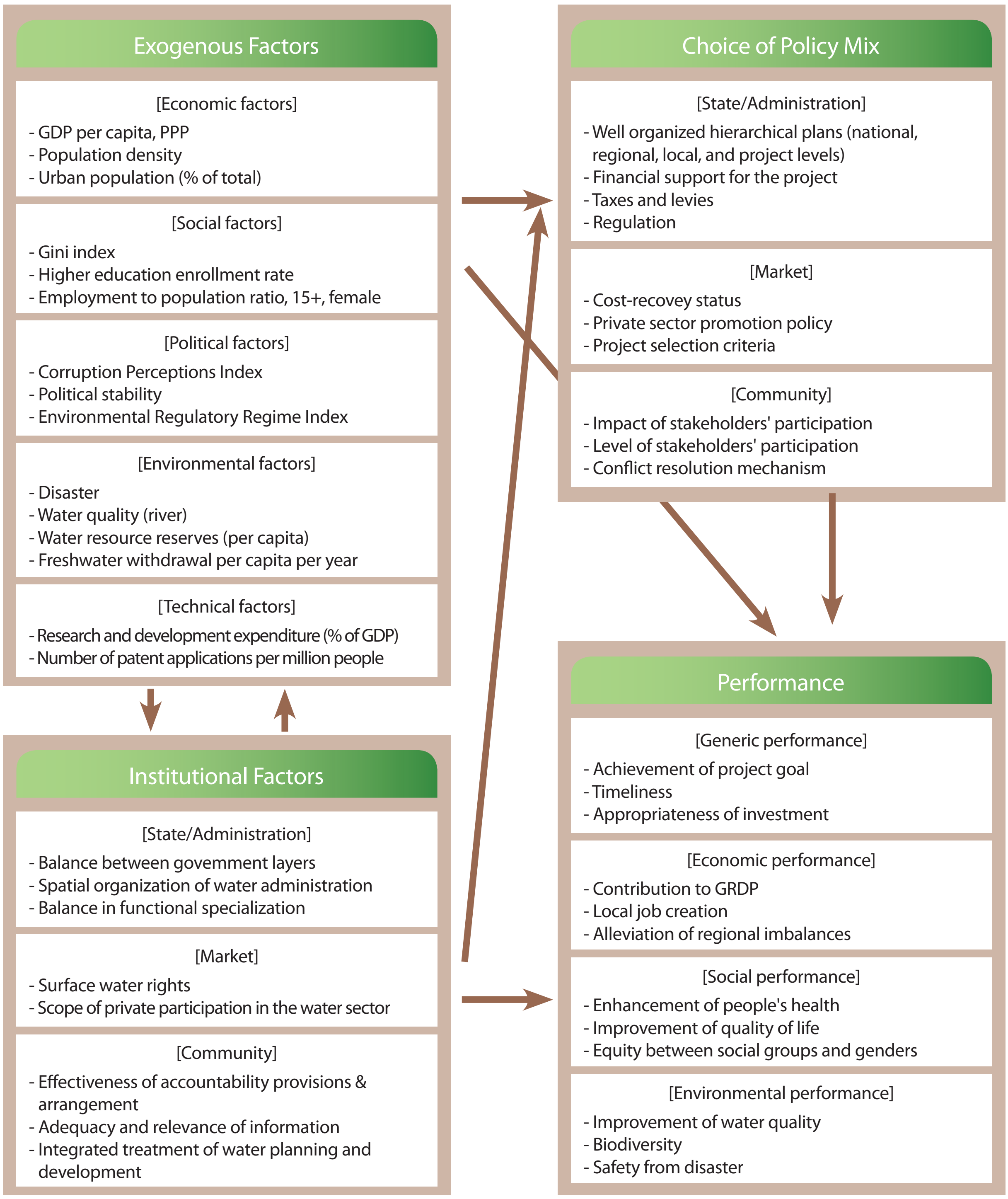


Source: Saleth and Dinar (2004)

<Figure 1> Saleth and Dinar's (2004) Analytical Framework

the interaction between institutions and water sector performance, endogenous, and exogenous factors of change are identified and assessed. Exogenous factors refer to national or regional political systems, legal systems, populations, economic factors, and natural and environmental factors.

The Water and Green Growth project defines green growth as “a strategy that fosters economic growth and development, protects natural ecosystems and the resources and environmental services they provide, and enhances socially-inclusive development” (WWC, 2012, p.11). In this context, exogenous political factors



Source: Modified from Saleth and Dinar (2004)

<Figure 2> Institutional Framework Modified from Saleth and Dinar (2004)

are very important since they shape regulatory and administrative settings through legislation on water and green growth that reflect the real levels of political commitment. They are also important for the design and implementation of coordinating mechanisms among ministries, and may allow or hinder cross-sectoral collaboration between diverse bureaus in the water and green growth fields. Economic factors have an impact on the design and operation of water related projects (e.g. the Zero Liquid Discharge Desalination for Agricultural Development project). Other factors like financial incentives for water saving users, tax breaks, and subsidies for green technology developers and users are also relevant for water and green growth. Finally, technological factors are important since technology contribute to green growth by cleaning the environment, conserving water, and providing alternatives to large-scale infrastructure projects. The water sector comprises all water sources and uses (both consumptive and non consumptive), and all major water issues ranging from quantity-quality conflicts to drought-flood conditions. Water institutions are defined as "an entity defined interactively by three main components: water law, water policy, and water administration" (Saleth and Dinar, 2004, p.95) and include the legal framework, policy regime, and administrative or organizational arrangements. Saleth and Dinar's institutional framework is re-categorized into state, market, and community (see Figure 2) to take into account the arguments about the drivers and instruments of economic and social development and environmental conservation based on the state, the market, and community. Clearly, the outcomes of a water-related project will differ if its institutional framework was predominantly state-driven, market-oriented, or community-centred.

3. Organization of the Report

The purpose of this case study is to investigate the economic, social, political, environmental, and technological levels in which the project on Zero Liquid Discharge Desalination for Agricultural Development is taking place; the policies and institutions that determine the project's course from 2005 until the present; and the changes in those policies and institutions over that time. From this investigation, the potential project's performance will be discussed and lessons drawn. The detailed structure of the report is the following. First, a brief review of Egypt's water resources is provided in order to contextualize the emergence of the project of Zero Liquid Discharge Desalination for Agricultural Development. Secondly, the external environment during the development period of the project is characterised in terms of its economic, social, political, environmental, and technological aspects (i.e. exogenous factors). Statistics from the World Bank, OECD, and other sources, as well as survey results, and expert interviews are used to analyze how exogenous factors influenced policies and institutions affecting the Zero Liquid Discharge Desalination for Agricultural Development project. Thirdly, the institutional change, focusing on applied policies of the project period, is examined across state, market, and community dimensions. Fourth, the project's potential performance is assessed in terms of economy, environment, and society. Lastly, overall lessons are drawn from the foregoing analysis.

II. An Overview: Zero Liquid Discharge Desalination for Agricultural Development

1. About Zero Liquid Discharge Desalination for Agricultural Development

The official name of this project is "Zero Liquid Discharge Desalination for Agricultural Development". Its main purpose is to use desalination of brackish groundwater for agricultural development. According to the questionnaire respondents, this project started its operation in 2005 and is still operating. This is a project financed 100% with private funds. The total cost of the project until 2014 was US $1,400,000. The pilot site is located in West of Cairo at the Alexandria Desert Road Egypt, Km 80, latitudes 30º 12.22´ and 30º 17.08´ and longitudes 30º 29.36´and 30º 37.42´ (see Figure 3). Ground elevation varies between 70m and 100m above sea level, and the average of temperature in June is between 36°C and 40°C. It produces 1000 m^3/day of water for irrigation to supply 100 Feddans of agricultural land.

Source: Final Agenda, Regional Workshop Use of Brackish Water for Agricultural Production in the Near East and North Africa: Status, Good Agricultural Practices and New Developments The Conrad Cairo Hotel / June 10-12, 2013 - Cairo - Egypt

<Figure 3> Site Location

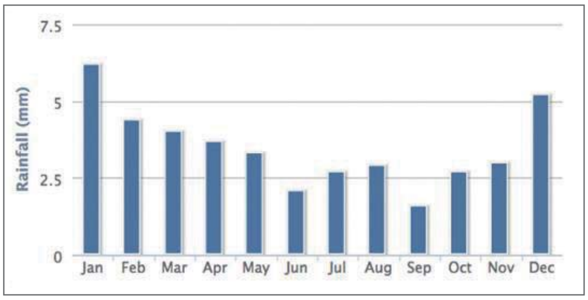
It should be highlighted that this project is not particularly well documented as it is a private venture, not a public venture. Thus, there is not enough information available to access in dept its performance and impacts on the local population, the environment, and the economy. The project has been completed in 2013 and is quite productive and profitable. The technological issues are resolved, and there is a clear policy program that aims to integrate this technology as a strategy for green growth, fostering economic growth and development, protecting natural ecosystems and the resources and environmental services it will provide, and enhancing socially-inclusive development. The rest of this section provides a brief review of Egypt's water and agricultural sectors in order to contextualize the emergence of this project. A detailed analysis of the exogenous factors is provided in section III.

2. Water Resources in Egypt

Scarce water resources pose a huge challenge to the Egyptian national development since water availability will define the different types, size, and location of the economic activities in the region. Egypt is located in North East Africa, bordered on its northern coast by the Mediterranean Sea and on its eastern coast by the Red Sea. It lies in a semi-arid to arid region and has a total land area of 995,450 km^2 (of which its population occupies only 5.5%) and distributed as follows: Nile valley and delta about 4% of the total; Eastern desert area about 22%; Western desert area about 68%; and the Sinai Peninsula area about 6%. Only 2.8% of Egypt's total land area is arable. Egypt has already reached the water poverty limit and is categorized as water-scarce country. The average annual rainfall is about 200 mm in the northern coast. Cairo receives a little more than 10 mm of precipitation per year. Rainfall decreases very sharply from the coast to the inland areas (see Figure 4). Scattered showers occur mainly in December and January (see Figure 5) and are not appropriate for extensive agricultural production. In consequence, a binding condition for Egyptian agricultural development is the access to reliable irrigation water (Allam et al., 2002; Abdel-Gawad, 2007; Salim, 2012; Soliman and Halim, 2012).

Source: Soliman and Halim (2012:5)

<Figure 4> Mean Annual Rainfall in Egypt, Arab Republic



*Note: Annual national figures
Source: Climate Change Knowledge Portal, World Bank

<Figure 5> Average Monthly Rainfall in Egypt, Arab Republic (1960-1990)*

The main source of renewable fresh water in Egypt is the River Nile. The estimated average annual yield of the river at Aswan, south of Egypt is 84 billion m^3/year. Nevertheless, Egypt's share from Nile's water is fixed at 55.5 billion m^3/year by the 1959 agreement with Sudan (Abdel-Gawad, 2007). The second most important source of freshwater is groundwater. Excess irrigation water and leakages from the Nile and the distribution network renewable recharge the groundwater aquifer of the Nile system. The current water abstraction from the Nile aquifer is about 6.3 billion m^3/year and forecasts predict that it will reach 7.5 billion m^3/year by the year 2017. Groundwater also exists in the non-renewable deep aquifers in the Western Desert and Sinai. In addition, there are non-traditional water resources that include the reuse of drainage and wastewater, and the desalination of seawater and brackish groundwater. The estimated treated groundwater amounts to 7.1 billion m^3/year (Allam et al., 2004; Abdel-Gawad, 2007; Salim, 2012). Coastal rainfall supplies less than 1.5 billion m^3/year on average. In the period 2010-2011, the allocation of the total water resources per use was 82% agriculture, 1.6% industry and 13% domestic use respectively (see Table 1) (El-Kady and El-Shibini, 2001; Allam et al., 2002). The per capita water share was 771 m^3/capita/year in 2005, which is below the international standards of "water poverty line" of 1000 m^3/capita/year (Shakweer, 2007).

Alnaggar (2003, p.55) explains that water shortages have been compensated by raising the use efficiency

<Table 1> Water Resources and Uses (2010-2011)

Water Resources	2010-2011	
	Billion m^3/year	As percentage
Share of Nile water	55.5	78.99%
Groundwater in Valley & Delta	6.3	8.97%
Recycling of agricultural water	5.8	8.26%
Recycling of sewage water	1.3	1.85%
Rains &Floods	1.3	1.85%
Desalination of sea water	0.06	0.09%
Total	70.26	100.00%
Uses of Water	**2010-2011**	
	Billion m^3/year	As percentage
Agriculture	60.9	82.58%
Waste evaporation from Nile & Canals	2.1	2.85%
Drinking and Healthy uses	9.55	12.95%
Industry	1.2	1.63%
Total	73.75	100.00%

Source: Ministry of Water Resources &Irrigation

of available water resources through reuse of drainage water and the use of groundwater. In this context, the Government of Egypt faces several challenges in relation to water resources management (MWRI, 2005):

1) Implement a strategy and action plan for achieving food security;
2) Reduce the gap between huge demands on freshwater resources resulting from a growing population and the expansion of industrial and agricultural water requirements and the limited supply of water resources;
3) Preserve and enhance water quality and prevent its pollution; and
4) Achieve the millennium development goals (MDG) in relation to water supply and sanitation.

3. Agriculture and Irrigation

As shown Table 1, 82.6% of water available in Egypt is used in agricultural activities. The agricultural sector contributes around 18% to the Gross Domestic Product (GDP), and employs 31% of the total labor force (Abdel-Gawad, 2007). Agriculture in Egypt depends almost entirely on irrigation from the Nile. Therefore, most of the cultivated land is placed close to the Nile River's banks, its main branches and canals as well as in the Nile Delta. Recently, there has been a shortage in Nile water, which may be worsened due to the disparities in the distribution of precipitation belts. On the other hand, various forecast models predict a potential decrease in the national output of food grains (Soliman and Halim, 2012). In response to these challenges, the West Delta Conservation and Irrigation Rehabilitation Project has been designed to improve the livelihood and increase the income of people in the West Delta region of Egypt.

On the other hand, Egypt's main national needs with respect to water can be categorized as: cost-effective water, drinkable water, water fit for its uses, and sustainable water. In order to increase water supply quantity and quality, Egypt's Integrated Water Resources Plan (IWRP) 2017 has identified the use of desalination technologies as a tool to increase water resources in Egypt. In addition, Egypt planned to increase its official reuse of marginal-quality water from 10% in 2000 to about 17% by 2017. In this context, the Desalination Technology Roadmap 2030 was developed to outline how different desalination technologies can contribute to meet these needs and objectives. One of the critical objectives identified is to provide water for supplementary irrigation coupled withgreenhouse irrigation (MWRI, 2005; Shakweer, 2007).

4. Desalination Technologies

Desalination refers to the removal of salts, minerals, and other materials from brackish water or seawater to make it suitable for human consumption (WHO, 2007). Worldwide, desalination plants provide about 30 million m^3 of freshwater everyday. It is estimated that two-thirds originates from seawater and the rest from brackish groundwater (Qadir et al., 2007). Brackish water could result from mixing of seawater with fresh water, as in estuaries, or it may be found in brackish fossil aquifers. In general, it is saltier than fresh water, but not as much as seawater. Technically, brackish water contains between 0.5 and 30 grams of salt per litre. Hence, brackish covers a range of salinity and is not considered a precisely defined condition. Many brackish surface waters that their salinity can vary considerably over space and/or time. This results from the fact that some brackish water aquifers are density stratified and when water is pumped from the top portion of the aquifer, higher salinity groundwater propagates upwards increasing source water salinity over time. Several brackish water aquifers may have a common boundary with other aquifers of different water quality. When the production aquifer is pumped, a certain portion of the recharge volume may be supplied from the adjacent aquifers, provoking changes of source water quality over time. On the other hand, since seawater is widely available in coastal areas, it is expected that desalination plants for drinking water and industrial use in areas - where no other cheaper resources are available - will be developed to meet increasing demand. However, if brackish water is available in sufficient amounts, it might be a more preferred source for desalination due to its lower levels of salinity (Qadir, 2007; Shakweer, 2007; WHO, 2007).

Distillation and membrane technologies are the main desalination technologies in use. Nevertheless, desalination technologies are energy intensive and research efforts have been done in order to improve their efficiency and to reduce energy consumption (WHO, 2007). Nair and Kumar (2013) identify three kinds of desalination procedures:

1) Thermal processes which include Multi-Stage Flash (MSF) distillation, Multi-Effect Distillation (MED), and Vapour Compression Distillation (VCD);

2) Membrane processes, which include Reverse Osmosis (RO) and Electrodialysis (ED); and
3) Process acting on chemical bonds like ion exchange processes. They are used mainly for industrial applications, which require extremely high-quality water. This method is not suitable to treat brackish water or seawater.

Distillation plants can produce water in the range of 1 to 50 mg/Lt Total Dissolved Solids (TDS). Alkaline cleaners remove organic fouling and acid cleaners remove scale and salts. The World Health Organisation (2007) describe the following desalination techniques:

Thermal Desalination Processes

Boiling of saline solutions results in water evaporation. The water gasses that are produced consist of two parts, namely pure water, and volatile organics. The salts and some organics are left in the unevaporated solution as by-products of this process. The water that is produced by the separation still contains salt but of very small amounts (usually below 5 mg/litre of TDS). However, another component of this procedure is the energy that is required to evaporate the water and which is of high scale. For this reason, the minimization of energy consumption has been the focus of many configurations of the techniques that have been developed over the years The two most widely used thermal desalination processes are multistage flash distillation (MSF) and the multiple effect distillation (MED). Both, processes are suitable to desalinate both seawater and brackish water, although the biggest share of the existing MSF and MED plants are related to desalinate the former than the later.

MSF Desalination

This method was the most commonly applied method of water desalination until the early 1990's. In the MSF process, seawater is boiled in different temperatures under low pressure. Therefore, the boiling point of seawater is lower. For this process closed vessels are used. Due to boiling, steam is produced due to the evaporation of the water, which at a later stage is condensed to pure water that is destined to produce drinking water.

More specifically, water enters the system and is gradually heated at low temperature. The temperature rises from one stage to the other. The lower pressure in tandem with the higher temperature results causes already heated seawater to reach its boiling point at different stages. Consequently, a portion of the seawater is vaporized, or flashed into steam. The water that turns into steam rapidly is directed through demister pads that cleanse it from brine droplets. This cleansed vapour is then diverted to a tube bundle that carries cool seawater. Due to the decrease of temperature the vapour is condensed into pure, distilled water. As vapour of water increases, so does the concentration of bride that is finally discarded.

MED Desalination

Multiple effect distillation is the oldest desalination process with its roots going back to the 1820s. It was quiet popular in the 1960s, due to configuration of the techniques it uses. More precisely, the use of the thin film evaporation techniques increased the practicality of the process relatively to the process that was developed initially. Most commonly, the procedure followed starts with feeding water into the system that is distributed and the sprayed on the outer surface of heated tubed and turned into steam. Several effects included in the process, the number of which varies between to 4-14. The preceded effects heat the surface of the on following effects. At the final stage, the steam that is produced in the last effect is lead to a heat exchanger to be condensed, while the water that enters the system cools it. In this while the exchange of heat, raises the temperature of the feed water. Droplets of brine are eliminated with the use of mist eliminators before the vapour is introduced to the next effect (Manjula and Kumar, 2013).

Membrane desalination

This is a process that separates the minerals from the source water by making use of semipermeable membranes. Currently, there are two types of technology that are used membrane desalination - Reverse Osmosis (RO) and Electrodialysis (ED).

Desalination by Electrodialysis

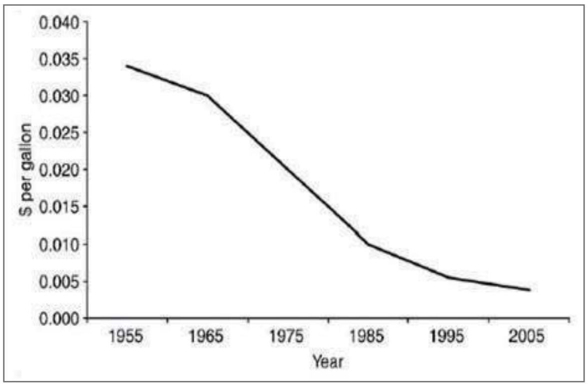
This method is suitable for desalination of brackish water of a certain level of salinity (approximately 12,000 mg/L). The water is directed through ion membranes of positive (anion) or negative (cation) electrical charge. The following process achieves the separate of salt from water. The positively charged electrodes of the membranes attract the anions in the water and the negatively charged membranes attract the cations in the water. The membranes are arranged alternately. Therefore, water passes through positively and negatively charged membranes. A recently developed desalination technology that is commonly used is Electro Dialysis Reversal (EDR). In such systems, the flow of ions is reversed. This is achieved by reversing the polarity of the electrodes periodically.

Reverse Osmosis Desalination

Membranes are also used for this process. Pressure is applied to the product water during its transport through a membrane to separate it from the salts that its contains prior to its. During this procedure, the minerals of the source water are concentrated by the membrane and withheld by it, pressure is used to transport the desalinated water through the membrane. Reverse osmosis desalination uses the naturally occurring phenomenon of osmosis. This occurs when membranes are used to separate solutions of different concentration (Manjula and Kumar, 2013). Osmosis is overcome when high pressure is used. Another process similar to RO is Nanofiltration (NF). This process is commonly used in food processing, uses membranes to remove compounds with high molecular weight with the purpose of removing the hardness of water.

5. Desalination in Egypt

Desalination has been used in Egypt for more than century. The earliest example is large distillation pond in the area of Helwan (south Cairo), its main objective was to produce fresh water for domestic use for areas far from the public water. However, Egypt began to apply advanced desalination technologies in the mid seventies (first ED in remote areas and then RO) as a result of the continuous population growth and the urban expansion along the coastal zone and in remote areas, which increased pressure on the existing water resources network. From 1975 to 1982, three different models of ED plants were installed in Egypt, and they differed in capacity (from 50 to 1000 m^3/day), and salinity levels (between 2,000 to 10,000 – ppm) of the feed water (E1-Kady and E1-Shibini, 2001; El-Sadek, 2010). Due to recent technological developments in water desalination processes, there is an increasing interest in desalination among scientists, policy-makers, and other stakeholders. These developments allow lower costs of desalinated water than before. In addition, the increasing cost of conventional water supplies due to its scarcity and overexploitation makes desalination an important alternative for potable water supply. Figure 6 shows that the cost per unit of Multi-Stage Flash (MSF) - a distillation desalination technology- has decreased 44% in average per decade in the last 50 years (El-Sadek, 2010).



Source: El-Sadek (2012, p.879)

<Figure 6> Cost of MSF Product ($ per gallon), 1955-2005

Zero Discharge Desalination

In this section, we analyze the technology used in the Zero Liquid Discharge Desalination for Agricultural Development project. First, it should be noted that the construction and operation of a desalination plant has to be subject to:

a) The sensitivity of the area it is built on; and
b) The concentrate disposal methods it uses.

Regarding the first restriction plants that are established close to densely populated areas may affect the residential environment, due to the generation of noise and gas emissions. As far as the second restriction is concerned, contamination of groundwater aquifers, energy consumption and disruption of the environment should be some of the main concerns. Moreover, in relation to the second argument, the concentrate disposal methods used by the desalination plant should be carefully considered. Some of the common methods include deep well injections, evaporation ponds, brine concentrators, and zero liquid discharge (ZLD technologies). There are other factors that should be taken into account in order for the most suitable disposal option to be chosen. Some of these factors are, the cost, the volume, and the quantity of the concentrate and the environmental regulation. For example ZLD technologies, that convert liquid concentrates into dry solid by using evaporators, are energy intense and thus expensive to apply, but it is an appropriate method when deep well injections cannot be applied. Furthermore, the final disposal of the dry concentrate should not be neglected. The presence of surface water in the vicinity results in the infeasibility of this method. However, water recovery should not be disregarded, especially in cases where water scarcity is a significant issue. In a water scarcitycontext Zero Discharge Technologies (ZDT) are suitable to be implemented. This technology, removes salts from water by utilizing Electrodialysis Metathesis (EDM). Source feed water is directed to reverse osmosis process. This process removes salts from feed water and recovers product water. The salts that extracted from water are further treated in the following way. Rich in calcium chloride salts are separated from salts rich in sodium sulfate. The dilute of the EDM is returned to the reverse osmosis feed. The ZDT process can incorporate add-on technologies that are adjusted to each case. For example, a process can be introduced in the system in order to treat high concentrations of a specific substance in the water stream. The technology is suitable for treatment of brackish waters. Pilot studies demonstrate that the water recovery can be up to 95-99% and the waste volume is significantly low (Younos, 2005). The use of ZDT aims to maximize the volume of water produced from brackish sources while minimizing impacts to the environment caused by concentrate disposal. Recent technological developments in water desalination processes have reduced the costs of production and increased the efficiency of the technologies. Currently, Egypt encourages both the public sector and the private sector to apply modern desalination technologies. The application of modern desalination technologies started with distillation followed by ED and ending with the use of RO (El-Sadek, 2010). The Zero Liquid Discharge Desalination for Agricultural Development is an example of adoption of innovative technology. Taking into consideration the restrictions discussed through this section, it is evident that the Zero Liquid Discharge Desalination for Agricultural Development project has several advantages. First, it is located far from densely populated regions (see Figure 3) reducing the impact of noise and other externalities on the population. Second, it uses ZDT in order to handle byproducts of the desalination process reducing its impact on the environment. Finally, according to the design of the desalination plant solar energy is used for its operation reducing in this way its energy costs.

III. The Case Study

1. Exogenous Factors

The exogenous factors presented in this section depict the general context in which the Zero Liquid Discharge Desalination for Agricultural Development project is being carried out. The following sections describe the Egyptian context at national level in which water resources are used in the Western Desert of Egypt and West Nile delta region across the economic, social, political, environmental, and technological dimensions. These dimensions are important because they influence the formation, change, and performance of institutions, and likewise they influence policies selection and their performance.

1-1. Economic Factors

1-1-1. Economic Growth and Structural Change

Egypt is a country with territories spanning over two continents (Africa and Asia). It has a total population of 82,6 million (2013 figures) and it is the 17th biggest country in the world, according to the World Bank. According to the same source, Egypt's GDP is estimated at $272.0 billion, which makes it the 41st biggest economy. In recent years, Egypt has been through political tensions that have adversely affected its economy. Egypt is in a process of political transition. The election of Mohammed Morsi in 2011 was not sufficed to provide assertive promises during the pre-election period. A case that is apparent in new democracies with new politicians (Keefer and Vlaicu, 2008). Additionally, the political tension during the demonstrations of 2013 yielded instability in its economic circumstances. More specifically, from 4.7 in 2009 and 5.1 in 2010 the growth rate dropped to around 1.8 in 2011 and remained almost constant at 2.2 and 2.1 in 2012 and 2013 respectively. In relation to this, a thorough look into Egypt's growth over the years leads to the conclusion that the economy faces periods of significantly high growth rates, followed by steep decreases to really low points. As an illustration, the highest growth rate recorded in the last three decades was 8.9% in 1983 with almost as high rates the subsequent two years. Nevertheless, in 1986 the growth rate decreased to 4.6%. The same trend can be observed in the most recent years (see Figure 7).

Source: World Economic Review (2014), IMF

<Figure 7> Growth Rate in Egypt, 1981 - 2013

Therefore, although the economy is going through a transition period as described above, a stabilization period is expected that will be characterized by growth rates at around 4%, according to IMF (see Table 2).

<Table 2> Growth Rate Forecast

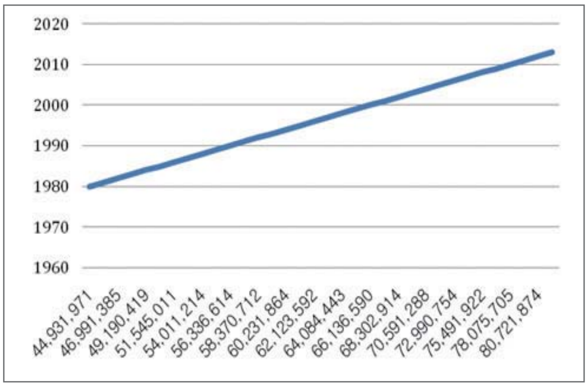
Year	Growth Rate (%)
2013	2.1
2014	2.2
2015	4.1
2016	4.1
2017	3.9
2018	4.0
2019	4.0

Source: World Economic Review (2014), IMF

With the newly elected government in June 2014, the country has stabilized and is encouraging investors to return as seen in the Economic Summit in March 2015.

1-1-2. Population Movement and Urbanization

According to the estimates of the World Bank, Egypt's population was as high as 82,6 in 2013. Data from the same source regarding the population, portrays constant growth rates hooked on 1.6-1.7% during the last decade. On the contrary the birth rate has been declining from 24.4% (per 1.000 people) in 2004 to 23.5% in 2012. Overall, the total population has been increasing between 1980 and 2013.

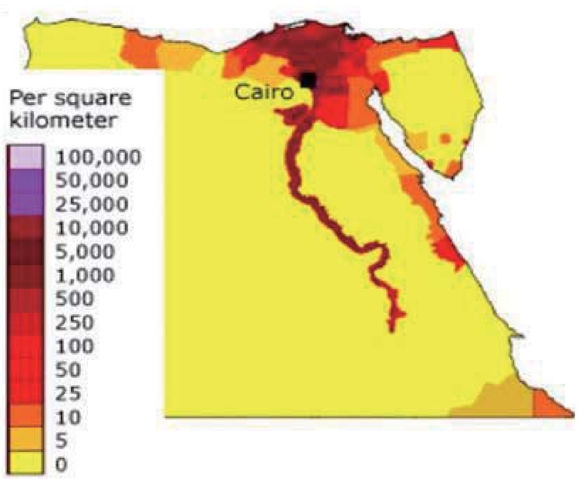


Source: The World Bank Databank

<Figure 8> Total Population in Egypt

1-1-2-1. Population Density and Distribution

According to World Bank Data, in 2012 Egypt had a population density of 81 people per km^2. However, the concentration of people is higher in the Nile Valley and Delta as shown on Figure 9. Of the total population, 44% is rural population. To prevent the urbanization of the fertile areas across the Nile, a plan to establish new cities and industrial areas has started in the 1970s. The number of cities has been increasing ever since, to reach 23 in 2006/07 (Soliman and Halim, 2012). According to the Department of Economics and Social Affairs of the United Nations, the growth rate of the urban and rural population will be 2.04 and 1.38 respectively between 2010 and 2015.



Source: Sedac/Ciesin, Columbia University

<Figure 9> Population Density in Egypt

According to the same source, the percentage of people in urban areas will rise to 44.2% by 2015, following a trend of 1995. Table 3 shows the estimated percentage of people in rural areas in Egypt.

<Table 3> Percentage of People in Rural Areas

Year	%
1990	43.5
1995	42.8
2000	42.8
2005	43.0
2010	43.4
2015*	44.2

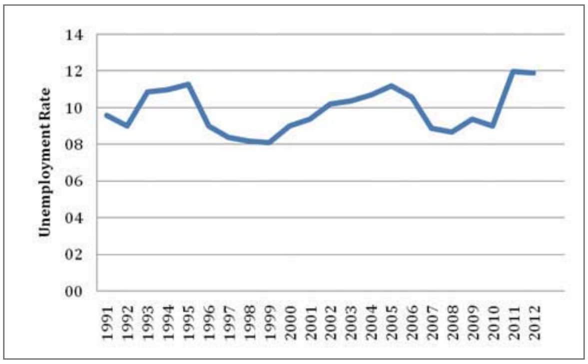
*Estimated number
Source: United Nations, Department of Economics and Social Affairs, own calculations

1-2. Social Factors

Romer (1986; 1990; 1994), Lucas (1988), Barro (1991), and other early endogenous growth theorists explain endogenous growth as arising from the mutual influencing of various growth factors amidst which increased investment in education leads to an increase in human capital, which in turn leads to technological progress and the accompanying rise in productivity that contributes to economic growth. In the following subsections we discuss the effect of social factors in the case of Egypt.

1-2-1. Income Inequality

The Gini index is used to illustrate income inequality in Egypt. The index was 30.1% in 1991 and 32.1% 2005. Data produced by the World Bank show that the Gini index was at 30.8% in 2008. On the other hand, the share of income held by the highest decile of the population was 26.6%. The unemployment rate of Egypt has been over 8% during the last 20 years. However, during the 2011-2012 period it climbed to 12%, which has been the highest rate so far (see Figure 10). As noted by the report by the UN World Food Program (WFP, 2013) and the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS), 17% of the population of Egypt faced food insecurity in 2011. Income inequality and poverty may lead to serious social problems such as higher crime rates. Increasing tensions between the top and bottom income group may result in social conflicts if the problem is left unattended. These problems are foreseen to worsen in the future, hindering the economic development of Egypt.



Source: The World Bank Databank

<Figure 10> Unemployment Rate in Egypt, 1991-2012

Moreover, as it is depicted in Table 4, the employment to population ration has been rising from 2002 to 2010 from 40% to 44%. Additionally a slight decrease has been noted in 2011, but that has stabilized to the same level the consequent year (2012). Overall, the level in 2012 was higher than this in 2000.

<Table 4> Employment to Population Ratio +15

Year	%
2000	42
2001	41
2002	40
2003	41
2004	42
2005	42
2006	42
2007	44
2008	44
2009	44
2010	44
2011	43
2012	43

Source: The World Bank Databank

Regarding the women participation in the labor force, this has been improved significantly over the years. Starting from 19% in 2000 the participation of women raised to 24% in 2012.

1-2-2.Education Level and Equality of Opportunity

The Egyptian government offers free education at all levels. The Ministry of education is responsible for the educational policy and every issue related to education, except for higher Education. The Ministry of Higher Education supervises the higher education system. The public education in Egypt's consists of three levels, namely the basic education (two years of kindergarten, six years of primary school, and three years of preparatory school), secondary school (three years), and tertiary education. The government aims to increase the participation to education. For this purpose, Egypt works in tandem with the World Bank, which assists Egypt to achieve the goals set with the Education Enhancement Program Project (EEP). The Government of Egypt has developed a long-term strategic framework defining thirteen objectives for basic education and the interventions the Government will employ to achieve these objectives. The project will assist the Government to improve the coverage and equity in basic education, improve the quality of student performance and improve the efficiency of the system.

However, according to the UN Institute of Statistics the expenditure on education as a percentage of GDP was declining between 2003 (4.95%) to 2008 (3.76%). Moreover, there are significant disparities in enrolment rates. In 2005/06, the highest enrolment rate was that of New Valley (46,9%) and the lowest that of Minia (7.2%). Additionally, the percentage of enrolled children in urban areas was higher (65.4%) than the percentage of enrolled children in rural areas (34.6%).[1] Regarding women´s access to higher education (as a percentage of the total number of participants in higher education), it can be claimed that it has been increased between 2004 and 2012. Starting from 43% the number of women in tertiary education increased to 46.2% in 2012 (see Table 5). This high percentage denotes equal opportunities in higher education.

<Table 5> Women in Tertiary Education (%)

Year	%
2004	43.0
2005	43.8
2006	45.3
2007	43.6
2008	44.5
2009	45.6
2010	42.2
2011	47.1
2012	46.2

Source: UNESCO Institute for Statistics

1-3. Political Factors

1-3-1. Bureaucratic Integrity

Transparency International annually publishes the Corruption Perceptions Index, an index of the perceived degree of corruption among public officials and politicians in a given country. A score of 100 indicates that a society is generally free of corruption, while a score of 0 indicates that a society's leadership is on the whole corrupt. In Transparency International's Corruption Perceptions Index (CPI), Egypt has scored 32 points and it is ranked 114th.[2] Furthermore, as it is shown on the table below although the Corruption Perception Index (CPI) was increased at 3.6 in 2001, during 2007 to 2011 has been in the vicinity of 2.8. Compared this to 2000, CPI has been decreased. This leads to the conclusion that the perception of corruption for Egypt has been improved.

<Table 6> Corruption Perception Index

Year	CPI
2000	3.1
2001	3.6
2002	3.4
2003	3.3
2004	3.2
2005	3.4
2006	3.3
2007	2.9
2008	2.8
2009	2.8
2010	3.1
2011	2.9

Source: transparency.org

1) International Bureau of Education, United Nations
2) Transparency International http://www.transparency.org/

1-3-2. Political Stability

A period of political turmoil throughout the Middle East and North Africa known as the “Arab Spring” started on December 17, 2010. That day, a 26-year-old vegetable merchant called Mohamed Bouazizi set himself on fire using paint thinner and a match in the Tunisian town of Sidi Bouzid. This desperate act prompted demonstrations and clashesthat led to the ousting of Tunisia’s autocratic President Zine al-Abidine Ben Ali, and inspired the immolation ofother menin Egypt, Algeria and Mauritania to show their desperation and frustration with the authoritarian regimes in their countries. Across the region the demands were similar: increased inclusion in economic and political life, better governance and strengthened civil liberties (Worth, 2011; Masetti et al., 2013). Hosni Mubarak's government showed a declining ability to provide basic services and a lack of clear policies to tackle the unemployment and poverty affecting millions of Egyptians. An increasing feeling of discontent among the population was exacerbated by corruption allegations of the business elite linked to Mubarak's son Gamal. On January 25 2011, tens of thousands of demonstrators gathered in Egypt's Tahrir Square to protest against worsening economic conditions, police brutality, political repression, and corruption. The demonstrators demanded the resignation of President Mubarak who in turn responded by sending out troops. Nevertheless, the military did not crack down the demonstration and often protected the protestors from violent police and paramilitary groups. On 7 February 2011, 1.5 million people gathered in Tahrir Square demanding regime change. Mubarak made several concessions in order to stop the demonstrations including a promise to not seek re-election. But protests continued and the 11th of February Vice-President Omar Suleiman announced that Hosni Mubarak resigned as president and had handed power to the army. From November 2011 to January 2012 parliamentary elections took place. The number of parties represented in the first post-Mubarak parliament increased from 9 to 15. The Muslim Brotherhood’s Freedom and Justice party gained 46.3% of the vote. In an alliance with the radical Salafist Nour party they dominated parliament with over 70% of all seats. Liberal movements that were central during the period of protests performed poorly during the elections due to internal disagreements. Mohamed Morsi, the candidate of the Muslim Brotherhood, won the presidential elections in June 2012 (Anderson, 2011; Nepstad, 2013; Masetti et al., 2013). The army's intervention during the social unrest indicated the continuing power of a military establishment. On June 30 2013, the biggest protest in history with 14 million protestors asking for the outster of Morsi. The army supported the will of the people and overthrew the Morsi government. Most of the generals that currently run the army were active during the 1967 and 1973 wars with Israel and cooperate with the United States since Cairo's 1979 peace treaty with Jerusalem (Anderson, 2011). Furthermore, authoritarian practices of the old political regime are still prevalent in Egypt. For example, it has been documented that the Supreme Council of Armed Forces (SCAF) has been involved in misemploying its power in many instances. In 2011 it seized both legislative and executive power. The same year it removed the prime minister of the country during the period of protests and social unrest. It has also been involved in arrests of politicians under the pressure of the protests. Moreover, although the constitution has been recently re-established, the military systems have not been reformed and effective restrictions to the old-regime have not been adopted (Lesch, 2014). As direct consequence of the political turmoil in recent years the flows of tourism and foreign direct investment have slow down.[3] In their analysis about the impacts of the Arab Spring in the MENA region Masetti et al. (2013) report that in Egypt the difference between the average real GDP growth in 2011-2012 and 2000-2010 was -3.1

3) World Economic Outlook, April 2014

pp.Compared with 2010, tourism arrivals decreased 33% in 2011. On the other hand, although according to IMF the new constitution that was adopted in 2014 has paved the way to economic recovery the estimated GDP growth is still weak to boost job creation since the business confidence is affected by the political events.

1-4. Environmental Factors

1-4-1.Water Resources

The Nile River is the world's longest river in the world with a length of about 6,825 km of which 1,530 km is in Egyptian territory. The Nile is also the main source of freshwater in Egypt. The agricultural sector in Egypt is almost entirely dependent on irrigation form the Nile. Additionally, its demand for water is as high as 85% of the total demand for water in Egypt. Furthermore, household water demand is associated with urban and rural households. Part of the demanded quantity is covered by extraction of water from the Nile and groundwater resources cover the rest. Moreover, industrial demand accounts for 2,5 billion cubic meters per year (2013).[4] As far as the demand due to population growth is concerned, it is expected that the rise in the population will exaggerate the problem of water allocation Subject to the 1959 Convention "Convention of Full Exploitation of Nile Water", Egypt as a signatory has a fixed share of Nile water of 55,5 billion cubic meters. Table 7 presents the distribution of water resources from 2002 until 2007.

1-4-2. Natural Disasters

As a result of heavy storms and geomorphological characteristics, Egypt has faced flash floods that caused severe damage on people and infrastructure. These take place mainly in the Red Sea area and the Southern Sinai.[5] Furthermore, sand and dust storms are common phenomena during the spring periods. Additionally, due to the tectonic setting in the area, three seismic trends are identified: i) North Red sea-Gulf of Suez-Alexandria trend; ii)Eastern Mediterranean-Cairo-Fayoum depression trend; iii) Gulf of Aqaba trend. Moreover, fires in rural areas are common events that to some extent are cause by bottled gas explosions.

<Table 8> Summarized Information on Natural Disasters in Egypt

No of events:	23
No of people killed:	1,527
Average killed per year:	49
No of people affected:	262,864
Average affected per year:	8,479
Economic Damage (US $ X 1,000):	1,342,000
Economic Damage per year (US $ X 1,000):	43,290

Source: http://www.preventionweb.net

<Table 7> Water Resources in Egypt 2002-2007 (Billions m^3/year)

Source	Year				
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Nile water	55,5	55,5	55,5	55,5	55,5
Ground water at Delta and Nile Valley	6,1	6,1	6,1	6,1	6,1
Reuse of agricultural drainage and waste water	4,4	4,8	5,1	5,4	5,7
Reuse of sewerage water	0,9	1	1,1	1,2	1,3
Rains and floods	1,3	1,3	1,3	1,3	1,3
Desalination of sea water	0,06	0,06	0,06	0,06	0,06

Source:Status and New Developments on the Use of Brackish Water for Agricultural Production in the Near East,2012

4) http://www.mfa.gov.eg

5) http://www.unisdr.org/2005/mdgs-drr/national-reports/Egypt-report.pdf

1-4-3. Change in River Water Quality

As far as water quality is concerned, deterioration in Nile occurs mainly by agricultural drainage water containing salts, nutrients, pesticides, and herbicides. Additionally, water quality is affected by municipal effluents from towns of Upper Egypt. The introduction of poorly treated sewage, industrial spills is a contributor as well. However, according to the 2009 State of the Environment Report produced by the Ministry of State for Environmental Affairs- Egyptian Environmental Affairs Agency, the Ministry of Irrigation and Water Resources in cooperation with the European Union as support to the Egyptian government has been part in the implementation of a project to strengthen national policy and improve water quality in the Nile river basin.[6] As the Nile Basin Initiative (2005) states, studies are being undertaken on both regional and national level. More specifically, under the Nile Basin Initiative, the countries related to the management of Nile basin aim to work on minimizing waste release and reinforce their efforts in order to increase their benefits. A distinctive example is a project in the Blue Nile tributaries (Baro-Acodo) that will lead to benefits for Ethiopia, Sudan and Egypt from the use of 12 milliard m^3.

1-4-4. Impact of Environmental Factors

The Egyptian Environmental Affair Agency reports in 2008 that 102 industrial settlements discharge into the Nile directly or indirectly. Among the contaminants are heavy metals and pesticides. The amount of these reached almost 4.5 tons per year. Additionally, industrial organic pollutants are also discharged in the river and they reach roughly 270 tons per day.[7] Between the Aswan High Dam and Cairo, the approximately 2,500 villages with population over 20 million discharge wastewater and untreated sewage into the river.[8] Consequently, the need for infrastructure is of utmost importance. In relation to that, CAPMAS 2010 statistics demonstrate that only 24.7% of the rural population was connected to a sewage system. The percentage for the urban areas is 88%. Discharges into the Nile are connected to bad sanitation of drinking water. According to statistics 99.5% of the drink is untreated water.[9] As the World Health Organisation 2008 report “Safer Water, Better Health” indicates, unsafe drinking water, inadequate sanitation, insufficient hygiene and an inadequate management of water resources in Egypt account for 5.1% of all deaths and 6.5% of all disabilities (disease and injury), yearly. Halim (2012, p.18), reports that water quality samples taken out along the Nile River have shown “a nearly uniform distribution of the values of quality parametersfrom Aswan to Cairo. The suspended sediment concentrations increase gradually along the Nile downstream direction. Total dissolved solids ranges from 130 mg/l in Lake Nasser to 200-250 mg/l at the Delta barrages. The pH increases from 7.7 at the head to 8.5 in the Nile Delta. The BOD as a result of human activities mainly shows a variable distribution but only occasionally exceeds the standard 6 mg/l (especially in the downstream sections of the river). The variability is the result of point discharge and self-purification of the river. As a result the dissolved oxygen drops below the limit of 5 mg/l with exceptional cases only. Nitrate and

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6) Report available at http://www.eeaa.gov.eg/english/reports/SoE2010En/Egypt%20State%20of%20Environment%20Report%202009.pdf

7) The Egyptian Organization For Human Rights issued a qualitative report titled The Egyptian Organization for Human Rights *The Egyptian Organization for Human Rights* The Egyptian Organization for Human Rights. http://en.eohr.org/17/12/2009/the-egyptian-organization-for-human-rights-issued-a-qualitative-report-entitled/ (Accessed 11 Sept 2013).

8) Mohamed Ayad, A. Water Quality and Cairo: Is it Safe? http://cairofrombelow.org/page/3/

9) Joint Submissions to the Committee for Economic, Social and Cultural Rights Periodic Review of Egypt, 51st Session, November 2013

ammonium hardly exceed the current standards except for ammonium at one location in Upper Egypt. The spatial distribution of fecal coli form varies strongly. The standard is significantly exceeded during the summer months at a few locations in Upper as well as Lower Egypt.

1-5. Technical Factors

1-5-1. Research and Development Expenditure in Egypt

Research and Development (R&D) expenditures are current and capital expenditures (both public and private) on work undertaken systematically to increase knowledge. R&D covers basic research, applied research, and experimental development. R&D expenditure in Egypt has been increasing from 2007 until 2011, from a minimum of 0.09% to a maximum of 0.43% (see Table 9). Nevertheless, Egypt still faces skills shortages that hinder its investment prospects and economic growth. Egypt could take advantage of opportunities in high-skilled economic sectors if a greater investment in human capital is done (Loveluck, 2012).

<Table 9> Research and Development Expenditure (% GDP)

Year	R&D Expenditure
1996	0.21
1997	0.20
1998	0.20
1999	0.19
2000	0.19
2001	NA
2002	NA
2003	NA
2004	NA
2005	NA
2006	NA
2007	0.09
2008	0.11
2009	0.24
2010	0.40
2011	0.43

Source: World Bank Databank

Regarding patent applications in Egypt, these have been increasing through the years (2000-2010). More specifically, although there seems to be some fluctuation both residential and non residential patent are higher in 2010 than they were in 2000. Additionally, patents applications per million people have been increasing, reaching a high point of 28,6% in 2010. In 2011 and 2012 this percentage decreased slightly, but it remained higher than 2000. The increase in patent application provides an idea about the progressiveness of technology in Egypt during this 20-year period.

2. Water Governance and Institutions

This section examines the direct and indirect influences that institutional factors have on the project and how they evolved to support a green growth strategy. These institutional factors can be divided into legal, administrative, and policy elements (Saleth and Dinar, 2004). In this section, the influence of such institutional factors on the Zero Liquid Discharge Desalination for Agricultural Developmentproject is explored.

<Table 10> Patents (Residents/Non-residents), Patents per Million of People in Egypt

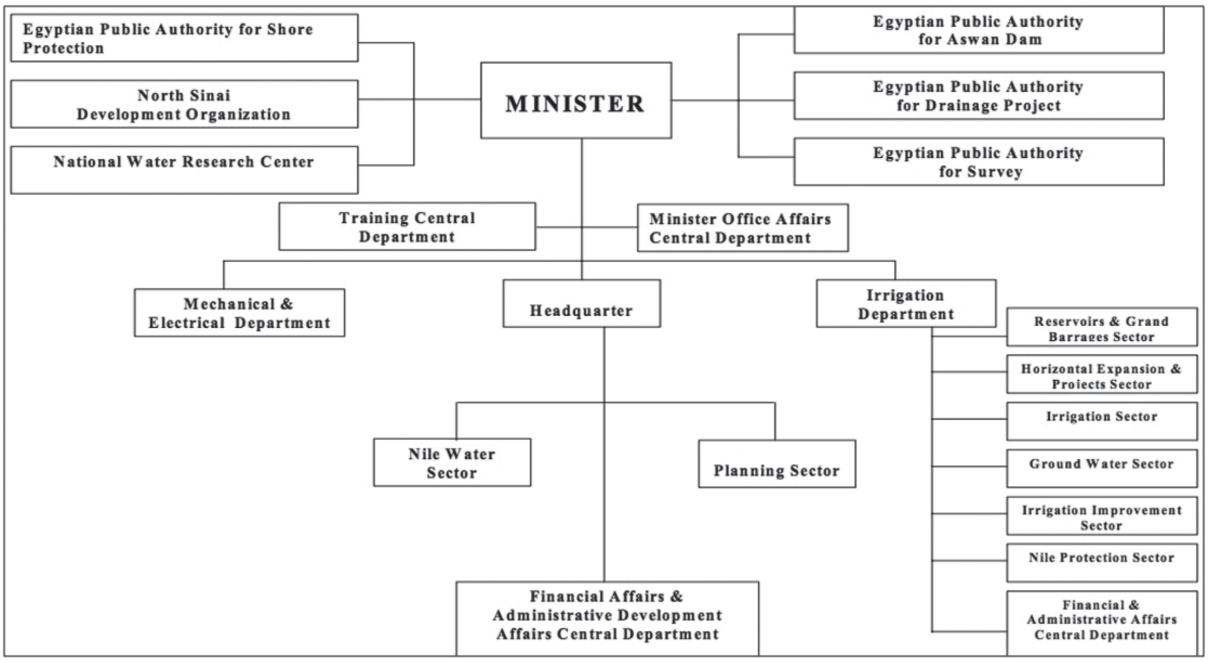
Year	Residents	Non-residents	Total	Patents per million people
2000	534	1.081	1615	24.4%
2001	464	923	1387	20.6%
2002	627	788	1415	20.7%
2003	493	626	1119	16.1%
2004	382	312	694	9.8%
2005	428	1.008	1436	20.0%
2006	NA	NA	NA	NA
2007	516	1.589	2105	28.4%
2008	481	1.649	2130	28.2%
2009	490	1.452	1942	25.3%
2010	605	1.625	2230	28.6%
2011	618	1.591	2209	27.8%
2012	683	1.528	2211	27.4%

Source: World Bank Databank, own computations

2-1. State and Administration

The Egyptian government plays a central role as both originator and decider of key policies in relation to the water sector and particularly in relation to irrigation through the Ministry of Water and Irrigation of Egypt (MWRI). The MWRI is responsible of the development, distribution and management of water resources and for the organization and maintenance of the related water works. The collection and disposal of agricultural drainage water, monitoring and assessment of water quality of the various water sources, and protection of coastal lakes and the shoreline are also under its control. In the MWRI, two departments (Irrigation Department (ID) and the Mechanical and Electrical Department (MED)) and four authorities (the Egyptian Public Authority for Drainage Projects, in charge of all drainage activities within MWRI, the Egyptian Survey Authority, the Coastal Protection Authority, and the High Aswan Dam Authority) that are responsible for operation of the water resources system, irrigation water delivery, and drainage water disposal. Each of these entities has a wide coverage along the Nile irrigation network and there are several entities within each administrative governorate that carries out all activities related to water distribution and drainage (see Figure 11).

The National Water Research Center (NWRC) carries out research related activities in the MWRI. The Center has 12 research institutes, a Central Laboratory for Environment Quality Monitoring and the Strategic Research Unit. In addition, other ministries that collaborate in the management and operation of part of the irrigation and drainage systems include the Ministry of Agriculture and Land Reclamation (MALR) (tasked with the improvement of agricultural activities and land reclamation, including water management at farm level) and the Ministry of Housing, Utilities and New Communities (MHUNC), that provides water supply and sanitation services to the municipal and industrial subsectors. Other ministries concerned with the water sector include the Ministry of Health and Population (MoHP), the Ministry of State for Environmental Affairs (MSEA), and the Ministry of Local Development (MoLD) (MWRI, 2005).



Source: MWRI (2005)

<Figure 11> Organisational Structure of the MWRI

2-2. Laws and Administration

The irrigation system in Egypt is divided into 18 Central Directorates (CD). Each of these Central Directorates is responsible for managing the full spectrum of water resources within its land of jurisdiction. Furthermore, the Central Directorates represent the MWRI and the Irrigation Sector of the Ministry supervises their activities. The MWRI is the leading organization in regards to development and management of the water resources in Egypt. Additionally, it is within the Ministry´s responsibility to monitor and assess the water quality. Regarding the management of water irrigation, it is controlled by the General Directorates of Irrigation (GD) that exist within the Central Directorates. Each of the Central Directorates may contain more than one GD, depending on the complexity of the irrigation network. For instance, in the Nile Delta and valley there are 27 GDs in total. The geographical boundaries of the GDs are not defined by the administrative boundaries of the CDs, but they are rather defined in relation to the irrigation system.

As it is shown on Figure 11, the CDs are subject to a general entity, namely Central Directorate for Water Distribution (CDWD). The CDWD in tandem with the CDs estimate the annual needs for water allocated in different uses. This is done at the Irrigation Directorate's level. The annual water requirements for water in Egypt are the result of the aggregation of the individual water requirements of each Irrigation Directorate. These water requirements form a schedule of releases that is passed on to the High Aswan Dam Authority that is responsible for the releases of water. Furthermore, the Mechanical and Electrical Department is responsible for the maintenance of the irrigation station and the drainage stations. This is done in accordance with the schedule issued by CDWD. It should be mentioned that other Ministries are involved in the management of water resource. More specifically, the Ministry of Agriculture and Land Reclamation is engaged in the management of water resources at on-farm level. In addition, the Ministry of Housing, Utilities, and New Communities is involved in household water supply and sanitation services. The use of the water quantity of Nile is conditional upon laws that set the legal framework of action in relation to the use of the resources, the rights on them and in total the management of the resource. Legislation has been set a long time ago in Egypt to regulate the Nile water. These laws have been modified according to the needs and the circumstances. The most relevant laws for the legislative framework of the water sector are:

a) Law 93 for the year 1962 for the discharge to open streams and its modifications for the years 1962, 1982, and 1989;
b) Law 27 for the year 1978 for Regulation of water resources and Treatment of Wastewater;
c) Law 43 of 1979 for Local Administration;
d) Decree 380 for the year 1982 for the Industrial Water Pollution Control;
e) Law 48 for the year 1983 Regarding the Protection of the River Nile and Waterways from Pollution;
f) Law 12 for the year 1984 for the Irrigation and Drainage;
g) Law 4 for the year 1994 for the Environment protection; and
h) Law 213 for the year 1994 for Farmer Participation and Cost Sharing.

The two most important laws in relation to irrigation are Law 48 of 1983 that is associated with the discharges and of wastes and wastewaters, and quality standards of these discharges and Law 12 of 1984 that regulates the use of and management of public and private irrigation systems. Under Law 12, cost recovery in irrigation works is also defined (MWRI, 2005; Shakweer, 2007).

2-1-1. Institutional Reform

The Ministry of Water Resources and Irrigation launched in 2004 a National Water Resources Plan for

Egypt (NWRP). This document describes how Egypt will protect its water resources in terms of quantity and quality, and how it will use these resources in the best way from a socio-economic and environmental point of view. Since 2005, Egypt has an Integrated Water Resources Management Plan (IWRM) that is defined as a "process through which water and land resources are managed and developed within a coordinated framework in order to maximize economic and social welfare, and ensure equity and sustainability of environmental systems (MWRI, 2005)." This is very close to the Water and Green Growth project definition of green growth as "a strategy that fosters economic growth and development, protects natural ecosystems and the resources and environmental services they provide, and enhances socially-inclusive development" (WWC, 2012, p.11). According to MWRI (2005), the share of the cost financed by public funds reached 90% for development, operation and maintenance of water services. Furthermore, the total financing by the public sector in irrigation sector amounted to 4% of the total public recurrent expenditure. As Allam, El-Gamal, and Hesham (2004) explain, the MWRI puts efforts in restructuring its functioning by reinforcing the decentralization of processes. It is of the Ministry's interest to implement integrated water resources management. It is believed that this will be achieved by the involvement of the private sector in irrigation activities and by the decentralization of decision-making processes.

3. Concluding Remarks

Egypt has a combination of exogenous factors that have had a huge impact on the development of the country and that have shaped the context of the design, implementation, and operation of the Zero Liquid Discharge Desalination for Agricultural Development project. Overall, Egypt is a country with a growing population that is mainly concentrated in urban areas. A growing population increases the demand for food water services (that in country like Egypt are scarce and costly to produce). Urban areas in Egypt are better off in terms of income distribution and participation in education and employment. The same indicators inrural areas are relatively worse, showing the various dimensions of disparity in the country. On the other hand, Egypt has been trying to promote equal opportunities, regardless the unstable political system and the recent political turmoil. These are the forces that on the one hand reinforce, and on the other hinder the development of the country. Nevertheless, Egypt's economy has been improving recently and maintains positive perspectives despite the fact that it is still weak to boost job creation. In terms of water resources, the Nile River that runs through the country is the most valuable source of fresh water in the country. Its management has been subject to national reforms that aim to create a decentralized model of decision-making processes. Additionally, the Nile River along with other water resources will be managed in a sustainable way under NWRP. The national water plans pay greater attention to both quality and quantity of the water resources, following socio-economic and environmental principles.

4. Performance of the Desalination for Agricultural Development in Egypt

4-1. Generic Performance

As mentioned in the second section of this document, the Zero Liquid Discharge Desalination for Agricultural Development project has not been properly documented and is still an ongoing project. Thus, a detailed assessment of its performance and impacts on the local population, the environment and the economy has proven challenging. It is evident that the technological issues have been resolved in recent years and the technology has become cheaper and more affordable. In addition, there is a clear policy program that aims to integrate this technology as a strategy for green growth. Efforts were done to assess the potential performance of the project as well as its possible impacts on the population, the environment and the economy using information available in the literature from research conducted in other places. However, it should be stressed that more research should be conducted at local level to accurately assess the performance of this specific project.

4-1-1. Attainment of Project Objectives

The use of desalination technologies for agricultural development was established as one of the objectives in the IWRP 2017, and in the Desalination Technology Roadmap 2030 in order to increase water resources in Egypt and attend other water related challenges (e.g. food security and attainment of the MDGs). Further, Egypt planned to increase its official reuse of marginal-quality water from 10% in 2000 to about 17% by 2017. Nevertheless, the desalination of seawater has remained constant from 2002 to 2010 at 0.06 billion m^3/year. On the other hand, the recycling of sewage water passed from 1.10 billion m^3/year in 2005 to 1.30 billion m^3/year in 2010. The recycling of agriculture water passed from 5.1 billion m^3/year in 2005 to 5.8 billion m^3/year in 2010. In 2010, less than 11% of marginal-quality water reuse was achieved (see Table 1). So far, it seems that attaining the 17% objective by 2017 will be very difficult unless more investment is done in this area. When completed the Zero Liquid Discharge Desalination for Agricultural Development project is expected to produce 1000 m^3/day of water for irrigation.

4-1-2. Timeliness of the Project

Given the problems of water scarcity faced not only in Egypt but also in the entire Middle East and North African region, the use of desalination technologies is one of the most viable alternatives for increasing both the quantity and quality of water resources available.

4-2. Economic Performance

Although the economic impacts of Zero Liquid Discharge Desalination for Agricultural Development project have not been documented so far, it can be expected that the project will have a positive economic impact in the region and for the communities nearby. Better access to water for irrigation have undoubtedly increased the agricultural productivity and quality. It is expected that this will also have a positive impact for the employment. So far, the construction of the facilities means that US $1,400,00 have been invested. Local laborers have been employed (see Picture 1).

4-3. Social Performance

Although the social performance of this project cannot be assessed so far, Soliman and Halim (2012) report that there are success stories in reusing brackish water in agriculture. For example, The El-Salam project mixes agricultural drainage water with Nile water. This project contributes to creating new communities that will decrease pressure in densely populated areas in the Nile Valley and to linking Sinai with the Delta. In addition, the local communities and farmers have been actively involved in the different stages of establishing and operating similar projects. However, the level of community participation is not clear, and from the surveys it appears that a top-bottom approach is being followed where most of the decision-making is done at the company and project owner level.

4-4. Environmental Performance

Younos (2005), explains that the construction and operation of a desalination plant requires understanding of the area of construction and attention to the disposal methods. Desalination plants that are established close to densely populated areas can affect the residential environment, due to the generation of noise and gas emission and if the disposal methods are not properly considered, this may lead to contamination of groundwater aquifers, extra energy consumption, and disruption of the environment. Some of the common methods include deep well injections, evaporation ponds, brine concentrators, and zero liquid discharge (ZLD technologies). In the case of Zero Liquid Discharge Desalination for Agricultural Development project, the selected area is not densely populated and it uses a ZLD technology. In this sense, it is heading to a good environmental performance.

4-5. Water Quality Improvement

The use of desalination technologies implies a huge improvement in water quality. As it was mentioned in Section 2, desalination refers to the removal of salts, minerals, and other materials from brackish water or seawater to make it suitable for human consumption (WHO, 2007). Brackish groundwater exists in almost all aquifer systems in Egypt. However, Soliman and Halim (2012) explain that the exploitation of this resource is still limited for a number of reasons that include the unfamiliarity with the dynamics of brackish groundwater during its exploitation. For example quality changes: the salinity of groundwater is estimated to range from 1,000 to >30,000 ppm at the beginning of development and is expected to increase with time, especially for the Pleistocene and the coastal aquifer systems. On the other hand, brackish groundwater occurs in low water demand areas and there are problems associated to the disposal of effluent. The major utilization of non-fresh groundwater at present is by Bedouins (natives) for small agricultural activities and as a drinking source for cattle. The total utilization is estimated at about 19 million cubic meters per year, mainly from the upper ranges of salinity (1,000-10,000 ppm). Similar to freshwater, potassium is contained in sea and brackish water. However, its concentration is significantly lower in freshwater. The exclusion of potassium is as possible as the removal of sodium from water during desalination. Furthermore, a difference between seawaters and brackish waters is the presence of nutrients, such as magnesium and calcium. To elucidate that, their concentration can be significant in sea waters but not in brackish waters. These nutrients can be removed by desalination as the aforementioned elements. However, these can be added to the purified water in order to stabilize the water and achieve a decrease in corrosivity. Neverthleless, other organic chemicals such as humic and fluvic acids among others will be included. These substances can affect the properties of the final water, for example odour. WHO (2004) has published guidelines in regards to the provision of cyanotixn Microcystin LR that belongs to this category of chemical. The guideline for other substances of the same kind are contained in WHO (2007).

4-6. Overall Performance

Overall, it can be said that the Zero Liquid Discharge Desalination for Agricultural Development project has been prove to have an excellent environmental, social, and economic performance, and it is very likely that it will contribute in Egypt's green growth strategy. So far, it has had a positive economic impact in the region, but once it is fully operating, the increased access to water resources for irrigation resulted in improved agricultural productivity, output, and employment. The very nature of the project implies the use of innovative technologies with important implications to the environment and to water quality and quantity. On the other hand, it is not very clear how the local community is involved in the project and its implications for its social performance.

V. Lessons Learned and Conclusion

In this report, we analyzed the Zero Liquid Discharge Desalination for Agricultural Development project in Egypt. The purpose of the project is to use desalination of brackish groundwater for agricultural development. It started its operation in 2005 and has been financed 100% with private funds. The total cost of the project until 2014 was US $1,400,000. When completed, it is expected to produce 1000 m^3/day of water for irrigation. Due to the severe scarcity of water in Egypt the use of desalination technologies is considered an important tool for its green growth strategy as evident in different policy documents (e.g. Integrated Water Resources Plan 2017 and Egypt's Desalination Technology Roadmap 2030). It is clear that some technological problems related to desalination plants have been resolved in recent years (more specifically issues related to energy consumption and disposal methods) and the technology has become more affordable. The main challenge in assessing the potential of Zero Liquid Discharge Desalination for Agricultural Development to contribute on Egypt's green growth has been the scarce availability of data and research conducted at local level. One of the first recommendations for the implementation of projects that are part of a green growth strategy is to keep a detailed record of the different stages of the design, operation, and management of the project. In consequence, efforts were done to assess the potential performance of the project as well as its possible impacts on the population, the environment and the economy using information available in the literature from research conducted in other places. Nevertheless, it is fundamental to conduct more research at local level in order assess more precisely the performance of this specific project. In general, the Zero Liquid Discharge Desalination for Agricultural Development project is likely to have positive environmental, social, and economic performance and to contribute in Egypt's green growth strategy. More access to water resources for irrigation will increase agricultural productivity, output, and employment. On the other hand, the use of ZLD technologies has important implications to the environment and to water quality and quantity. However, it is not very clear how the local community is involved in the project and its implications for its social performance. It is advisable that the views of the local community are taken into account, and that the potential benefits of the project are explained to all relevant stakeholders.

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Interview 1

Respondent 1 was required to provide his expert opinion about the "Zero Liquid Discharge. Research & Implementation" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for water users than for officials. About the way that legal provisions of accountability administratively are translated and how effective they are in practice, he identified administrative supervision and Monitoring procedure for sectoral and regional water allocation. He considers that water data is not adequately collected, managed and publicized. He considers the data is little open to the public. However, he mentioned that data is available through printed materials, company reports, and upon request. He stated that this data is a adequate for the planning and research for the project. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he did not answer if there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that there are no tax exemptions for the project. Finally, he stated that there are no specific regulations directly affecting the project. In the case of market policies, he stated that there is partial cost recovery for all water used. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that financial and quality factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the central government along with residents participated in important decision-making and firms were consulted. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that the judicial/legislative/constitutional could intervene in conflict resolution. He identified basin organizations for transboundary conflicts. When questioned about the overall performance of the project, he identified important factors that contributed to the successes of the project: the Minister of Agriculture's commitment to additional implementation with government funds. On the other hand, added value to land and ensure agriculture sustainability caused positive unexpected results in the case's implementation. Overall, he considers that the intended objectives of the project have been achieved 100%.

In terms of economic performance, he considers that the most positive impact was on the gross regional domestic product, on job creation in the local economy, on technological performance and on local development. In terms of social performance, he reckons that the project had a very positive impact on quality of life and a marginal positive impact on improving citizen participation in decision-making. There was no impact on people's health and on gender equality. In terms of environmental performance, he considers that the most positive impact was on restoring biodiversity, on increasing environmental awareness and on water quality improvements and a marginal positive impact on disaster safety.

Interview 2

Respondent 2 was required to provide his expert opinion about the "Zero Liquid Discharge. Research & Implementation" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers, and users. In his opinion, those legal provisions are more effective for water users than for officials and water suppliers. About the way that legal provisions of accountability administratively are translated and how effective they are in practice, he identified administrative supervision, grievance cells, interministerial committees and monitoring procedure for sectoral. He considers that water data is not adequately collected, managed, and publicized. He considers the data is little open to the public. He stated that this data is publicly available for the planning and research for the project. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies, he reckons that there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that there are no tax exemptions for the project. Finally, he stated that there are no specific regulations directly affecting the project. In the case of market policies, he stated that there is partial cost recovery for all water uses. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that financial, ecological, and quality factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, he mentioned that the firms participated in important decision-making and residents and central government were informed. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that water user associations and the judicial/legislative/constitutional could intervene in conflict resolution. He identified basin organizations for transboundary conflicts. When questioned about the overall performance of the project he identified as important factors that contributed to the successes of the project the interest in agriculture sector to expand with government policy support. On the other hand, added value to land and ensure agriculture predicting caused unexpected results in the case's implementation. Overall, he considers that the intended objectives of the project have been achieved 100%.

In terms of economic performance, he considers that the most positive impact was on the profitability, on job creation in the local economy and on technological performance. He reckons that there was no impact on local development. In terms of social performance, he reckons that the project had the most positive impact on quality of life and no impact on improving citizen participation in decision-making, on people's health and on gender equality. In terms of environmental performance, he considers that the most positive impact was on restoring biodiversity, on increasing environmental awareness and on water quality improvements and a positive impact on disaster safety.

Interview 3

Respondent 3 was required to provide his expert opinion about the "Zero Liquid Discharge. Research & Implementation" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In his opinion, those legal provisions are equally effective for water users, for officials and for water suppliers. About the way that legal provisions of accountability administratively are translated and how effective they are in practice, he identified administrative supervision, and monitoring procedure for sectoral and regional water allocation. He considers that water data is adequately collected, managed, and publicized. He stated that this data is adequate for the planning, implementation, evaluation and research for the project. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he reckons that there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that there are no tax exemptions for the project. Finally, he stated that there are no specific regulations directly affecting the project. In the case of market policies, he stated that there is partial cost recovery for all water uses and water costs are very low for the end users. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that economic and quality factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the firms and central government were informed. On the other hand, he mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that local administration/govt, basin organizations, water user associations and the judicial/legislative/constitutional could intervene in conflict resolution. When questioned about the overall performance he considers that the intended objectives of the project have been achieved 100%.

In terms of economic performance, he considers that the most positive impact was on the gross regional domestic product, on job creation in the local economy and on technological performance. He reckons that there was no impact on local development. In terms of social performance, he reckons that the project had the positive impact on people's health on quality of life and no impact on improving citizen participation in decision-making, and on gender equality. In terms of environmental performance, he considers that the most positive impact was on water quality improvements a very positive impact on restoring biodiversity and a positive impact on increasing environmental awareness and on disaster safety.

Interview 4

Respondent 4 was required to provide her expert opinion about the "Zero Liquid Discharge. Research & Implementation" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers and users. In her opinion, those legal provisions are more effective for water users than for officials and for water suppliers. About the way that legal provisions of accountability administratively are translated and how effective they are in practice, she identified administrative supervision, grievance cells, interministerial committees, monitoring procedure for sectoral and regional water allocation. She stated that this data is adequate for the planning and research for the project. Finally, she considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies she reckons that there are well-organized plans related to water management. She declared that the project has not received financial support such as subsidies or Official Development Assistance (ODA). She stated that there are no tax exemptions for the project. Finally, she stated that there are no specific regulations directly affecting the project. In the case of market policies, she mentions that there is partial cost recovery for all water uses. In relation to private sector promotion policies, she considers that users are favorable overall. Finally, she mentioned that financial and quality factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, she mentioned that the central government participate in important decision-making, firms were consulted and residents were informed. On the other hand, she mentioned that there are clear conflict-resolution mechanisms explicitly specified in the law. She mentioned that water user associations and the judicial/legislative/constitutional could intervene in conflict resolution. When questioned about the overall performance she considers that the intended objectives of the project have been achieved 100%. The factors contributed to the successes of the case were the Minister of Agriculture's commitment to additional implementation with government funds and added value to land and ensure agriculture sustainability caused positive unexpected results in the case's implementation.

In terms of economic performance, she considers that the most positive impact was on the return on investment and on technological performance, a positive impact on job creation in the local economy. She reckons that there was no impact on local development. In terms of social performance, she considers that the project had the positive impact on quality of life and no impact on improving citizen participation in decision-making, on people's health and on gender equality. In terms of environmental performance, she states that the most positive impact was on water quality improvements on restoring biodiversity on increasing environmental awareness and no impact on disaster safety.

Interview 5

Respondent 5 was required to provide his expert opinion about the "Zero Liquid Discharge. Research & Implementation" project. In terms of community institutional factors, he stated that there are no explicit legal provisions for ensuring the accountability of officials, water suppliers, and users. About the way that legal provisions of accountability administratively are translated and how effective they are in practice, he identified administrative supervision, inter-ministerial committees, and monitoring procedure for sectoral and regional water allocation. He considers that water data is adequately collected and managed but is not open to the public. He stated that this data is somehow adequate for the planning, implementation, evaluation, and research for the project. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies, he reckons that there are well-organized plans related to water management. He mentioned that the project has not received financial support such as subsidies or Official Development Assistance (ODA). He mentioned that there are no tax exemptions for the project. Finally, he stated that there are no specific regulations directly affecting the project. In the case of market policies, he stated that there is partial cost recovery for all water uses. In relation to private sector promotion policies, he considers that users are favorable in particular sector. Finally, he mentioned that financial and quality factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation he mentioned that the firms and central government participate in important decision-making and residents were consulted. On the other hand, he mentioned that there are not clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that local administration/govt and water user associations could intervene in conflict resolution. When questioned about the overall performance he considers that the intended objectives of the project have been achieved 90%.

In terms of economic performance, he considers that the most positive impact was on the return on investment, on job creation in the local economy and on technological performance and on local development. In terms of social performance, he reckons that the project had the most positive impact on quality of life and no impact on people's health, on improving citizen participation in decision-making, and on gender equality. In terms of environmental performance, he considers that the most positive impact was on water quality improvements a very positive impact on restoring biodiversity, on disaster safety and a marginal positive impact on increasing environmental awareness.

India

Water Management in Gujarat State: Mix of Policy and Infrastructure Initiatives Result in Green Growth

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

AMC Ahmedabad Municipal Corporation
BJP Bharatiya Janata Party
CEO Chief Executive Officer
CETP Common effluent treatment plants
CHETNA Center for Health Education, Training and Nutrition Awareness
CMWS Community Managed Water Supply Project
CSO Central Statistical Organization
CSR Corporate social responsibility
DMIC Delhi Mumbai Industrial Corridor
DSC Development Support Center
EVs Extension Volunteers
GDP Gross Domestic Product
GERI Gujarat Engineering Research Institute
GGRC Gujarat Green Revolution Company Limited
GIDC Gujarat Industrial Development Corporation
GP Gram Panchayat
GPCB Gujarat Pollution Control Board
GR Government Resolution
GSDWICL Gujarat State Drinking Water Infrastructure Company Limited
GWRDC Gujarat Water Resources Development Corporation Limited
GWSSB Gujarat Water Supply and Sewerage Board
IMT Irrigation Management Transfer
INC Indian National Congress
IRAP Institute for Resource Analysis and Policy
ISP Indira Sagar Project
IWRM Integrated Water Resources Management
KL Kilolitres

MAF Million Acre Feet

MCM Million Cubic Metre

MDGs Millennium Development Goals

MI Micro Irrigation

MINARS Monitoring of Indian National Aquatic Resources System

MT Million Tons

NGO Non-governmental Organization

O&M Operation and Maintenance

PIM Participatory Irrigation Management

PS Pani Samiti

RO Reverse Osmosis

SDTT Sir Dhorabji Tata Trust Mumbai

SEWA Self-Employed Women's Association

SPPWCP Sardar Patel Participatory Water Conservation Project

SPVs Special Purpose Vehicles

SRTT Sir Ratan Tata Trust

SRFDCL Sabarmati River Front Development Corporation Limited

SRFDP Sabarmati River Front Development Project

SSNNL Sardar Sarovar Narmada Nigam Limited

SSP Sardar Sarovar Project

TERI The Energy and Resources Institute

VIKSAT Vikram Sarabhai Center for Development Interaction

WALMI Water and Land Management Institute

WASMO Water and Sanitation Management Organization

WGG Water and Green Growth

WUAs Water Users Associations

WWC World Water Council

Executive Summary

In November 2010, the World Water Council (WWC) signed a memorandum of understanding with the Government of the Republic of Korea to initiate a joint project on Water and Green Growth (WGG). The first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille in March 2012. A case study on water management in the State of Gujarat was included in the first edition; the expanded case study included here is an input into Phase II of the project, leading up to the Seventh World Water Forum in Daegu.

The Gujarat water management case study explores the rapid growth of the State's economy, based on an analysis of exogenous factors and water institutions at the State and local levels that have had a major impact on that growth. The present research explores how the exogenous economic, social, political, environmental and technical factors drive water resources planning and management processes. It examines how the institutional framework in the water and related sectors contributed to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in *The Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions. The questionnaires presented to representatives of the main water-related institutions in Gujarat State were developed to reflect that framework.

Gujarat is one of the most water scarce regions in India, with nearly 80% of its geographical area having a renewable water resource endowment of less than 1,000 m^3 per capita per annum, with north Gujarat being absolutely water-scarce (less than 500 m^3 per capita per annum). More importantly, the regions with a poor water endowment have excessively high water demands. Most of this demand comes from agriculture, due to aridity, high per capita arable land availability and high dependence of the rural population on water for their livelihoods. Water use in three out of the four regions, namely north Gujarat, Saurashtra, and Kachchh, is currently unsustainable. The State has been known for problems of groundwater mining in north Gujarat, and seawater intrusion in coastal areas of Saurashtra and Kachchh. Nearly two thirds of the state's geographical area is drought prone.

Yet, the State has made major economic progress during the past 10-15 years through rapid growth in the manufacturing sector and impressive growth in agriculture through technology, skill development and infrastructure development. In this drought-prone State, water security to drive this growth was achieved through water imports for rural and urban drinking supply, industrial use, and irrigation. For this, large water infrastructure projects were implemented, including the Sardar Sarovar Project (SSP); the transfer of water for recharge of depleted alluvial aquifers in north Gujarat; large scale promotion of drip and sprinkler irrigation systems; the Sabarmati Riverfront Development Project; and large-scale decentralized water harvesting. The conditions that enabled these developments were: a stable government; the determination to find permanent solutions to droughts and scarcity of water for drinking and irrigation; consistently high growth in GDP and better economic conditions; and improvements in human development; and a good pool of technical manpower.

While there are indications that the large inter-basin transfer projects have had a positive impact on the environment and social well-being apart from improvements in economic conditions, it is crucial to monitor these impacts over time to make sure that they do not cause environmental problems in the water surplus areas over time. Intensive commercial farming, rapid urbanization, and industrial growth continue to pose challenges for water and environmental management, with depletion of groundwater, over-appropriation of surface water and threats to ecosystem health in rivers.

On the social development front, there are indications that rural women, as well as other demographic segments of the population, have not fared well. Trends show a shift in cropping patterns to high value cash crops, which can threaten domestic food security in the long run, if farming systems are not made resilient. Malnutrition among women and children in rural and urban areas still remains a concern for the state.

Water administration in Gujarat is organized around three State departments: Department of Water Resources (also includes minor and medium irrigation systems), Department of Narmada and Major Irrigation, and Department of Water Supply. Other ministries such as industry, environment, and local self-governments are also associated with the administration of water. The Gujarat Water Resource Development Corporation is an autonomous body whose primary responsibilities are survey, monitoring, and development of groundwater. The Sardar Sarovar Narmada Nigam Ltd. (SSNNL)is an autonomous body that is responsible for the implementation of the Sardar Sarovar project, one of the most ambitious multi-purpose projects of modern India.

The institutional structure of the water supply sector in Gujarat is complex. The administration and regulation of water supply, covering domestic and industrial sectors, is provided by a number of different government departments, municipalities, local governments, and public-private enterprises. The Water and Sanitation Management Organization (WASMO) was created to empower village-level institutions to manage their own rural water supply facilities. It has brought about effective citizen engagement through its innovative governance model for community-led water supply program throughout the State of Gujarat.

Overall, the state water administration is geared up to develop water resources and distribution and deliver for various competitive uses. However, the major reforms on the legal and policy front have not effectively addressed the concerns of equity, efficiency and sustainability in water use. The problems in the water sector, such as groundwater mining, environmental water scarcity in rivers and inefficient use of water in agriculture, are being tackled through technological interventions and large-scale infrastructure projects. Organizational changes to implement the large projects are often in the form of Special Purpose Vehicles. Changes in norms are brought about for speedy acquisition of land for building of the canal network of SSP. New regulations for issuing new power connections can be inequitable, as they entail metering of agricultural connections, while many of the old agricultural connections remain unmetered.

The major initiatives in Gujarat over the past decade, which had a significant impact on the development and management of water resources in Gujarat State are outlined in the case study. Amongst them, the SSP produced the most remarkable impact, by raising agricultural productivity in the command area; improving the groundwater regime not only in the command area, but also in alluvial areas of central and north Gujarat; reducing energy use for pumping groundwater for both irrigation and domestic water supply; improving sustainability of well irrigation; and producing clean energy.

To ensure that water resources became an engine of sustainable growth, the Government of Gujarat implemented exactly the same types of policies which are recommended in the Water and Green Growth policy framework under "water as an engine of growth": promote technology transfer and invest in innovative tools to improve water and energy efficiency; revitalize and better use urban waterways and waterfront areas; adopt a package of economic instruments, including demand management and incentives for recycling and reuse of water; and balance green and grey infrastructure among the competing uses.

On the economic front, the case study demonstrates a good example of growth based on water. However, the other two dimensions of green growth have not been as strong: protection and conservation of water resources; and water for an improved quality of life.Some of the lessons learned and challenges still facing the State in the water sector are summarized below and are discussed in more detail in the case study.

1. Better coordination is needed among various line agencies of the government responsible for water resources development and management. A number of different departments and agencies are responsible for large, medium and small irrigation, and these overlap with those that implement watershed development, minor irrigation schemes and groundwater irrigation. There needs to be a coordination mechanism so that these do not work at cross-purposes.

2. The ecosystem needs are not sufficiently addressed in watershed development programs. In treated watersheds, there has been a shift in cropping and land-use patterns to more water-intensive crops, using more water, and causing water quality problems from agricultural runoff. A regulatory framework for development and management of water resources and water allocation is needed, with appropriate institutional mechanism to enforce it at the level of hydrological units, i.e., basins.

3. There is a need for empowering the local communities to derive maximum benefits from the water management initiatives. The village water committees require capacity building in operation and maintenance, and they need to understand their rights and responsibilities, so as to function as effective local institutions for overall governance of water resources.

4. Groundwater conservation initiatives, such as Micro Irrigation promotion, have focused on technical solutions, and have not sufficiently considered the needs of poor farmers. Such schemes need to consider not only economic aspects, but social aspects as well. Thus, the community institutions need to have the capabilities and powers to play an effective role in water governance at the local level.

5. Though the government of Gujarat has adopted a participatory irrigation management policy to promote farmers involvement in irrigation management at the tertiary level of canal systems, there has not been an effort to introduce volumetric pricing of water. Hence, the farmers have no incentive to use water efficiently in both physical and economic sense.

6. There are no well-defined rights or entitlements for groundwater or water allocated from surface water systems. In the absence of this, the opportunity cost of using water is very small in most situations. Water is inefficiently used in agriculture for growing water-inefficient crops, or appropriated by those who pay more rather who need it more. Water rights need to be established in the case of groundwater resources, which are still linked to land ownership, if equity and sustainability are to be addressed.

I. Introduction

1. Purpose of the Case Study

Since the Brundtland Commission defined the concept of sustainable development in 1987, it has been accepted that development must include not only economic growth, but also environmental and social dimensions.[1)]

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then the United Nations and the international community have considered water as essential to the attainment of sustainable development. Water resources and sanitation were at the top of the agenda for negotiations leading to the Johannesburg Plan of Implementation (World Summit on Sustainable Development, Johannesburg, August-September 2002) and the World Conference on Sustainable Development in Rio in June 2012. Since 1977 there have been two International Decades for water (International Water Supply and Sanitation Decade, 1981-1990 and the International 'Water for Life' Decade, 2005-2015), the International Year of Freshwater (2003), the International Year of Sanitation (2008) and the International Year for Water Cooperation (2013). Water and sanitation were an important part of the Millennium Development Goals and water resources are at the center of negotiations for the post-2015 Sustainable Development Goals. The General Assembly declared the right to water and sanitation as a basic human right in July 2010.

In addition, innumerable international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991 and the triennial World Water Forums, convened by the World Water Council every three years since 1997. The Seventh World Water Forum will be held in Daegu, Republic of Korea in 2015.

In November 2010, the World Water Council signed a memorandum of understanding with the Government of the Republic of Korea to initiate a joint project on Water and Green Growth (WGG).[2)] Following considerable background research and the collection of case studies, a policy framework was developed and the first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille in March 2012. A case study on water management in the State of Gujarat was included in the first edition; the expanded case study included here is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu. It has been supported by the World Water Council and the Government of the Republic of Korea, the organizers of the Forum.

1) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced *Our Common Future* (1987, Oxford University Press), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

2) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

2. Case Study Context

Gujarat State, located on the west coast of India, has a total geographical area of 196,000 km^2 with a coastline of 1600 km, one-third of India's total (see Figure 1). The state has experienced very rapid economic growth over the past 20 years.

Gujarat is one of India's most prosperous states, having a per-capita GDP that rose from well below India's average in 2000 to above the average in 2012 (US $1,142 compared to US $1,107 for India as a whole). The State's economy grew at an average rate of over 12.3% per year from 2000 to 2011 at constant prices, reaching US $70.27 billion in 2011.[3] Gujarat ranked third in India in terms of GDP per capita growth.[4] The state is considered the growth engine of India; while Gujarat contributes around 7% to the country's overall GDP, it has just 5% of the nation's population (just over 60 million).

The state experienced balanced growth in its economy, with robust growth in the agriculture, industry, and service sectors in the past decade. There are many reasons for the rapid growth of these sectors, but one main factor has been water security, with major improvements in the availability of dependable and reliable water supplies to meet the competing demands from all sectors. Analysis of global data sets shows how improved water security of countries drives economic growth and human development at the national level.

Source: Wikimapia: http://wikimapia.org/country/India/Gujarat/

<Figure 1> Map of Gujarat and Location in India

3) World Bank Country Dataset http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India

4) http://states-of-india.findthedata.org/q/7/4242/What-is-the-Gross-Domestic-Product-of-Gujarat

The countries which had high levels of water security had high human development indices, which in turn drive economic growth, resulting in high per capita GDP.[5] This case study will examine a number of the initiatives taken in the water and energy sectors by the government, the private sector, and the communities, which have direct bearing on water security in different sectors, to realize economic well-being and social advancement.

The questionnaires presented to representatives of the main water-related institutions in Gujarat State were developed to reflect that framework. Saleth and Dinar define a water institution to be an entity defined interactively by three main components: water law, water policy, and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

3. Case Study Methodology

The Gujarat water management case study explores the rapid growth of the State's economy, based on an analysis of exogenous factors and water institutions at the State and local levels that have had a major impact on that growth. The work was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[6] The present research will explore how the exogenous economic, social, political, environmental, and technical factors drive water resources planning and management processes. It will examine how the institutional framework in the water and related sectors contributed to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in T*he Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[7]

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which the State of Gujarat (India) undertook its water management reform. The policies and institutions that have been responsible for the improvements in water availability underlying the State's rapid economic growth have mainly been implemented since the year 2000. These policies and institutions are still evolving, changing, and adapting to cliverse circumstances and lessons learned. The stability in government over that time period has made it possible to adapt those policies and institutions. From this investigation, the different water management institutions and policies are described, and their performance is analyzed and lessons drawn. First exogenous factors are examined, then institutional factors and the policy mix considered together, and performance analyzed last.

This report is organized as follows. First, the Gujarat Water Management case study is summarized, indicating the main reforms and the main economic and social impacts. Second, the external environment during

5) *Kumar, M.D. 2010. Managing Water in River Basins: Hydrology, Economics, and Institutions*. New Delhi: Oxford University Press.

6) Research Center for Water Policy and Economy at K-water Institute. 2013, Sept. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report. Daejeon, Republic of Korea.

7) Saleth, R. and Dinar, A. 2004. The Institutional Economics of Water: A Cross Country Analysis of Institutions and Performance. Washington D.C.: The World Bank.

the evolution of the water management reforms is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Statistics from international, national, and State sources, and from independent academic studies, to provide an overview of the situation in the State.

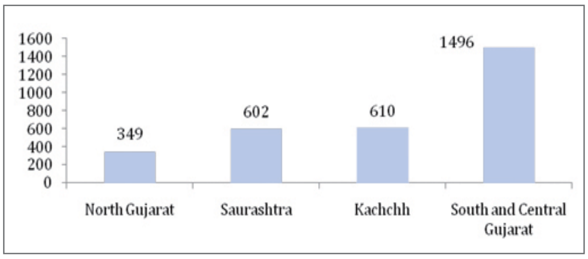
Next, the water resources developments, institutions and policies are summarized and analyzed, showing the changes over time. Finally, the impact and performance of the water management projects, survey results and expert interviews are used to analyze the current situation and performance of the water management reforms in Gujarat State.

II. An Overview: Water Management in Gujarat

1. About Gujarat

Gujarat is one of the most water scarce regions in India, with nearly 80% of its geographical area having a renewable water resource endowment of less than 1,000 m^3 per capita per annum, with north Gujarat being absolutely water-scarce (less than 500 m^3 per capita per annum). More importantly, the regions with a poor water endowment have excessively high water demands. Most of this demand comes from agriculture, due to aridity, high per capita arable land availability, and high dependence of the rural population on water for their livelihoods. Water use in three out of the four regions, namely north Gujarat, Saurashtra and Kachchh, is currently unsustainable. The State has been known for problems of groundwater mining in north Gujarat, and seawater intrusion in coastal areas of Saurashtra and Kachchh. The per capita renewable water resources of the four distinct regions of Gujarat are given in Figure 2.

The mean rainfall in Gujarat varies from from 350mm/year in Kachchh to 2000 mm/year in the Southern part.[8] The land is mostly fertile. There are 17 river basins in North Gujarat, with 71 river basins in the Saurashtra region and 97 river basins in Kachchh region. Although the state has more than 184 major and medium irrigation schemes, several parts of North Gujarat, Saurashtra, and Kachchh regions frequently suffer from severe water scarcity due to poor dependability of rainfall. Nearly 70% of the surface water resources of the state are concentrated in South Gujarat, which has perennial rivers[9] such as Mahi, Tapi, Narmada, Damanganga and Karjan. The rivers of north Gujarat, Saurashtra, and Kachchh are ephemeral, and the surface water resource potential is very low. When surface water is insufficient, groundwater has been overexploited to sustain intensive crop production in these regions. In many areas, people suffered from lack of adequate drinking water. Water levels in tube wells in certain areas of North Gujarat have fallen to 300 metres below ground level.



Source:Kumar, Sivamohan and Bassi, 2012 [10]

<Figure 2> Renewable Water Availability in Gujarat (m^3/capita/annum)

8) Institute of Rural Management Anand (IRMA)/UNICEF. 2001. White Paper on Water in Gujarat. Government of Gujarat, Gandhinagar.

9) Ibid.

10) Dinesh, K.M., Sivamohan, M.V.K., and Nitin B. 2012. Water Management, Food Security and Sustainable Agriculture in Developing Economies. London: Earthscan from Routledge.

Nearly two-thirds of the state's geographical area is drought prone, with half of it severely drought prone. The total geographical area of the state affected by droughts during the past three decades ranged from a low of 23% during 1973/74 to 87% during 1987/88, whereas the population affected by droughts ranged from a lowest level of 18% during 1973/74 to 67% during 1987/88.[11] Therefore, the state's experience in mitigating the impacts of climate variability and reducing carbon emissions would be valuable for many other developing and emerging countries. Water scarcity not only puts severe constraints on economic growth, but also threatens the very survival of the human population in certain parts of this large State, with people lacking access to water for basic needs locally. The unique agro eco-systems, the long coastline, and a large tribal population pose additional challenges.

2. Timeline for Water Management Advances

Over the last 30 years, Gujarat has tried both the dominant international model, and the decentralized participative model in the water sector. While construction of large multi-purpose reservoirs like the Sardar Sarovar Project and large regional water supply pipelines involving bulk water transfer are examples of the former, community-centered infrastructure for water harvesting is an example of the latter. Since 1997, the State introduced a large water conservation program in the Saurashtra peninsula, involving nearly 100 ephemeral rivers draining into the ocean, with nearly 100,000 small water harvesting structures built in the rural areas for capturing runoff.

On the drinking water front, Gujarat has experienced water riots; migration took place in search of water and to reduce the drudgery of women and the plight of villagers. Excessive withdrawals of groundwater posed serious quality problems affecting the health of millions of people in the coastal areas. The government realized that over-dependence on local groundwater for water supplies, whose availability is affected by excessive withdrawal for irrigation and consequent seasonal depletion, could threaten the sustainability of drinking water supplies in rural and urban areas. To ensure water supply dependability, the State, through the Gujarat Water Supply and Sanitation Board (GWSSB), created a "state-wide drinking water grid" for the transmission of surface water with the help of large-scale infrastructure installations. Box 1 presents water management milestones in Gujarat.

<Box 1> Significant Milestones in Water Laws, Policies, and Administrationin Gujarat

1974: The Gujarat Pollution Control Board (GPCB) was established; it is responsible for monitoring the quality of rivers, lakes, reservoirs, and other surface waters, bore wells and groundwater, as well as coastal waters.

1975: The Gujarat Water Resources Development Corporation Ltd. (GWRDC) was established to concentrate on groundwater investigation, exploration, management and recharge works. Presently, GWRDC is functioning under the Narmada Water Supply and Water Resources Department with a separate Board of Directors headed by a Chairman and Managing Director, who is also the Chief Engineer of the Government of Gujarat.

1978: The Government of Gujarat established the Gujarat Water Supply and Sewerage Board (GWSSB), a statutory body overseeing development, regulation, and control of drinking water in the State. The Board is mainly responsible for rural water supply systems and for operational management of rural regional water supply schemes.

1979: The Sardar Sarovar Dam project took form as part of the Narmada Valley Project, a development scheme to increase irrigation and produce hydroelectricity. It is a gravity dam on the Narmada River near Navagam, Gujarat and is the largest of 30 large dams planned on the Narmada River. The Narmada Valley Development Authority is an organization of the government of Madhya Pradesh. The Narmada Valley Project has been one of the most widely criticized water development projects around the world in recent years, because of its potential social and environmental impacts. At the same time, it is an ambitious project to provide water and energy security for the states of Madhya Pradesh and Gujarat.

11) Roy, A.K. and Hirway, I. 2007. Multiple Impacts of Droughts and Assessment of Drought Policy in Major Drought Prone States in India, Project Report Submitted to the Planning Commission, Government of India, New Delhi.

1988: Establishment of Sardar Sarovar Narmada Nigam Ltd (SSNN) as a Special Purpose Vehicle of the Government of Gujarat; the Nigam was registered under Companies Act.
1997: The Ahmedabad Municipal Corporation (AMC) set up the Sabarmati Riverfront Development Corporation (SRFCDL) as a Special Purpose Vehicle to oversee the massive task of cleaning up the Sabarmati River by flushing out the effluent and sludge in the riverbed using excess flows of Narmada from the main canal.

1999: The Government of Gujarat set up the Gujarat Water Infrastructure Co. Ltd. to implement, operate and maintain the Sardar Sarovar Drinking Water Supply program.

2000: The Gujarat Infrastructure Company, Ltd. was formed to build the water distribution infrastructure under the Narmada and Mahi Canal based regional water supply scheme.

2000 Onward: Construction of Sardar Sarovar Dam (Ongoing)

2000-01: Plan for the state-wide water grid completed.

2002: The Government of Gujarat set up the Water and Sanitation Management Organization (WASMO) as a Special Purpose Vehicle – an autonomous society – to implement decentralized rural water supply management

2000-01: Phase I of the Sardar Patel Participatory Conservation Project (SPPWCP). The project involved construction of check dams and village tanks or ponds by a designated beneficiary group, with technical and financial assistance from the district office. Over 10,000 works were completed in phase I.

2001-13: Phase II, III and IV of SPPWCP. By March 2013, over 88,000 check dams had been built with people's participation by Narmada Water Resources, Water Supply and Kalpasar Department and over 162,000 by other Departments in Gujarat State.

2005: Establishment of Gujarat Green Revolution Company Ltd. (GGRC) to popularize the adoption of drip irrigation and implement micro irrigation schemes among farmers on behalf of the government of India and Gujarat State. GGRC offers highly subsidized loans to farmers and has simplified the administrative procedures.

2006: The Jyotigram Scheme was initiated by the President of India. It is an initiative that uses a rationing system for farm power supply to limit the competitive pumping of water. The Scheme improved reliability and reduced low voltage fluctuations for agricultural power supply and also assured 24 hour, three phase power supply for the domestic sector.

2013: A new Irrigation and Drainage Act was adopted. The earlier Irrigation and Drainage Act (when Gujarat was part of Bombay State) was created in the colonial framework. The new Bill dropped irrelevant provisions and gave more legal authority to the irrigation departments (mainly to enforce penalties against those tapping illegal water). [12]

III. The Case Study

The case study on water management in Gujarat State chronicles a combination of huge investments in water infrastructure, modifications in water and energy policies, and changes in water administration. One of the important lessons learned from the case study is that technological initiatives to improve water supply for domestic consumption and irrigation have to be complemented by grassroots people's participation in management and distribution of water. The community-managed water supply program in Gujarat has been a model for the entire country. Small innovations, such as micro-water harvesting, have made a large impact on agricultural production.

Key factors for success of the water initiatives are:

- Support for large-scale infrastructure for transfer of water from relatively water rich regions to water-scarce regions that are affected by droughts, balanced with small-scale community-led innovations for local water harvesting and water management; and
- Proactive policies, institutional reforms and organizational development that led to rapid development of water and energy infrastructure for optimal use of water and adoption of efficient water use technologies in the major water consuming sectors.

The biggest investment in water infrastructure is the Sardar Sarovar Project on the Narmada River, part of a multi-State, multi-purpose river valley project, that resulted from a long period of deliberations of a constitutional body. The agreement was based on the principles of 'Equality of Right' and 'Equitable Utilization' along the entire course of the interstate

12) Gujarat Irrigation and Drainage Bill to replace Gujarat Irrigation Act of 1879. Full text at http://guj-nwrws.gujarat.gov.in/downloads/drainage_bill_2013_eng.pdf

river. The project is projected to irrigate 1.90 million ha of land, increase agricultural production by 8.7 million tons per annum (worth US $430 million) and generate hydropower with installed capacity of 1,450 MW. The project is also expected to supply drinking water to over 8,200 villages and 135 urban centers of Gujarat (around 20 million people) generate jobs in rural areas, and reduce the rate of desertification, saline intrusion and rural to urban migration in Gujarat. The command area and drinking water supply areas of the project represent the worst water scarcity-hit areas of the State.[13)]

Along with this huge infrastructure project is the Sardar Patel Participatory Conservation Project (SPPWCP), which involves construction of check dams and village tanks or ponds by a designated beneficiary group, with technical and financial assistance from the district offices of the water resources department of the government of Gujarat. More than 350,000 check dams and village tanks or ponds were created in the last 10 years, providing direct benefit to over 13 million people in rural Gujarat. Gujarat has also created the Gujarat Green Revolution Company Ltd. to popularize the adoption of drip irrigation technologies among farmers. GGRC offers highly subsidized loans to farmers and has simplified the administrative procedures for obtaining loans and government subsidy.

As described below, the State of Gujarat has taken a multi-pronged approach to tackling its water management challenges. This was necessary in an economically-vibrant but drought-prone and semi-arid region of the world.

1. Exogenous factors

This section presents the exogenous factors that helped shape the context in which Gujarat State implemented key water resources management decisions. It describes some of the economic, social, political, environmental, and technological elements that influenced the decisions that were made and contributed to the achievement of green growth.

1-1. Economic Factors

Gujarat's rapid economic growth is reflected in a balanced economy, with agriculture and food output averaging growth of 11% annually from 2001 to 2011, while industry and services attained over 10% per year growth.[14)] It should be pointed out here, however, that Gujarat was hit by a devastating earthquake in January 2001 and experienced a large rainfall deficit from 2000 to 2002, which would indicate that the base from which the growth rate figures were taken was relatively low. Nonetheless, Gujarat has recorded steady economic growth over the last decade.

Gujarat is one of India's most prosperous states, having a per-capita GDP (in constant prices) that rose from well below India's average in 2000 (US $352 to India's $ 578) to above the average in 2012 ($1,142 compared to US $1,107 for India as a whole).[15)] The State's economy grew at an average rate of over 12.3% per year from 2000 to 2011at constant prices. The per capita net state domestic product (per capita income) at constant prices grew at an annual compounded growth rate of 10.3% over the period 2000 to 2012.[16)] Economic growth for the period

13) *Gupta, R.K. 2003. Dams and Water Development for Poverty Reduction. Water and Development and Poverty Reduction.* Kluwer Academic Publishers. Part 4(Ch. 10): 199-226.

14) World Bank Country Dataset http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India

15) Ibid.

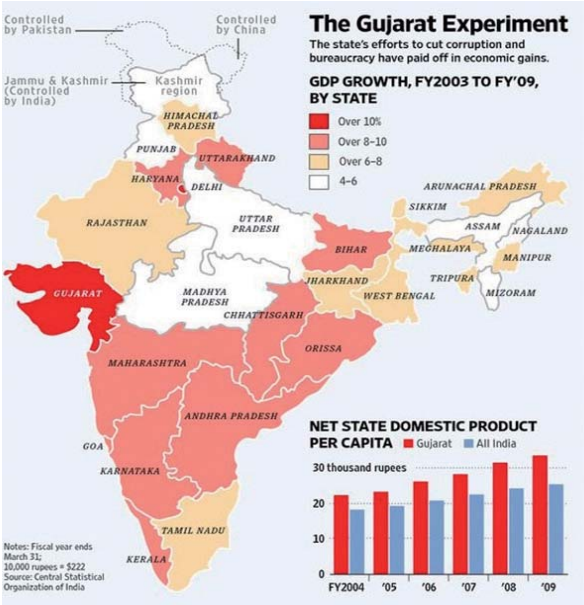
16) Author's calculations from Table 1 data.

2000 to 2012 in the State as compared to India as a whole is shown in Table 1. Figure 3 shows the comparison graphically, but in current rupees from FY 2004 to 2009.

<Table 1> Gross Domestic Product and its Growth in India and Gujarat, 2000-2012

Year	GDP at constant prices (in billion US $)		GDP growth (annual %)		GDP per capita at constant prices (in US $)	
	India	Gujarat State	India	Gujarat State	India	Gujarat State
2000	602.65	17.42	3.8	-4.9	578	352
2001	631.72	18.88	4.8	8.4	596	373
2002	655.76	20.42	3.8	8.1	609	395
2003	707.30	23.43	7.9	14.8	647	445
2004	763.34	33.90	7.9	8.9	687	630
2005	834.22	38.96	9.3	14.9	740	713
2006	911.50	42.23	9.3	8.4	797	761
2007	1,000.84	46.88	9.8	11.0	863	833
2008	1039778	50.06	3.9	6.8	885	877
2009	1127948	55.69	8.5	11.3	948	962
2010	1246906	61.26	10.5	10.0	1034	1052
2011	1325842	66.48	6.3	8.5	1086	1100
2012	1368759	70.27	3.2	5.7	1107	1142

Source: World Bank Country Dataset: http://databank.worldbank.org/data/views/reports/tableview.aspx and Central Statistical Organization of India



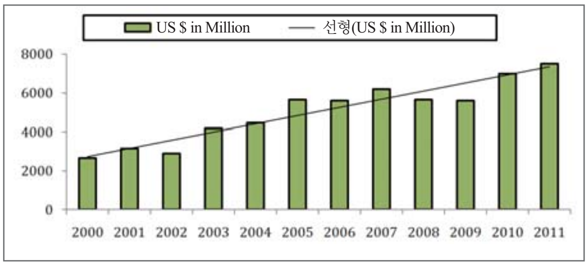
Source: Central Statistical Organization of India

<Figure 3> GDP Growth in Gujarat, 2003-2009.

1-1-1. Agriculture

According to the Directorate of Economics and Statistics, the agriculture sector in Gujarat has experienced an annual compound growth rate of 9.9 % over the decade 2000/01 to 2011/12. The State is a major producer of cotton, groundnuts, bananas, dates, sugar cane, oil seeds such as castor and mustard, milk and milk products, and tobacco.[17)]

The agriculture sector is still a critical factor in the overall performance of the state economy. During the period 2000 to 2011, the contribution of agriculture including animal husbandry to Gross State Domestic Product rose from US $ 2.66 billion to US $ 7.51 billion at 2004-05 prices (see Figure 4).



Source: Gujarat socio-economic reviews, 2012-13 [18)]

<Figure 4> Performance of the Agricultural Sector (at Constant 2005 Prices) in Gujarat, 2000-2011

Agricultural growth has been shown to have the greatest impact on poverty reduction and rural development. In recent years, a major expansion in irrigation has been achieved through the execution of the Sardar Sarovar Project, improvements in water management and use of water efficient irrigation technologies such as drips and sprinklers.

These and other innovations in the agriculture sector have led the rural economy towards more inclusive

17) Directorate of Economics and Statistics, Government of Gujarat. 2013. Socio-Economic Review, 2012-13, Budget Publication No. 34, Gandhinagar: http://financedepartment.gujarat.gov.in/budget13_14_pdf/34_Socio_Economic_Review_English.pdf.

18) Ibid.

growth. The role of the agriculture sector remains very critical, as it accounts for about 52% of employment in the State. Hence, the growth of agriculture can be considered a necessary condition for 'inclusive growth'. More recently, the rural sector (including agriculture), in addition to being a supplier of food, fodder, and raw materials for a vast segment of industry, is being seen as a potential source of domestic demand, a recognition that is shaping the marketing strategies of entrepreneurs wishing to widen the demand for goods and services.[19)] Hence, agricultural growth is a precondition for balanced growth in the economy. During FY 2010 to 2011, production of food grains, which are generally low valued, dropped by around 8% over the year. The production of cotton rose by 5.5% and the production of oil seeds showed a slight decline over the year. Agricultural growth in the State in recent years has been driven more by crop diversification and expansion in the area under fruits, vegetables, oil seeds, and other cash crops.

Given the fact that the net sown area has not been changing significantly over the past few decades, the only way to achieve agricultural growth is through crop intensification and crop diversification. The former would be possible through the irrigation expansion, while the latter could be achieved through the production of lower water-using crops. The shift towards high value fruits and vegetables, oil seeds, and other cash crops such as cotton and castor has been water-intensive, and was accompanied by the adoption of micro irrigation systems, such as drips and sprinklers. The use of MI systems, especially drips, enhanced water use efficiency in irrigation. However, to promote green growth and water conservation in the long run, it would be appropriate to revert to the production of crops that use less water.

In Gujarat, it has been shown that there is a strong correlation between rainfall and the production of food grains. Both the area and production of food grains have been largely influenced by the rainfall fluctuations over the years. Over the decade FY2000 to 2010, six years registered declines in rainfall over the previous year. The largest decline was in 2000, followed by another deficit year, which caused food grain production to decline over 25% in each of those years. As FY 2000 was the baseline for growth rates over the 10-year period, the agricultural growth rates should be treated with caution. Nevertheless, it is indisputable that there has been a major recovery of the agriculture sector after the two consecutive years of drought, i.e., in 1999 and 2000. The SSP has played a crucial role in the recovery, by starting the delivery of large volumes of water for irrigation.[20)]

1-1-2. Industry

One of India's most industrialized states, Gujarat established itself as a leader in various industrial sectors from the 1960s to the 1990s – textiles, engineering, chemicals, petrochemicals, drugs and pharmaceuticals, dairy, cement and ceramics, and gems and jewelry. Gujarat accounts for more than 35% of Indian chemical production. Newer industries include the production of fertilizers and petrochemicals. With 6% of India's geographical area, the State has a coastline of 1600 km and is home to 41 ports and handles around 25% of the country's sea-cargo. Growth of state GDP in the industrial sector for Gujarat as compared to GDP in industry for India as a whole is shown in Table 2.

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19) Directorate of Economics and Statistics, Government of Gujarat. 2013. Socio-Economic Review, 2012-13, Budget Publication No. 34, Gandhinagar: http://financedepartment.gujarat.gov.in/budget13_14_pdf/34_Socio_Economic_Review_English.pdf.

20) Kumar, M., Dinesh, A., Narayan, A., Singh, O.P., Sivamohan, M.V.K., Sharma, M.K., and Bassi, N. 2010. Gujarat's Agricultural Growth Story: Exploding Some Myths. Occasional Paper #2. Hyderabad: Institute for Resource Analysis and Policy

<Table 2> Growth rate of Gross Domestic Product in the Industry Sector, India and Gujarat, 2000 to 2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gujarat	-12.3	-2.0	17.7	12.5	15.1	14.6	9.4	10.8	6.5	21.2	6.6	5.2
India	6.0	2.6	7.2	7.3	9.8	9.7	12.2	9.7	4.4	9.2	9.2	3.5

Source: World Bank Country Dataset and Central Statistical Organization of India

The State is rich in mineral resources such as calcite, gypsum, manganese, lignite, bauxite, limestone, agate, feldspar, and quartz.

Gujarat ranks first among India's states in gas-based thermal power generation, with a national market share of over 8%. The State increased its power generation capacity by over 35% during the period 1995/96 to 2000/01. It was one of the first states in India to have encouraged private sector investments, which has had a big impact on the energy sector.

India's total petroleum refining capacity in 2012 was 213 million tons (MT) per annum, of which around 120 MT was produced by the public sector, 15 MT by joint ventures and 78 MT by the private sector. The largest private producer is Gujarat's Jamnagar Refinery, a crude oil refinery owned by Reliance Industries Limited in Jamnagar.[21)] The refinery was commissioned in 1999 and is the largest refinery complex in the world.[22)] In 2012, the refinery had a capacity of 33 MT in its domestic tariff area and 29 MT in the Special Economic Zone (strictly for export).[23)]

The State's industrial policy (2009) aims to catalyze robust, sustainable, and inclusive growth.[24)] Since 2007 the State has held six investors' summits entitled Vibrant Gujarat (www.vibrantgujarat.com), and the seventh is planned for January 2015. Gujarat currently accounts for 15% of total investments in India (US $114 billion), the highest among the Indian states. It offers numerous investment opportunities, particularly through its Special Economic Zones and Special Investment Regions, which include industrial areas and industrial parks. Gujarat is in the middle of the Delhi Mumbai Industrial Corridor (DMIC), 38% of which passes through the State. Other industrial policy initiatives include port-led development, promotion of environmental protection, and green business.[25)]

Gujarat is India's industrial powerhouse, but water is a key input for energy that fuels industrial growth. Water is a critical input for process and cooling requirements in a number of major industries. Unreliable supplies and water shortages can have an adverse effect on the expansion of small and medium sized enterprises, resulting in a loss of economic opportunities. Securing water and energy supplies of high reliability was the first step in positioning Gujarat to support rapid industrial growth. In many of the industrial areas of the State (including the manufacturing hub of Ahmedabad) and the inland and coastal areas of Kachchh and Saurashtra, obtaining freshwater for manufacturing has been a major challenge, due to high levels of salinity in groundwater or limited groundwater or surface water potential. Some of the large industrial groups such as Tata Chemicals and Reliance Petroleum had set up their own desalination systems in the coastal

21) http://data.gov.in/dataset/petroleum-refining-capacity-india-april-2012

22) http://en.wikipedia.org/wiki/Jamnagar.

23) *Economic survey 2011-12: India's oil refining capacity likely to rise 15% to 214 MT. 2012, 15 March. The Economic Times*. http://articles.economictimes.indiatimes.com/2012-03-15/news/31197265_1_refinery-production-refining-capacity-refinery-capacity (Accessed 1 Feb 2014)

24) Official State Portal http://gujaratindia.com/business/investment-oppurtunities.htm

25) http://www.vibrantgujarat.com/investment-opportunities.htm

areas of Saurashtra. While supplies from groundwater resources have become highly unreliable in most parts of the State, there has been enormous pressure on the government from industrial groups to invest in infrastructure that would help them secure freshwater supplies on a long-term basis. The State government also realized that this would be one major way to attract investors in the State.

1-1-3. Demographic Trends

The population of Gujarat State was 60.4 million according to the 2011 census data. The population density is 308/km^2, lower than most other Indian states. The latest census also reveals that the State has a sex ratio of 918 girls for every 1000 boys, one of the lowest (ranked 24) among the 29 states in India. The state has made impressive progress in reducing the population growth rate since the early 1970s, as can be seen in Table 3.

Many large cities have recorded exponential growth. As can be seen in Table 2, urbanization trends have shown faster growth than population increases. While the population of Gujarat rose by almost three times over the 50-year period, the people living in urban areas increased by almost five times (from 5.31 million in 1961 to 25.72 million in 2011). The state has witnessed the fastest urbanization in India. A little more than 43% of the people of Gujarat now live in urban areas, according to the 2011 census. Over the decade 2001-2011, the rural population decreased by 5.2 percentage points, while the urban population rose from 37% to 43% of the population over the 10-year period.[26] Ahmedabad is one of the fastest-growing cities in the world.

Cities being points of concentrated demands for high quality water, the government had to look for alternative sources of dependable water supplies to feed the growing urban population in the wake of drying up groundwater-based sources.

1-1-4. Effects of Economic Factors

Regarding agriculture, major strides were made in expanding the irrigated area through the completion of new gravity-based surface water transfer systems (mainly SSP) and use of water-efficient irrigation technologies, such as drips and sprinklers, especially in water scarce regions of the State. While availability of surface water for irrigation has reduced demand on energy-intensive groundwater irrigation. The adoption of micro-irrigation technologies has resulted in both groundwater and energy savings at the farm level. Thus, the growth in agricultural GDP in the State has been characterized by a “green pathway” as it resulted in water savings and more importantly reduction in carbon emissions due to lower energy use for groundwater abstraction.

<Table 3> Growth of Population and Trends in Urbanization, Gujarat State, 1961 to 2011

Sr. No	Year	Total Population (million)	Decadal Growth Rate	Density (Persons per km^2)	Sex Ratio (F/M per 1000)	Literacy Rate	Percentage of Urban Population
1	1961	20.6	+26.88	105	940	31.47	25.77
2	1971	26.7	+29.39	136	934	36.95	28.08
3	1981	34.1	+27.67	174	942	44.92	31.10
4	1991	41.3	+21.19	211	934	61.29	34.49
5	2001	50.7	+22.66	258	920	69.14	37.36
6	2011	60.4	+19.17	308	918	79.31	42.58

Source: Socio-Economic Review, Gujarat State, 2012 –13.

26) http://www.vibrantgujarat.com/investment-opportunities.htm

In the industrial sector, some of the large industrial groups had set up their own desalination systems in the coastal areas of Gujarat, and others have installed reverse osmosis plants to purify and reuse wastewater. These actions have reduced demand for freshwater sources and reduced the costs of energy for treatment of polluted freshwater sources. Setting up of common effluent treatment plants (CETPs) for industrial clusters is another important initiative from the manufacturing sector to promote sustainable growth, as seen in Ahmedabad, Vadodara, and Vapi. This again reflects the sustainable use of water resources for industrial production.

1-2. Social Factors

There has been a significant reduction in the proportion of people living in poverty in Gujarat since the 1970s. According to the Planning Commission of India, the percentage of people falling below the poverty line was 48% in 1973/74.[27] This fell to 31.6% in 2004/05 and further to 16.6% in 2011/12, according to the National Sample Survey Office.[28]

Methods of calculating poverty in India were revised in the last decade, showing a larger proportion of people considered poor under the new methodology. In 1993, the Government of India convened an expert group to review methodology for poverty estimation, chaired by DT Lakdawala, based mainly on calorie consumption and consumer prices (Lakdawala method). In 2005, another expert group was formed to review the methodology, chaired by Suresh Tendulkar, to address shortcomings of the previous methods. The committee formed in 2009, with Tendulkar as Chairman, came out with a new method to calculate poverty (Tendulkar methodology). According to this method, the number of the poor in India in 2004–05 rose from 27.5% to 37.2% of the total population. In the past, poverty had been estimated by looking at a limited view of money required for a stipulated minimum calorie intake by individuals. But the Tendulkar committee moved to a wider definition, including spending on food as well as education, health, light (electricity), clothing, and footwear.[29] The differences in estimates are shown in Table 4.

<Table 4> Percentage of Population below the Poverty Line, 1994 to 2010

	Lakdawala Methodology		Tendulkar Methodology		
	1994	2005	1994	2005	2010
Gujarat	24.2	16.8	37.8	31.6	23.0
India	36.0	27.5	45.3	37.2	29.8

Source: World Bank Country Dataset and Data Book DCH, 2013[30]

In both methodologies the percentage of people below the poverty line in Gujarat is considerably less than in India as a whole. Table 5 shows the comparison between Gujarat and India in 2012, using the Tendulkar Method. While the general indicators of social development in Gujarat are better than the national average, given its rapid economic progress, the State has the potential to perform much better on the social and human development front. According to the "India Human Development Report 2011" the human development index of Gujarat was 0.527 in 2007/08, ranking 11th among the Indian states. Between 1999/2000 and 2007/08, the human development index for the State increased by only 0.06 points. This marginal improvement is not commensurate with the economic progress that the State has witnessed since 2000/01. The dividends of the rapid economic progress are yet to be translated into improvement in the quality of life of the people of the State.[31]

27) http://planningcommission.nic.in/plans/planrel/fiveyr/10th/volume3/v3_ch3.pdf

28) http://www.business-standard.com/article/economy-policy/planning-commission-estimates-show-sharp-fall-in-poverty-rate-113071701028_1.html

29) http://en.wikipedia.org/wiki/Suresh_Tendulkar

30) Data Book for Deputy Chairman, Planning Commission, Government of India.

31) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p.x.

<Table 5> Number and Percentage of Population below the Poverty line in Gujarat and in India, 2012 (Tendulkar Method)

	Rural		Urban		Total	
	% of persons	No of persons (million)	% of persons	No of persons (million)	% of persons	No of persons (million)
Gujarat	21.54	7.53	10.14	2.69	16.63	10.23
India	25.70	216.66	13.70	53.13	21.92	269.78

Source: Press Note on Poverty Estimates, 2011-12, Government of India

1-2-1. Health and Education

The health status of the people in the State is better than the national average. Death rates and infant mortality rates in Gujarat are slightly lower than the national average. Life expectancy at birth is 66.8 years in Gujarat, compared to 66.1 in India as a whole. These comparisons are shown in Table 6.

During India's 11th five-year plan period (2007 to 2012), Gujarat increased its allocations for social services in terms of the proportion of the overall state budget. The allocation in 2011/12 was 42% of total state expenditure. This compares to 35% for social services in 2007/08. The largest proportion of social spending was for education, culture and sports, followed by water supply, sanitation, and housing.[32)]

According to the 2011 population census, more than 79% of the people over the age of 7 in the State were able to read and write with understanding. The proportion was 87% for males, 71% for females, 73% of people in rural areas, and 88% in urban areas. The provisional results of the 2011 population census suggest that the gap in literacy between men and women has been substantially reduced. The State aims to achieve universal literacy.

The total number of primary schools in the state increased by 220 from 2010/11 to 2011/12, accompanied by an increase in enrollment and a reduction in the dropout rate (from over 22% in 1999/00 to only about 2% in 2011/12). The literacy rate increased from 69.1% to 79.3% during the decade from 2001 to 2011. What is more remarkable is the fact that the enrollment in higher education increased by 15% from 2010/11 to 2011/12. The intake capacity of technical institutions for degree

<Table 6> Selected Indicators of Human Development in Gujarat State and India, 2000 to 2011

Year	Life Expectancy at birth		Infant Mortality Rate (total per 1000 live births)		Birth Rate per 1000		Death Rate per 1000	
	Gujarat	India	Gujarat	India	Gujarat	India	Gujarat	India
2000	65.6	62.2	62	68	25.2	25.8	7.5	8.5
2001	65.6	62.6	60	66	25.0	25.4	7.8	8.4
2002	65.6	62.9	60	63	24.7	25.0	7.7	8.1
2003	65.6	63.3	57	60	24.6	24.8	7.6	8.0
2004	65.6	63.7	53	58	24.3	24.1	6.9	7.5
2005	66.4	64.1	54	58	23.7	23.8	7.1	7.6
2006	66.8	64.5	53	57	23.5	23.5	7.3	7.5
2007	66.8	64.8	52	55	23.0	23.1	7.2	7.4
2008	66.8	65.1	50	53	22.6	22.8	6.9	7.4
2009	66.8	65.4	48	50	22.3	22.5	6.9	7.3
2010	66.8	65.7	44	47	21.8	22.1	6.7	7.2
2011	-	66.0	41	44	21.3	21.8	6.7	7.1

Source: World Bank Country Dataset; Databook for DCH, 18 December 2013 and SRS Based Abridged Life Tables

32) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p. S-105.

and diploma courses and for MBA and MCA courses also increased significantly during 2011/12.

The fertility rate in the state was 2.5 in the year 2010 according to the sample registration system, compared to replacement level fertility of 2.1 live births per woman of reproductive age. While the fertility rate had been reduced to the replacement level in urban areas by 2010, fertility rates in rural areas were over 2.7 live births per woman of reproductive age.

Because of the focus on engineering and science in the State, Gujarat has a highly-skilled work force prepared to support high tech industries. The situation of women in rural areas still lags behind other demographic segments, as illustrated by the case described in Box 2.

1-2-2. Effects of Social Factors

Enhancement in social indicators, such as the decline in the proportion of people falling below the poverty line, improvement in health status and literacy rate, has empowered people and improved their capacity to manage and use resource more efficiently. With better education and awareness, people have begun to recognize the value of obtaining better quality water and power supply, and keeping the environment clean. While many of these outcomes have resulted from investments in social welfare and in large-scale water projects, various local level institutions such as Water User Associations and Pani Samitis, have also played an important role in improving water security for both domestic and agricultural purposes.

Numerous NGOs, social activists, environmental groups, the international donor community, and many scientific and academic institutions that are active in the State have played a crucial role in highlighting the issues of water security, environmental protection, water management options, and their linkages with human development. Advancements in social indicators and human development indices contributed to economic growth, resulting in increased willingness of the government and the people to invest in sustainable development technologies, leading to 'green growth'. The investment in riverfront development projects, the CETPs, and the solar power project are a few examples of this process.

<Box 2> Case study of Women, Water, and Empowerment

A recent case study on the situation of women and water management [the "Drudgery Report" (2013)] was conducted in villages of Gujarat, Andhra Pradesh and Karnataka. The portion of the study in Gujarat showed that the situation for women in relation to their access to drinking water in the three villages studied was not satisfactory, although it is improving. The villages selected were Tarakwadia, Dhundhera, and Zarda in the Meghraj block of Sabarkantha District, where the Sujal project is located. The drudgery for the women includes fetching water, fetching fuel-wood and working in the fields, especially seed sowing, weeding, harvesting and other tasks. It was found that the main sources of water supply, mainly hand pumps and overhead tanks, generally did not function, and the villagers had not been trained in repair and maintenance. When the overhead tanks were working, the women appreciated improved access to water and reduction in time spent fetching water, but the motorized pump burned out and it was not repaired.

The water supply and sanitation in schools in the villages is inadequate. With poor quality water, insufficient water supplies and poor sanitation infrastructure in the villages, water-borne diseases are widespread, and most villagers do understand the relationship between disease and poor water and sanitation. Most of the people in the villages still practice open defecation in the fields. The three villages in Gujarat had a few toilets and pit latrines with open drainage systems. In one village the government dug 15 pits, but toilets were never installed.

In 2011 the Development Support Center (DSC), an EU-IWRM implementing partner in Gujarat, introduced the "People and Panchayat-led equitable water governance" project in 18 villages of Meghraj Block (three of which were from the case study above). The DSC has been working in Meghraj since 1996 undertaking projects on watershed development, agriculture enhancement and micro-finance. The DSC project focuses on three critical areas: improving access to water supply; improving water demand management through more efficient use of water; and better water governance through a people-led process that builds capacities to manage water resources, addressing the water needs of everyone including the poor, marginalized and the women.

In the three villages covered by the case study, the communities are mobilized into 'Sujal Committees' with the help of locally-selected women as extension volunteers (EVs). The three EVs are young, dynamic, reasonably educated, and with supportive families to enable them to do the extension work. The Sujal Committees include members of already existing self-help groups, farmers' clubs, Panchayats or other groups and have relatively equal numbers of men and women.

The main sources of drinking water in the villages are hand pumps and open wells. Through the project, the hand pumps were repaired, and a new hand pump was installed in Tarakwadia. People contributed about 10-20 % of the total cost for the pump. Now the villagers are getting a regular supply of water. The men and boys have started fetching water from the nearby hand pumps, and the women/girls have reported that hand pumps are especially useful when the power supply fails. They are learning about rainwater harvesting and the overhead water tank in Zarda is being repaired for use. Moreover, a number of simple labor-saving technologies have been introduced to reduce the drudgery in agricultural operations. Women mentioned that the reduction in drudgery enables them to expand agriculture and rest. Importantly, it enables girls to attend school.

Gujarat is home to thousands of NGOs. The type of project outlined above can improve water management and empower women at the same time.

Source:Access to Water and Empowerment of Women: Study of Drudgery Work and Relief by SUJAL (March 2013). IWRM: a pilot initiative in Gujarat, Andhra Pradesh and Karnataka [study of villages in Gujarat by Meena Bilgi]. Gender and Water Alliance and SUJAL.

1-3. Political Factors

From 1818 to 1947, most of present-day Gujarat was in the form of hundreds of princely states, but several districts in central and southern Gujarat were ruled directly by British officials. India's "Father of the Nation", Mohandas Karamchand (Mahatma) Gandhi, was a Gujarati who led the India's independence movement against British colonial rule.

The people of Gujarat were among the most enthusiastic participants in India's struggle for freedom, and many leaders of the independence movement, including Sardar Vallabhbhai Patel, hailed from Gujarat. It witnessed some of the most popular revolts and non-violent demonstrations. After independence and the partition of India in 1947, the new Indian government grouped the former princely states of Gujarat into three larger units: Saurashtra, which included the princely states on the Kathiawar peninsula; Kutch (Kachchh); and Bombay state, which included most of the former princely states of eastern Gujarat. In 1956, Bombay State was enlarged to include Kutch, Saurashtra and parts of Hyderabad and Madhya Pradesh States in central India. The new State had a mostly Gujarati-speaking north and a Marathi-speaking south. Agitation by Marathi nationalists for their own State led to the split of Bombay State into the two new States of Gujarat and Maharashtra along linguistic lines on 1 May 1960.[33)]

Gandhinagar, the capital of Gujarat, is one of the three planned cities in India and is considered to have excellent infrastructure, and the densest urban forest. There are 25 administrative districts in the State, and Gandhinagar is its political hub. Ahmedabad is the largest city in the State and is one of the fastest growing cities in the world.

The State is governed by a legislative assembly of 182 members, of which 13 constituencies are reserved for scheduled castes and 26 for scheduled tribes. The term of office for a member of the Legislative Assembly is five years. The leader of the majority party or coalition in the legislature acts as Chief Minister and Leader of the Legislative Assembly. The Chief Minister is responsible for the administration of the State. The governor of the State, currently Hon. Kamla Beniwal, is appointed by the President of India.

From 1947 until 1960, the Indian National Congress (INC) ruled the Bombay State, which included present-day Gujarat. The INC continued to govern Gujarat after the State's creation in 1960 and thereafter until 1995. In the 1995 Assembly Polls, the Congress lost to the Bharatiya Janata Party (BJP), and since that time the BJP has been the dominant party in the State. In 2002, the BJP retained a majority in the election and Narendra Modi became Chief Minister. Since 2002 Mr. Narendra Modi has served as Chief Minister of the State, and he is the longest serving Chief Minister of Gujarat. The BJP retained a majority in the most recent election in December 2012.

33) Directorate of Economics and Statistics, Socio-Economic Review, Gujarat State, 2012-13, Gandhinagar, p. S-105.

The government of Gujarat has shown remarkable stability over the past decade and has encouraged large-scale private and public investments in infrastructure and manufacturing throughout the period. The State government has promotional policies and incentives for investment in infrastructure, in particular energy, water and transportation. Water being an important subject for the people of Gujarat, the continuance of a single political party in power has also helped maintain consistency in policy measures with regard to water.

1-3-1. Effects of Political Factors

Since 1998, a single party has been in power in Gujarat, and since 2001 the Chief Minister in the State has not changed. As a result, decisions on important policy matters which have major implications for human development and economic growth have been consistent and the process of decision making has been smooth. Since water is a State subject in India, continuation of a stable government in Gujarat has led to major water resource development projects (small and large) being executed without major opposition and delays. The SSP, Sujalam Sufalam and Sardar Patel Participatory Water Conservation Program are a few examples. Reforms in the power sector were also pursued rigorously-with metering of agricultural connections, 24 hour power supply to households in rural areas and reduction in transmission and distribution losses. The result of such efforts can be seen in terms of expansion in irrigated area, adoption of MI technology and improved access to water supply and sanitation by the community, all contributing to green growth.

1-4. Environmental Factors

The State of Gujarat has an enormous variety of ecological systems. It has mountain ecosystems, vast arid and semi-arid plains, desert ecosystems and coastal ecosystems. The large mountains, coupled with a very long coastline, deserts, many agro-ecologies, important wildlife, complex geological formations and geographical features, as well as socio-economic and ethnic diversity, pose major challenges.

1-4-1. Environmental Degradation

The state is rich in biodiversity. The data on the total number of recorded species of flora and fauna in the state, against those at the national level, according to the Gujarat Biodiversity Board, is given in table 7. In spite of having nearly one fourth of the geographical area under a desert ecology, the state has nearly 9% of the plant species and 6% of the animal species. In the recent past, Gujarat's record in protection of flora and fauna has been good. Gujarat has many wildlife sanctuaries and national parks, including one marine national park in Jamnagarin the Gulf of Kachchh and a wild donkey sanctuary in Little Rann of Kachchh. The state is world renowned for the Gir sanctuary, which is the only home for Asiatic lions.

In its race to achieve rapid economic growth, Gujarat has introduced some policies and safeguards to protect the environment, but at the same time has not been very successful in tackling the vexing problems of environmental degradation in the state.

The following issues require long-term solutions:

- Saline intrusion in the coastal areas of Saurashtra, which has affected coastal aquifers and agricultural land, with the increase in salinity affecting water supplies for human and animal drinking and irrigated crop production;
- Rapid urbanization causing degradation of wetlands, with indiscriminate disposal of solid waste and construction debris in the reservoir area, and encroachment on their catchment area;
- Use of mineralized groundwater from deep aquifers in alluvial areas of north and central Gujarat, causing long-term changes in soil salinity levels; and

- Indiscriminate building of large and small dams in the rivers of Saurashtra, Kachchh and north, and central Gujarat have caused over-appropriation of stream-flows, environmental water stress, and destruction of riverine ecology.

The State of Gujarat will need a strong political will, as well as resources to address the environmental concerns outlined above. As seen in certain cases, engineering solutions are resorted to for solving the environmental problems, in particular setting up of common effluent treatment plants (CETPs). In Vapi, one of the oldest industrial estates in Gujarat, the Vapi Waste and Effluent Management Company Ltd. treats effluents from industries, using a very advanced treatment process. In addition to primary treatment and aeration tanks, the treatment system includes secondary clarifiers, sludge thickener, sludge drying beds, up-flow anaerobic sludge blanket, reactivated clarifier, and other highly advanced oxidation systems.[34)] In general, however, institutional interventions would be required to deal with many of the pollution and environmental problems on a long-term basis.

<Table 7> Biological Diversity in Gujarat and India

Flora/Fauna	Total number of recorded species	
	Gujarat	India
Flora		
Algae	1,933	6,500
Fungi	164	16,500
Bryophyta	8	2,850
Pteridophyta	16	1,100
Gymnosperms	1	64
Angiosperms	2,198	17,500
Total Flora	4,320	46,286
Fauna		
Lower animals	1,736	76,455
Fish	606	2,546
Amphibians	19	206
Reptiles	107	485
Birds	479	1,228
Mammals	107	372
Total Fauna	3,054	81,292
Overall (Flora + Fauna)	7,374	127,578

Source: Gujarat Biodiversity Board

1-4-2. Department of Forests and the Environment

The Department is divided into an environment wing and a forest wing. The Forest Wing covers forestry, wildlife (fauna and flora) and the social forestry program. The environment wing is the primary body for dealing with all the environment-related matters including enforcement of the Environment (Protection) Act of 1986, which is the umbrella act to oversee environmental matters in the country.

The mandate of the Department is to achieve sustainable development in the State and to introduce sound environmental management practices. The Department has four executing agencies for discharging its functions: Gujarat Pollution Control Board, Gujarat Ecology Commission, Gujarat Institute of Desert Ecology, and Gujarat Environmental Management Institute.[35)]

The Department's Social Forestry Program for planting trees on non-forest lands has improved the green cover of the State. The objectives were to increase the number of trees in the State, promoting the participation of people and institutions to grow trees, and to make use of unproductive land for productive use. As 57% of the people still live in rural areas, the regeneration of forests and maintenance of non-forest lands, particularly the common lands, have become imperative for the State to meet the needs of rural people.

34) *Doshi, R. 2014. Experience of Wastewater Treatment Technologies: A Case Study of Vapi Waste and Effluent Management Co. Ltd. The Asian Journal*, 1(1).

35) Forests and Environment Department http://www.envforguj.in/department/

1-4-3. Impacts of Large-Scale Infrastructure Works

At the national level, the Ministry of Environment and Forests of India conducted an assessment of planning and implementation of environmental safeguards related to the Sardar Sarovar (SSP) and Indira Sagar projects (ISP) on the Narmada River.[36] The report covered the status of compliances on catchment area treatment, flora and fauna and carrying capacity upstream, command area development, compensatory afforestation, and human health aspects in project impact areas. The report recommended that no further raising of dam height be done at either SSP or ISP, until compliance on the various environmental parameters has been fully met. The government of Gujarat, particularly the Sardar Sarovar Narmada Nigam, is working towards compliance of the norms set for environmental clearance by the Ministry of Environment and Forests, to get permission for raising the dam height to realize the full benefits from the project.

In its efforts to minimize the negative environmental impacts of the SSP, a massive program of afforestation and catchment area treatment works have been carried out. Catchment area treatment, which includes planting new trees and carrying out soil conservation measures, had been completed in the entire catchment area (almost 30,000 ha) of the Sardar Sarovar reservoir within Gujarat. Compensatory afforestation has been carried out in over 4,500 ha of non-forest area and over 9,000 ha of degraded forest area in Kachchh district. A plantation of 4,600 ha has been established in the vicinity of the dam and along canal banks. The temples of Hamfeshwar and Shoolpaneshwer were relocated to higher elevations. Appropriate measures are also being undertaken for fisheries development, control of malaria, and other water-borne diseases in the command area sites.[37]

A number of impact studies have been undertaken on the environmental, agricultural, flora and fauna, wildlife sanctuaries, health, and socio-economic aspects that have been affected by the project. Work plans have also been prepared for forests, health, and fisheries and they are being implemented through the concerned State Government Departments.

1-4-4. Water Pollution Control

With high growth in urban population and rapid industrialization happening around cities and towns in Gujarat, safe disposal of effluents and control of pollution of water bodies such as rivers, lakes and naturally drained groundwater are posing major challenges. The volume of sewage generated in cities and towns of Gujarat (from metro areas, Class I and Class II towns) and the sewage treatment capacity available in the state as of 2009 are provided in Table 8. While the capacity of wastewater treatment systems available in Gujarat is sufficient to treat only 40% of the sewage generated, the capacity is only 30 per cent at the national level.

<Table 8> Wastewater Generation and Treatment in Gujarat

Sr. No.	Urban Center	Total No. of Cities/ Towns		Sewage Generation (MLD)		Sewage Treatment Capacity (MLD)	
		Gujarat	India	Gujarat	India	Gujarat	India
1	Metropolitan cities	4	35	1,045	15,644	728	8,040
2	Class I cities (other than metropolitan cities)	24	463	636	19,914	55	3,514
3	Class II towns	31	410	228	2,697	-	234
	Total	59	908	1,909	38,255	783	11,788

Source: Adapted from Central Pollution Control Board, 2009

36) Committee for Assessment of Surveys/Studies/Planning and Implementation, 2010, February. Second Interim Report of the Plans on Environmental Safeguard Measures for Sardar Sarovar & Indira Sagar Projects. Final Report submitted to the Ministry of Environment and Forests, Government of India.

37) Directorate of Economics and Statistics, Government of Gujarat. 2013, February. Gujarat State Profile Socio Economic Review 2012-13. Budget Publication no. 34, 15.

<Table 9> Status of Water Quality in Gujarat, 2011

River basin/type of water body	No. of observa-tion stations	Water quality parameters					
		pH	Conductivity (μmhos/cm)	DO	BOD	Faecal Coliform	Total coliform
		Water quality criteria					
		6.5-8.5	-	→4 mg/l	←3 mg/l	←2500 MPN/100ml	←5000 MPN/100ml
		Observed range					
Mahi basin	9	7.1-8.7	256-903	3.0-8.9	0.9-8.0	2-9	7-26
Sabarmati basin	2	8.1-8.5	506-3830	7.1-7.9	2.9-32.0	6-90	20-430
Narmada basin	1	7.1-8.4	222-404	6.9-8.2	1.1-5.0	0.6-14	4-34
Tapi basin	8	7.1-7.8	318-41836	3.2-7.6	1.2-9.0	33-9000	430-24000
Medium & Minor reservoirs	11	7.0-8.5	4-38593	1.1-7.9	0.7-19.0	3-2300	3-9300
Canal	1	7.3-8.4	207-628	6.1-7.5	1.0-3.0	9-43	23-150
Lake/Pond	7	7.5-8.8	230-3610	3.2-9.0	1.4-12.0	2-4300	4-24000
Groundwater	19	7.5-8.5	381-12018	-	0.8-3.1	2-400	2-900

Source: Compiled using data tables from Central Pollution Control Board, 2010

The Gujarat Pollution Control Board (GPCB), established in 1974, is responsible for the Monitoring of the Indian National Aquatic Resources System (MINARS) Project. The program monitors the quality of rivers, lakes, reservoirs and other surface waters, bore wells and groundwater, as well as coastal waters. It provides information on the status of water quality and the status of rivers under water quality stress. Under MINARS, the Board has 70 monitoring stations on rivers, 10 on lakes and groundwater monitoring in 20 districts.[38] Table 9 summarizes the results of water quality monitoring done by GPCB.

A quick review of the data in Table 9 shows that there is a wide variation in the values of chemical and biological quality of water even within the same river basin, with the maximum values exceeding the permissible levels or minimum values falling below the threshold levels in many cases. Overall, Tapi river basin in South Gujarat and the medium and minor reservoirs have high levels of biological contamination and salinity levels. Comparing groundwater and canal water, canal water has very low levels of salinity and is within the permissible levels, as indicated by low values of conductivity. Groundwater sources appear to be low in biological contamination, with faecal coliform and total coliform count much below the permissible levels.

1-4-5. Climate Change

In order to address the challenges of climate change, Gujarat established a separate Department for Climate Change in February 2009 to be headed by Chief Minister Narendra Modi.[39] The Department was supposed to empower people to become active agents of sustainable development and to promote an understanding that communities are pivotal to changing attitude towards environmental issues. By late 2013, however, it appeared that the State government did not accept the draft report of the State's Climate Change Action Plan 2012-17

38) Gujarat Pollution Control Board http://www.gpcb.gov.in/projects-water-quality-monitoring-programmes.htm

39) Climate Change from Official Gujarat State Portal http://www.gujaratindia.com/initiatives/initiatives.htm?enc=TEnmkal8rLd9cWRBUEX85lswwfZZ+o8b+w+YfQPy7dU93tk/rntr0H+OnwOK0bubl3+goYyJYykc1/dBRv+06CbmqSVNPGxGVsKl4u4sIibrqAnIU6NnDw0tj6RQxr6Wy2kLs1KAPRYw6nzEy3BJww==

prepared by The Energy and Resources Institute (TERI).[40] Thus, Gujarat failed to submit its action plan for inclusion in the Prime Minister's National Climate Change Action Plan, and the department was not functioning at the end of the year.

According to the Times of India, the draft action plan raised serious concerns about the likely socio-economic and environmental impact of climate change on Gujarat, while predicting an adverse impact on agriculture, health and environment. It recommended huge investments in new infrastructure to mitigate the impact of climate change and also stressed radical policy changes in the functioning of the government departments and overall policy changes for industries and other sectors. The draft proposed that the government create environment-friendly water resource management, public health projects, forest and environment improvement projects, agriculture improvement projects, and a number of studies.[41]

1-4-6. Effects of Environmental Factors

Most parts of Gujarat are located in fragile ecosystems, and around two thirds of State territory has an extremely limited water resource endowment and is drought prone. This situation had attracted attention from the national government and international community to improve its natural resources management, particularly for water and forests, ecosystems, biological diversity, and environment in the State. For instance, the problems of groundwater depletion in Gujarat had attracted the attention of UNDP in 1976; the agency implemented a pilot project on artificial recharge in Mehsana. Gujarat issued a White Paper on Water in Gujarat, which was the result of the attention it received from the international development community (particularly from the UNICEF), after the consecutive droughts of 1999 and 2000.

The poor water resources endowment, groundwater depletion, and the consequent environmental degradation helped the state to mobilize international development assistance for many of its major projects, including the Narmada Canal based Drinking Water Supply project for Saurashtra and Kachchh. The ability of the State to bring water resources to the development discourse of the international community by linking it to issues of rural livelihoods and human security was crucial to this effort.

The efforts to conserve the natural environment through the establishment of common water effluent treatment plants, forest regeneration, sewage treatment, catchment area treatment, and building institutions to deal with the projected impacts of climate change, hint at the 'green path' which the State has pursued for protecting its natural resource and thereby achieving the well-being of the people who depend on these resources. The State's inability to pass a climate change plan has delayed efforts to prepare for and adapt to climate change and thus undermines its commitment to promote green growth.

1-5. Technical Factors

Gujarat has been a leader in engineering, science and technology, and information technologies in India. It has a relatively high Internet density, and is home to some world-renowned institutes of management, engineering and design. The government through the Gujarat Council on Science and Technology has provided support to Centers of Excellence in such fields as nanoscience, nanomaterials, nanotechnology, nano polymeric materials and nanocatalysts. Out of six sponsored COE projects, five have been completed with their targeted

40) 2013, 14 Nov. Times of India. http://articles.timesofindia.indiatimes.com/2013-11-14/ahmedabad/44072702_1_climate-change-action-plan-draft-report

41) Ibid.

research outcomes at Bhavnagar University, Saurashtra University, Gujarat University, M.S.University of Baroda, and Sardar Patel University.[42)]

The Gujarat Technological University Ahmedabad, and its affiliates the Gujarat Institute of Technical Studies and Gandhinagar Institute of Technology, are considered as international innovative institutions. Masters and Bachelor degrees and diplomas are available to national and international students in Engineering, Computer Science, Pharmacy and Business Administration, among others. The University includes an Indo-Canadian and an Indo-German Study Center and has a number of international professors.[43)] The Indian Institute of Technology Gandhinagar and other technical institutes also provide engineering degrees, research and development opportunities, and technical education to the rising numbers of educated youth. Many of the courses are also available to international students.

While these universities and institutes provide high quality education, the Gujarat Matikam Kalakari and Rural Technology Institute also provides skills training and extension services to both women and men in rural areas.[44)]

Gujarat is the hub of the chemical industry in India, contributing 51% of chemicals and over 60% of the petrochemicals.

1-5-1. Effects of Technical Factors

Gujarat has the intellectual capital for technical and engineering manpower, and this has been an important factor in improving water management and building water infrastructure. The State has been able to move forward with projects such as the water grid, the Sardar Sarovar project and other important large-scale engineering infrastructure for water resources development and management. It is important to ensure that these works also provide equitable access to water for poor people in urban and rural areas. In order to make green growth a reality, rural people who are stewards of the watershed areas must be involved in making the system sustainable.

1-6. Concluding Remarks

Gujarat has made major economic progress during the past 10-15 years through rapid growth in the manufacturing sector and impressive growth in agriculture through technology, skill development through investment in human capital and infrastructure development, particularly the development of large water infrastructure. In this drought prone state, improved water security achieved in the regions facing desiccation, through water imports for rural and urban drinking supply, industrial use and irrigation have been crucial in achieving this. As a matter of fact, Gujarat has become an illustrative example of how water development can drive economic growth, with progress in human development indices. While there are indications that the large inter-basin transfer projects have had a positive impact on the environment and social well-being apart from improvements in economic conditions, it is crucial to monitor these impacts over time to make sure that they do not cause environmental problems in the water surplus areas as time goes by.

As for social well-being, there are indications that rural women, as well as other demographic segments of the population, have not fared well. It may be the case that, when new irrigation projects are introduced,

42) Gujarat State Portal http://www.gujcost.gujarat.gov.in/centre-excellence.htm
43) Gujarat Technological University Website http://www.gtu.ac.in
44) Gujarat Rural Technology Institute Website http://www.rtigujarat.org/extension-work.html

the land which is used for growing cereals, which takes care of the domestic food security needs, has been reallocated for growing cash crops. Trends show a shift in cropping patterns to higher value cash crops. Malnutrition among women and children in rural and urban areas still remains a concern for the state.

The State of Gujarat should thus make sure that the marginalized and poor people in rural areas are not left behind by rapid economic growth, and that the growth is inclusive. The state should lay equal emphasis on reducing income disparities between the rich and the poor through special policy measures. While water security drives growth in the state, the emphasis should be on improving the water security of the poor and the marginalized. People in rural areas. Women in particular can be engaged in water resource protection, watershed management, operation and maintenance of drinking water supply systems, while the access of poor families to improved water supply and sanitation systems should be improved. Skills development and engagement of rural women in protecting the environment are essential ingredients of green growth.

2. Water Resources Governance and Institutions

2-1. National/Union Water Policy, Law, and Administration

2-1-1. National Water Policy

India does have a National Water Policy that was first enacted in 1987 and then updated in 2002 and 2012.[45)] One problem is that the national water policy falls under the Ministry of Water Resources, which despite its name is not a real umbrella water ministry; but only one of the several ministries having key responsibilities in the water sector, some of the others being, for instance, the Ministry of Drinking Water & Sanitation. One of the results has been that the national water policy does not constitute a comprehensive policy statement taking into account the needs and specificities of all water uses to the same extent. The Planning Commission recognizes this and has initiated an attempt to draft framework water legislation in the context of the preparation of India's 12th five-year plan (2012-17).

Although the legal and policy framework for water in India has evolved dramatically over the past two decades, India lacks an umbrella framework to regulate freshwater in all its uses. The existing water law framework in India is characterized by the co-existence of a number of different principles, rules and acts adopted over many decades. These include the common law principles and irrigation acts from the colonial period as well as more recent regulation of water quality and the judicial recognition of a human right to water.

2-1-2. National Water Law and Administration

The lack of umbrella legislation at the national level has ensured that the different state and central legal interventions and other principles do not necessarily coincide and may in fact be in conflict in certain cases. Thus, the claims that landowners have over groundwater under common law principles may not be compatible with a legal framework based on the human right to water and the need to allocate water preferentially to domestic use and to provide water to all, whether landowners or not on a equal basis.[46)]

Historically, irrigation laws constitute the most

45) Full texts available at International Environmental Law Research Center http://www.ielrc.org/water/docs.htm.

46) Cullet, P. 2007. Water Law in India: Overview of Existing Framework and Proposed Reforms. IELRC Working Paper 2007-01. International Environmental Law Research Center. http://www.ielrc.org/content/w0701.pdf

developed part of the water law, because of the colonial government's promotion of large irrigation works and the need to introduce a regulatory framework in this area. As a result, some of the basic principles of water law applicable today in India derive from irrigation acts. For example, the early Northern India Canal and Drainage Act 1873 sought to regulate irrigation, navigation and drainage in Northern India. One of the long-term implications of this act was the introduction of the right of the Government to 'use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes.'[47] The 1873 act refrained from asserting state ownership over surface waters, although surface waters are considered in the public domain.

Nonetheless, a number of new water laws have been adopted that relate to the national water policy since the second half of the 1990s. The general characteristic of these new acts is that they are all sectoral (i.e., irrigation, drinking water supply, and industrial water supply,). For groundwater, new legislation filled a gap where there was no statutory framework, while legislation related to water user associations is in need of an updated legal framework. National (or Union) water law has thus evolved rapidly but in a sporadic manner that does not strengthen water law as a whole.[48]

The union government frequently has used administrative directions as a mode of intervention in the water sector. In certain cases, as for rural drinking water supply, the national-level intervention has been extremely influential, even though it has never taken the form of a legislative instrument.[49] Even though the union has no specific mandate to get involved in rural drinking water in individual states, its policy framework has been widely adopted across the country. This also means that when the policy framework changes at the center, states are relatively quick to adopt the same, as happened with the adoption of a new policy framework for the 11th plan (2007-12).[50]

Similarly, the union government has used its authority to adopt programs such as for drinking water supply in rural areas without accompanying legislation. These have in practice been followed by states throughout the country, in part because of the related financial incentives. The use of such administrative directions (policy) that are not backed by a legal framework may have drawbacks. Thus, even though the human right to water is now clearly established in India, the administrative instruction may not include human rights language in its scope.[51]

2-2. State Water Policy, Law, and Institutions

Water resources—precipitation and surface water resources—are inadequate in three out of the four regions: Saurashtra, Kachchh, and north Gujarat. Groundwater has been seriously over-exploited, and the State suffers frequent droughts. The depletion of groundwater resources in regions like north and central Gujarat had affected the drought proofing ability of the State. Prior to 2001, drinking water scarcity posed a serious threat

47) Cullet, P. 2007. Water Law in India: Overview of Existing Framework and Proposed Reforms. IELRC Working Paper 2007-01. International Environmental Law Research Center. http://www.ielrc.org/content/w0701.pdf

48) *Cullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1).

49) Government of India, 2010. National Rural Drinking Water Program – Movement Towards Ensuring People's Drinking Water Security in Rural India: Framework for Implementation. Dept. of Drinking Water Supply, Ministry of Rural Development, www.ielrc.org/content/e1002.pdf. Accessed 06 March 2014.

50) *Cullet, P. 2012. Is Water Policy the New WatCullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1).er Law? *Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin*, 43(1)..

51) Ibid.

to human and cattle populations. The State government addressed these problems by spending billions of rupees on temporary measures to supply drinking water by road tankers and special water trains. Water shortages in the past had affected access to drinking water and irrigation, constraining economic and social development in the State. The response of the State over the last 15 years has been to introduce a number of programs, institutional, and technological solutions that have included: creation of a state-wide water grid; small water harvesting for irrigation; inter-basin transfers of water from the Narmada River Basin; and power sector reforms. Community-based institutions and private sector participation have been incorporated into these initiatives.

Providing access to good quality drinking water and improved irrigation were among the top priorities in water policy. Many areas suffered from serious water quality problems due to excessive fluoride, nitrate and salinity. Fluoride has been the cause of extensive health problems in many parts of Gujarat. As most of the drinking water supply had earlier consisted of groundwater from deep tube wells with high-capacity pumping machinery, water supply was also a very high consumer of electricity.

The water problem also led to intra-state migration from drought prone-regions in the west and southwest of the State to the central and southern regions. The migration of people and livestock resulted in the economic, social, and cultural dislocation of hundreds of thousands of people. Therefore, the regional imbalances in Gujarat were accentuated because of increasing water scarcity.[52) Growth in the proportion of people with access to safe drinking water over time is shown in Table 10.

2-2-1. Policy Instruments

Gujarat drafted a state water policy in 2012 that provides general guidelines on water resource development, use, and water management that are meant to affect the water sector as a whole, but it still hasn't finalized the water policy. Outside of such a policy, however, most of the water sector reforms in Gujarat have been implemented under strategies, programs or legislation relating to a specific sub-sector.

For example, the state in 2001 drew up an ambitious strategy for extending the water grid through bulk water transmission from sustainable surface water resources to areas with shortages. This was a part of the State water policy, but was not based on legislation. The strategy involved a huge investment in large-scale infrastructure, including bulk pipelines, distribution pipelines and water filtration, and treatment plants. This initiative, carried out by the GWSSB, largely solved the problems of drinking water distribution and poor water quality associated with excessive fluoride contamination.

Other policy instruments have been issued for the irrigation, water supply, and sanitation sub-sectors. One state-level policy covers the construction of "sub-minors" (tertiary canals) involving the Public-Private Partnership model. This policy sets out how the construction will be

<Table 10> Percentage of Households With Access To Safe Drinking Water (Tap Water, Hand Pumps, Tube Wells)

Gujarat/ India	1981			1991			2001			2011		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Gujarat	52.4	36.2	86.8	69.8	60.0	87.2	84.1	76.9	95.4	90.3	84.9	97.0
India	38.2	26.5	75.1	62.3	55.5	81.4	77.9	73.2	90.0	85.5	82.7	91.4

Source:Data book for DCH, Planning Commission, Government of India 18 December 2013.

52) Gupta, R.K. 2003. Dams and Water Development for Poverty Reduction. Water Development and Poverty Reduction. Kluwer Academic Publishers. Part 4(Ch. 10): 199-226.

paid for (between SSNNL and farmers); it also provides incentives to Water User Associations to adopt micro irrigation systems. The State of Gujarat has also adopted a "Total Sanitation Policy" under the Rural Sanitation Program, under which it is providing assistance to construct low-cost latrines in all districts.[53)]

2-2-2. Legal Instruments

According to the existing legal framework in the State, surface and groundwater are treated differently. Further, the water law does not recognize private property rights in water. Currently, surface water is managed as State property, whereas, De Jure rights to groundwater are not clearly defined. De facto, the rights to groundwater are linked to land ownership rights. Those who own land have rights to the groundwater underlying their land, though these rights are not defined in volumetric terms.

The State of Gujarat has enacted a number of sector-specific legislation relating to water. For example, the State enacted the Gujarat Irrigation and Drainage Act in 2013, to replace the Gujarat Irrigation Act of 1879. The Act covers: irrigation from rivers, canals, tanks and groundwater; construction and maintenance; compensation; conflict resolution; adjudication; supply rates (set by State government); and offences and penalties. Another example of a specific water law is the Gujarat Water Users Participatory Irrigation Management Act of 2007 that provides a framework to encourage participatory irrigation management by water users.

According to the respondents to the questionnaires, the overall water laws in the state are perceived as effective in terms of promoting green growth and implementing various reforms in the water sector. However, respondents felt that water laws were not very effective in: addressing conflict resolution among stakeholders; ensuring accountability of various stakeholders (officials, water suppliers, users); promoting integrated water resources management; and encouraging private sector participation in the water sector.

There are no laws or state wide regulations pertaining to inter-sectoral water allocation in the state, except that drinking water gets the highest priority in water allocation from public water sources such as reservoirs, as per the National Water Policy (2012). In the case of SSP, a norm for inter-sectoral water allocation was laid out by the Narmada Water Disputes Tribunal in 1979. This norm is being adhered to.

2-2-3. Water Administration in Gujarat

The case study in Gujarat shows an enormous state-wide effort with many components working together to improve the water situation. The multi-faceted effort was made almost entirely by the public sector, with enormous public investments. While the case study shows savings in some areas such as provision of drinking water and electricity costs, a huge public sector investment was needed for such a wide range of initiatives.

The governance and management of water resources and services include management of water-related organizations, water bodies, and water supply systems. Their domain comprises: storage and control of water sources; delivery of water to different use sectors; actual use and management of water; and disposal of used/waste water. Each of these functions involves a number of distinct activities such as construction, operation and maintenance of facilities, allocation of water, conservation and management of water bodies, and resolution of conflicts among users and service providers. Table 11 shows the institutional structure of the water sector in Gujarat.

53) Socio-Economic Review, 2013. http://www.gujaratindia.com/state-profile/socio-eco-review.htm

<Table 11> Institutional Structure of Water Sector in Gujarat

Administration and regulation		
Agency	Jurisdiction	Role
Department of Narmada, Water Resources, & Water Supplies	State level	Regulatory oversight of the water sector in the State Oversight of State government owned corporations involved in the implementation and operation of water schemes.
Department of Urban Development	State level	Oversight of urban local bodies, excluding corporations, in matters of financial, planning and management issues. Regulation of political and administrative appointments in the local authorities.
Municipal Corporations	Major cities	Provision of retail water supply services for domestic and industrial purposes in the area of their jurisdiction
Municipalities & Nagarpalikas	Smaller Cities	Provision of water supply services for domestic and industrial purposes in the area of their jurisdiction.
Gram Panchayats	Villages	Provision of water supply services for domestic and industrial purposes in the area of their jurisdiction
Gujarat Industrial Development Corporation	State level	Provision of retail water supply services in industrial estates owned by GIDC.
Gujarat Water Resources Development Corporation	State level	Survey, assessment and planning of groundwater resources in Gujarat Planning and design of artificial recharge schemes
Implementation and Operation		
Agency	Jurisdiction	Role
Gujarat Water Supply and Sewerage Board (GWSSB)	State level	Mainly Implementing water supply and sewerage schemes for urban local bodies Operation of some schemes Inspection of schemes where State government fund is provided.
Gujarat State Drinking Water Company Limited	State level	Bulk transmission and bulk supply of drinking water to local bodies, GWSSB, and Industrial estates.
Water and Sanitation Management Organization	State level	Responsible for ensuring decentralized management of water supply at the village level, through promotion of village level pani samitis, with the involvement of NGOs
Sardar Sarovar Narmada Nigam Ltd.	State level	Implementation of Sardar Sarovar Narmada project; Operation and maintenance of the multi-purpose project Operation and maintenance of the irrigation infrastructure under the project Bulk supply of water for industrial water supply, domestic water supply (rural and urban)
Narmada and Major Irrigation Department	State level	Operation and maintenance of large irrigation projects, excluding SSP
Department of Water Resources	State level	Operation and maintenance of medium and minor surface Irrigation Schemes in the state

Source: Gujarat Infrastructure Development Board: http://www.gidb.org/cms.aspx?content_id=358; and IRMA/UNIEF (2001)

Water administration in Gujarat State is the responsibility of three State departments: Department of Water Resources (also includes minor and medium irrigation systems); Department of Narmada and Major Irrigation; and Department of Water Supply. Other ministries, such as industry, environment, and local self-governments are also associated with the administration of water. The Department of Water Resources is responsible for the management of water bodies, which includes conservation and protection of water resources, as well as designing, construction and operation and maintenance of small and medium size surface and groundwater irrigation systems. To assist the Department in promoting groundwater development, the Gujarat Water Resource Development Corporation (GWRDC) was established in 1975. The Corporation is an autonomous body, and its primary responsibilities are survey, monitoring, and development of groundwater.

The Corporation had established over 3000 public tube wells all over the State to promote the groundwater utilization. In addition, the department is responsible for management of drainage and drainage-based irrigation within the command areas of major canal systems. Two state-level institutes under the department, the Gujarat Engineering Research Institute (GERI) and the Water and Land Management Institute (WALMI) were established to support design, construction and management of water resources and services.

The selection of any new water project in the State is guided by multiple criteria that include financial, equity and ecological considerations. In most of the projects, water is priced below the production and supply cost, leading to only partial cost recovery. However, rates for industry and the commercial sectors are substantially higher than the irrigation and domestic sectors.

Irrigation Administration

The Narmada and Major Irrigation Department is responsible for designing, construction, operations, and maintenance of major irrigation systems. The Sardar Sarovar Narmada Nigam Ltd. (SSNNL), a Special Purpose Vehicle, is responsible for the implementation of the Sardar Sarovar project. The SSNNL is an autonomous body that has linkages with the department for the purposes of resource generation. The department is also responsible for negotiation and settlement of disputes related to the Sardar Sarovar Dam in the other States.

There are twelve major irrigation systems (excluding Narmada) in the State. The maintenance and operation of these major irrigation systems is the responsibility of this Department. The performance of major irrigation systems varies widely. In order to improve its performance and increase water use efficiency, the department has launched several programs, including participatory irrigation management, which actively seek farmers' involvement in the management and control of water resources.

One could infer from the above description that there are overlaps of authority and control exercised by various water related line agencies of the State government. For example, the Chief Engineer, Command Area Development, who works as part of the Department of Narmada and Major Irrigation, is also accountable to the Department of Water Resources for activities related to water conservation and minor irrigation networks within the canal command areas as well as groundwater.

Similarly, the Gujarat Water Resources Development Corporation Ltd. (GWRDC) has a role within the command areas of canals for groundwater development and utilization. This overlap of authority and jurisdiction creates confusion among water resources and services managers, which leads to inefficiency and delay in the implementation of the projects. While it is possible that top officials within the water departments may coordinate their activities, the same cannot be said about the lower-level functionaries within each ministry. As a result, it creates frustrations among the personnel of each ministry.

In general, any proposal for a new scheme goes through a very long and tedious process. It begins with an application made by the beneficiary to the district council. The application is routed through a number of local government intermediaries, and is processed by the Executive Engineer, Superintendent Engineer, Minor Irrigation Department, Tribal Development Department, and the Executive Committee of the district council. If everything is found in order, the State government invites tenders for implementation of the irrigation works. Execution and completion of a scheme is a long drawn out process, with delays at every level. Although the local community institutions are expected to contribute a part of the project costs from their own resources, common experience has been that the entire expenditure was borne by the State government.

Administration of Water Supply Services

The Water Supply Department, under a Minister, is responsible for providing water supply services that include domestic water supply and water supply for industries. Thus, it is responsible for the identification of sources of water and design, construction, and operation of water supply systems for domestic and industrial purposes. Depending upon the source of water, the Department has to constantly coordinate its activities with the Department of Water Resources (Minor and Medium Irrigation) or the Department of Narmada and Major Irrigation. For water supply to rural areas, it has to build strong linkages with village authorities, the Gujarat Industrial Development Corporation (GIDC) and municipalities for the operation and management of water supply systems.

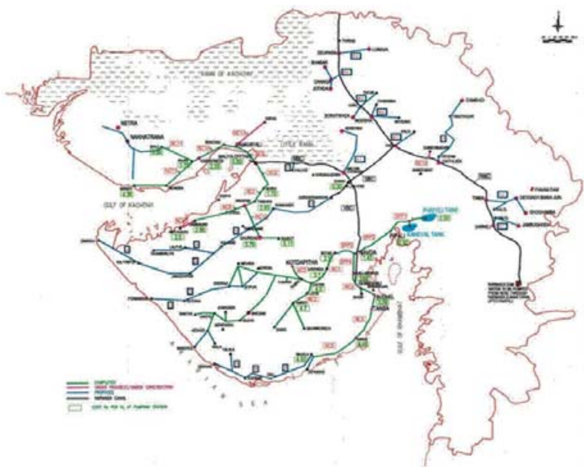
The design, construction, and implementation of water supply schemes is done through the Gujarat Water Supply and Sewerage Board (GWSSB), which is an autonomous board, headed by a Chairman appointed by the State government. The relationship between the Department of Water Supply and GWSSB is similar to that between the Department of Narmada and Major Irrigation and the Sardar Sarovar Narmada Nigam.

The institutional structure of the water supply sector in Gujarat is complex. The administration and regulation of water supply, covering domestic and industrial sectors, is provided by: the Department of Narmada, Water Resources and Water Supplies; Department of Urban Development; Municipal Corporations; Municipalities; local governments; and the Gujarat Industrial Development Corporation. At the same time, the implementation and operation of water supply projects are handled by: the Gujarat Water Supply and Sewerage Board; Gujarat State Drinking Water Infrastructure Company; Sardar Sarovar Narmada Nigam Ltd. (SSNNL); and Department of Narmada, Water Resources and Water Supplies.[54)]

The Department of Narmada, Water Resources and Water Supply (now Narmada, Water Resources, Water Supply and Kalpasar Department) under the Minister for Water Supply is responsible for domestic water supply, both rural and urban, and is administered by the Secretary-Water Supply.

Gujarat Water Supply and Sewerage Board(GWSSB)

The establishment of the state-wide water grid that would eventually provide safe drinking water throughout the State was the responsibility of the GWSSB, the largest player in the water supply sector (see Figure 5). Its jurisdiction extends to the entire State with the exception of the large cities headed by Municipal Corporations and the cantonments. This is an autonomous body headed by a Chairman and administered by a full-time Member-Secretary who is appointed by the State Government. It has three zones, each headed by a Chief Engineer. Each zone is further divided into circles of Project, Mechanical



Source: GWSSB, Gandhinagar

<Figure 5> Proposed Water Grid for Supply of Drinking Water in Gujarat Towns and Villages

54) Socio-Economic Review, 2013. http://www.gujaratindia.com/state-profile/socio-eco-review.htm

and Works, each headed by a Superintending Engineer. Each circle is further sub-divided into divisions, each headed by an Executive Engineer. The smallest unit is the sub-division headed by a Deputy Executive Engineer. In the line function, the GWSSB has five zonal offices, 15 circle offices, 41 divisional offices and around 200 sub-divisional offices.

The objectives of the Board are: to provide safe and adequate drinking water on a sustainable basis to all; and to maintain sanitary conditions so as to promote public health by preventing water-borne diseases. The main functions are:

1) to identify "no-source" villages and develop water resources for them;
2) to undertake rural sanitation works and regenerate/augment rural water supply schemes;
3) to combat drought-related water problems in the rural area;
4) to undertake research and development; and
5) to conduct training.

The villages of Gujarat State were broadly classified for purposes of planning the drinking water supply schemes as: 1) difficult and scarcity villages; 2) villages in specially deprived areas; 3) villages having unsafe water; 4) villages having inadequate water sources to be stepped up in per capita water supply; and 5) deserted villages.

The design considerations adopted by the agency for planning rural water supply schemes take into account several physical and socio-economic parameters such as water availability, quality and distance to the sources of water, and minimum water required for human and cattle populations. A study of water-borne diseases was made for each district for providing suitable precautionary measures in selecting sources of water, location of stand posts, cisterns etc., and chlorination was done in all the schemes. The approach for solving the drinking water supply was to bring water sources very close to the village or bring water through pipelines in unavoidable circumstances.

In early years, when GWSSB started its operations, water levels in the wells and tube wells were at reasonable depths all over Gujarat. There was no fear of water level receding as irrigation water withdrawal was at moderate levels. But, as groundwater irrigation grew at a rapid rate with energized wells and deep tube well pumping, the depth increased and wells started drying up. Drinking water supply sources faced the greatest threat from irrigators and industries. In years of low rainfall, thousands of villages lack surface and groundwater sources. Hence, drinking water problems become acute in drought years.

Photo by Nitin Bassi

<Picture 1> Community Stand Post in a village near Bhavnagar, Gujarat

With over 4000 people on its staff, GWSSB is a massive bureaucracy. Among its human resources, it has a large number of engineers, who are its strength when it comes to implementing large engineering projects. But most of the engineers are not competent in managerial functions, due to inadequate managerial training. Further the lack of real autonomy for the GWSSB hinders efficient planning and operations.

A detailed analysis of GWSSB's strengths and weaknesses was done twice, in 1994 and in 1999, as a part of the Netherlands mission.[55] It was found that the strengths of GWSSB derive from its infrastructure, professional human resources and access to State funds. It is the nodal agency for all water supply and sewerage projects in the State. It also has a significant planning and regulatory role envisaged in the GWSSB Act that has been largely unfulfilled. The Board also can tap any natural source for water, and can set tariffs, but the government endorses the upper limit. The Board is even allowed to "enter into contract or agreement with any person… for performing its duties and discharging its functions" (Section 15[2] [f]). Despite the impressive room for maneuver, the Board has been unable to derive any effective autonomy because it has no powers of enforcement or policing, and is too closely linked with the Government.

Its weaknesses derive from its structure, its procedures, its systems, and the fact that, in many ways, it functions no differently from a government department. Its human resources management policies are not strategic in nature and generate apathy, inefficiency, and even incompetence in otherwise qualified people. It is not financially self-sufficient because of poor cost recovery and limited sources of independent resource generation. Operations and maintenance have been a major failing of the Board, particularly for hand pumps, which are supposed to be maintained by the Panchayats. The O&M of the regional piped water supply schemes fares slightly better, but is still beset with the problems of a slow moving bureaucracy, inappropriate procedures and vandalism by citizens. The dug wells and individual water supply schemes are handed over to the local governments.

2-3. Market-oriented Institutions

Although most of the reforms in water management have been undertaken by the public sector, the government of Gujarat is promoting wide participation of the private sector in infrastructure development, including in the water supply sector. One of the approaches the State has taken to involve the private sector is to create Special Purpose Vehicles (SPVs) to handle aspects of water resources management. An SPV is a legal entity (usually a limited company or partnership) that is created to fulfill narrow, specific or temporary objectives. Such SPVs are typically used by a government agency or water management entity to limit its financial risk. A government agency can transfer assets to the SPV for management or use it to finance a large project, thereby achieving a narrow set of goals without putting the entire agency or department at risk. They are an integral part of public-private partnerships that rely on a project finance type structure. It thus involves the private sector, but in partnership with a government agency.

2-3-1. The Gujarat Green Revolution Company

The Gujarat Green Revolution Company (GGRC) is an agency set up by the government of Gujarat as a SPV to promote efficient irrigation technologies in Gujarat on a large scale. The state government's initiative to bundle all the state assistance and central scheme for promotion of micro irrigation under one agency with a large endowment, had led to setting up of the GGRC in 2005. It had an operating capital of 1500 crore rupees (nearly US $250 million) to start with.

The GGRC had made it easy for the farmers to purchase a micro irrigation (MI) system, mainly using drip or sprinkler irrigation, with state subsidy. Under the MI scheme, a farmer who wants to install an MI system in his or her farm and also wants to avail of the government subsidy will have to first have his farm surveyed and have the surveyors prepare the estimates. Along with the survey record and cost estimates for MI system, the farmer makes an application to the GGRC, along with payment of 50% of the total cost. On receiving the

55) The Netherlands Government, which had assisted four drinking water supply projects in Gujarat, initiated studies on institutional reform, one of the objectives of the Dutch assistance.

necessary documents from the farmer, the agency places a work order to the Company identified by the farmer. A tripartite agreement is signed between the farmer, the MI Company, and the GGRC.

In Gujarat, more than 20 MI Companies are partners of GGRC in the micro irrigation enterprise. They include some well-known firms such as Netafim, Plastro, Nan Dan, and Jain Irrigation. Some of these companies have their manufacturing plants in Gujarat, while others have suppliers and dealers.

Once the company installs the system in the farmer's field, the concerned officials of GGRC visit the farmer's field and make sure that the installation is done as per the specifications made in the work order, and upon certification by the agency official a payment equal to 90% of the cost of the system is released to the company. An amount equal to 10% of the system cost is retained with GGRC, and would be released only after five years. This is to make sure that the farmer uses the system properly and the company provides the necessary 'after sales' service for smooth working of the system. Though GGRC offers up to 60% subsidy on the capital cost of the MI system, the maximum subsidy available for the farmers is only Rs. 60,000 per ha (US $ 1000 per ha).

Photo by Nitin Bassi

<Picture 2> Cotton Crop Using Drip Irrigation, North Gujarat

The entire process, starting from the day farmer makes the application to the day the company receives the payment, takes around three months. If the farmer also applies for a bank loan for purchase of an MI system, then the total time required, which includes the time required for sanctioning the agricultural loan, would be nearly six months.

Overall, though water scarcity is driving MI adoption in the country, not all water-scarce areas are experiencing the same level of MI adoption in spite of the high potential. This means that water scarcity at the societal level alone is not a motivating factor for the farmers to adopt MI.

To the farmer, what matters is how the adoption improves the economics of crop cultivation. Water scarcity provides the required economic incentive to adopt MI systems only in certain situations. Factors in the consideration include access to an individually owned well and presence of favourable power supply. The economic incentive comes from the ability to expand the area under irrigated production with MI adoption, as only a small percentage of the area is currently irrigated in Gujarat due to severe groundwater scarcity. Other factors taken into consideration are affordability, which is improved by the subsidy, and the presence of crops that are amenable to MI systems.

2-3-2. Other Special Purpose Vehicles

The Sardar Sarovar Narmada Nigam Ltd. (SSNNL) is a Special Purpose Vehicle set up for transferring water from surplus areas to scarcity areas, and implements the Sardar Sarovar Project of the Narmada Canal. It is responsible for bulk supply of the water from Narmada through its canal network.

The State Government set up the Gujarat Water Infrastructure Co. Ltd. in 1999 for the implementation, operation and maintenance of the Sardar Sarovar Drinking Water Supply program. This is still a growing organization and therefore has been entrusted with limited responsibilities, The major responsibility of regulation and development of drinking water sector is shouldered by the GWSSB.

The Gujarat State Drinking Water Infrastructure Company Limited (GSDWICL) is another Special Purpose Vehicle, a bulk carrier, set up to purchase Narmada waters from the SSNNL in bulk and sell in bulk to other users such as GWSSB, Municipal Corporations, municipalities, and industrial estates.[56)]

2-3-3. Sabarmati Riverfront Development Project

In Gujarat's largest city Ahmedabad, the Sabarmati Riverfront Development project aims to protect the deteriorated river banks of Sabarmati, which was once was the lifeline of Ahmedabad city. As the city grew, the river became increasingly polluted from the disposal of untreated and partially treated urban domestic and industrial effluents, and remained one of the most polluted rivers in India. The Sabarmati River became essentially a trunk sewer carrying the effluent from Ahmedabad city and the neighbouring industrial areas, compounded by lack of inflows from the upper catchment.

To improve the urban environmental conditions, the Ahmedabad Municipal Corporation (AMC) set up the Sabarmati Riverfront Development Corporation (SRFCDL) in 1997 as an SPV to oversee the project. It has begun the massive task of cleaning up the river by flushing out the effluent and sludge in the riverbed using excess flows of Narmada from the main canal. Plans include: the construction of artificial water channels; diversion of clean water from the main canal into the river; and storage in a 16-km long stretch, with approach roads, gardens and other recreational facilities. Simultaneously, water treatment systems were installed for treating the polluted water from industrial and other sources, and the entry of wastewater into the river was completely stopped. This was a very important step to begin urban renewal and restore the waterway for environmental, social, and economic benefits.

2-3-4. Power Sector Reforms

The power sector reforms in Gujarat mainly involved unbundling the State Electricity Board into a power generation company and regional power distribution companies. Four power distribution companies were subsequently created in Gujarat. The power distribution companies purchase electricity from the state electricity utility and supply to various consumers. Metering of power distribution is done up to the level of the transformer. The privatization led to major reduction in transmission and distribution losses, which were mainly occurring due to power theft from the feeders, particularly in the rural areas by farmers.

Another important step was metering of electricity in the farm sector. Earlier the State Electricity Board used to charge for electricity from farmers on the basis of connected load or pump horse power. This created a situation where farmers had no incentive to use either groundwater or electricity efficiently for irrigation. But since 2003, there has been a gradual shift towards metered tariff regime, as the State was under enormous pressure to reduce the revenue losses through power subsidies. This is achieved by adopting a norm that new power connections would be offered only to those farmers who are willing to agree to a pro rata tariff. This appears to have been a very pragmatic approach, and currently nearly 50% of the agricultural connections in Gujarat are metered. Empirical studies carried out in north Gujarat show the positive impact of pro rata pricing of electricity in the farm sector for groundwater pumping on efficiency and sustainability of groundwater use and socio-economic viability of raising power tariff in

56) GSDWICL will also be responsible for laying down and managing 2500 km of drinking water trunk transmission mains from the Narmada canal network. In order to avoid the same problems faced by GWSSB, it needs to retain autonomy and run on professional lines.

agriculture. Not only was the water use efficiency higher in physical and economic terms, but also the amount of groundwater pumped per unit irrigated area was lower for farmers who paid for electricity on a pro rata basis. The net return per unit area of land was equal to or higher for the farmers paying on a pro rata basis compared to their counterparts who paid for electricity on the basis of connected load[57]. The introduction of electricity metering in the agriculture sector is emerging as a major policy initiative for water demand management.

2-3-5. Role of Corporate Social Responsibility in the Water Management Sector

The role of private sector in water resources development and water management cannot be overstated. Several of the industrial groups which operate in Gujarat have set up their own philanthropic organizations which are active in economic and social development. Water management is one of the key activities of these organizations. The interventions of these organizations revolve around the broader theme of natural resources and rural livelihoods, and they follow community-centered approaches for addressing water problems.

Some of the most well established institutions are:

1) Sir Ratan Tata Trust (SRTT) and Sir Dhorabji Tata Trust (SDTT) Mumbai, which are the philanthropic arms of the largest industrial conglomerate in India, i.e., the Tata Group of Companies;
2) Ambuja Cement Foundation, a corporate social responsibility (CSR) wing of the Ambuja Cements Ltd;
3) NM Sadguru Water and Development Foundation, initially set up as a CSR wing of Mafatlal Industries;
4) the Aga Khan Foundation, which works through Aga Khan Rural Support Program (India); and
5) the Nehru Foundation for Development, which works through VIKSAT (Vikram Sarabhai Center for Development Interaction).

The NM Sadguru water and development foundation works in the tribal area of eastern Gujarat, whereas Ambuja Cement Foundation works in the coastal area of Saurashtra. The SRTT and SDTT have national presence, and are actively supporting a wide range of projects related to water and livelihoods, including several field projects on coastal salinity ingress in Saurashtra and Kachchh, a project on groundwater depletion in north Gujarat, and grassroots interventions on improving access to water for agriculture in the tribal area of eastern Gujarat. The Aga Khan Rural Support Program works in three regions in Gujarat: coastal Saurashtra (Junagadh); Bharuch district of South Gujarat; and Surendranagar district. VIKSAT works in north Gujarat addressing water management issues.

Some of these philanthropic institutions have been active in the water management sector of Gujarat over the past three decades. They support NGOs, both large and small, using financial and other resources. These NGOs work in the villages to mobilize community action to address the specific problems, which translate into technical and institutional interventions. The positive outcomes of many of the small-scale water management projects supported by private foundations in different parts of Gujarat in many cases influenced the launching of large schemes on water conservation and management by the state government.

In addition to supporting grassroots level action on local water management, the private companies have also started water stewardship programs to reduce 'water footprint' of their manufacturing activities. The most illustrative example is the Ambuja Cements, which while implementing water harvesting and water

57) *Kumar, M.D., Scott, A.S., and Singh, O.P. 2001. Inducing the Shift from Flat Rate or Free Agricultural Power to Metered Supply: Implications for Groundwater Depletion and Power Sector Viability in India. Journal of Hydrology*, 409(1-2): 382-394.

use efficiency improvement programs in the villages surrounding their plant through their CSR wing, had initiated many steps to reduce wastage of water in their manufacturing plants. The company aims to make their plants in Gujarat water neutral. The Tata Chemicals runs mobile RO plants to supply fresh water to many villages in the coastal areas of Saurashtra that do not have access to freshwater from public systems.

2-4. Community-centered Institutions

The importance of decentralization in India also has an impact on water law. At the local level democratically-elected Gram Panchayats have control over most water-related issues at the local level in rural areas.However, numerous laws related to water user associations adopted in the past decade may bypass the GPs in favour of an alternative institutional structure. Water user associations tend to be less inclusive in terms of participation, as they are generally based on land ownership, and some of the more progressive aspects of the Panchayat system such as reservation for women and scheduled castes and scheduled tribes are often dispensed with.[58)]

2-4-1. Pani Samitis (Village Water Committees)

A proposed solution to make a bridge between the various bodies that are responsible for water management at the community level was to establish Pani Samitis (elected water committees with at least one third women). Pani Samitis were first tried out during the Santalpur project with both the Self-Employed Women's Association (SEWA) and the Center for Health Education, Training and Nutrition Awareness (CHETNA) trying different approaches. The pani samitis were expected to assist with local operation and maintenance, since there was no user organization that deals exclusively with O&M.

The Panchayat and Rural Housing Development Department of the Government of Gujarat introduced a resolution in 1995 that requires that a Pani Samiti be formed in every village panchayat, especially where a drinking water scheme was being implemented. The purpose was to facilitate local participation. The order stipulates the structure, the duties and functions in a typically top-down manner. The resolution and a subsequent one passed later in the year only increase the responsibilities of the villagers without giving them any corresponding authority. Having been charged with the bulk of the responsibility for O&M, the committees have been given less than 50% share in the taxes collected. The responsibilities assigned require considerable managerial skills as well as power to enforce rules, regulations, and impose penalties. The resolution does not take into account the existence of any other grassroots institutions, such as Water Users Associations (WUAs) or other social or cultural institutions that could support more effective discharge of the functions. However in 2002, the Water and Sanitation Management Organization (WASMO) was set up, which is supposed to deal with community-based management committees, including the pani samitis and the WUAs.

Despite the lack of capacity among the pani samitis, there are many examples of self-help initiatives where villagers have managed the problems by themselves. For a pani samiti to function well, it should be formed at the initiative of the people, be able to generate resources, have the skills required, function democratically, be accountable to the people, and enjoy a reasonable degree of freedom from government control. Skills required for hand pump repair, for example, can be taught to relatively uneducated people. Training can be done at the village level so as to reduce dependency on the GWSSB. Besides managing the infrastructure installed by the government, the pani samiti should also protect other

58) Cullet, P. 2012. Is Water Policy the New Water Law? Rethinking the Place of Law in Water Sector Reforms. Institute for Development Studies Bulletin, 43(1).

sources of water that the village relies on, such as ponds, lakes, and wells. The committee should ensure that sufficient water is set aside for drinking purposes, and thereafter allocate water judiciously for agriculture and other uses.

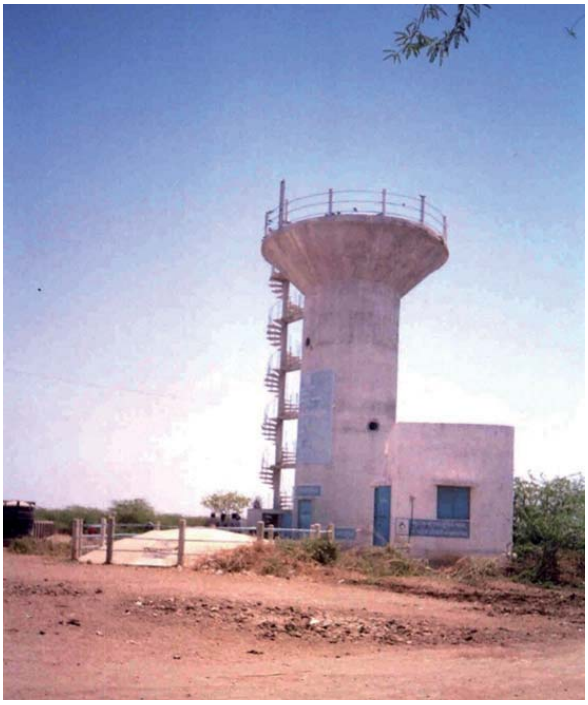


photo by Nitin Bassi

<Picture 3> Elevated Service Reservoir with Pump House in a Village, Saurashtra, Gujarat

Avoiding nepotism and discrimination in the committees requires strong institution building processes that can be catalyzed by NGOs such as SEWA having the requisite trust and competence. Sometimes, minor innovations such as "parceling" of the stand post by having more posts with fewer taps each and spread around the village rather than having one with several taps, reduces conflicts and promotes equity. With the tradition of sharing that is common in Gujarat, there could also be experiments with quasi-private ownership, where an accepted individual could be given the connection or hand pump on a small group ownership basis.

There are many cases where water meant for drinking is utilized for irrigation by a few. Until such practices are curbed with gradual democratization of village society and increased accountability, the GWSSB can play a policing role by identifying such inequities and helping to resolve them. They should have the power to impose penalties on offenders.

Alternatively, strong NGO involvement should be facilitated wherever there are respected and reliable NGOs. In those cases the role of the Board would be that of a partner or a facilitator. Experiments with micro water resources management at the village level, and conducting water audits would indicate if comprehensive water resources management is possible in the individual village. Finally, the restructuring of roles and responsibilities should be based on who can manage the system most effectively. In many cases, it is village women who can perform these tasks effectively, as they have high stakes in keeping the system running and they are more likely to remain in the village during the day. Training of women in pump maintenance and other tasks has proved valuable in a number of pilot projects, as demonstrated by the work of SEWA (Self Employed Women's Association). It should not become an exercise in abdication of its duties by the State and handing over duties without any compensation of power or authority.

In some instances, tankers were also provided mainly to meet the water demand for livestock. Rainwater harvesting has also been promoted, and more than 14,000 roof top rainwater harvesting tanks have been constructed. The establishment of the water grid has improved the domestic water security in the villages. It has especially helped to increase in dairy production in North Gujarat and Kachchh.[59]

59) Interview with Mr. Mahesh Singh, Member Secretary GWSSB 30-01-14

Photo by Nitin Bassi

<Picture 4> Check Dam, Saurashtra

2-4-2. Participatory Water Conservation Project

One technique used to improve water supply to small and marginal farmers was the introduction of rainwater harvesting for micro-irrigation. The Sardar Patel Participatory Conservation Project (SPPCP) involves construction of check dams and village tanks/ponds by a designated beneficiary group or an NGO, with technical and financial assistance from the district office. Six prototype designs were circulated with a maximum cost of 1 million rupees. More than 350,000 check dams and village ponds/tanks have been created in the last 10 years, providing direct benefit to over 13 million people in rural Gujarat.

Gujarat State had been implementing the construction of check dams in the 1990s, but the progress was slow under the government-sponsored system. In 2000, the government of Gujarat decided to launch the Participatory Water Conservation Program to promote water conservation programs all over the State. This was an institutional innovation for implementing small water harvesting schemes, as it promoted decentralization in water development and management by giving powers to the local village Panchayat to identify sites, prepare estimates and secure funds directly from the water resources department for execution of schemes.

Check dams have been identified as viable water conservation structures particularly for Saurashtra, given its drainage pattern and terrain conditions. They collect and conserve surface water, while at the same time replenish and recharge groundwater in the adjacent areas depending on the presence of geological conditions such as weathering and presence of fractures and fissures.

Check dams are constructed across rivers and streams at a height of 1.5 to 2.0 m. They are low weirs which divert some water, but without canals. They generally require less operation and maintenance compared to surface irrigation projects, but do get silted up in 3-5 years depending on the nature of catchment. They are effective in conserving water at low maintenance and low operational cost. Check dams do not require land acquisition and thus legal complications are avoided. Moreover the benefits are made available to the farmers quickly, and poor farmers can participate. The check dams do not require expensive technology and they provide employment opportunities to local residents. The widespread and equitable distribution of water resources through this project has had a positive impact on social and economic development.[60)]

However, the implementation of the SPPCPscheme lacked serious hydrological and technical (engineering feasibility) considerations of the total amount of utilizable/'uncommitted' flows in the river basins in which it was carried out. As a result, in most instances, the total capacity of the structures built was much higher than the total utilizable flows in normal years, leading to over-appropriation of water in normal and drought years. Large-scale construction of water harvesting structures led

60) Narmada, Water Resources, Water Supply and Kalpasar Department http://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=1538&lang=English

to negative impacts on the existing downstream (minor, medium and major) reservoirs and local tanks and ponds in many basins of Saurashtra and Kachchh regions where maximum structures were built. The planning also did not consider the storage capacity of the aquifers for receiving the impounded 'water' that is recharged artificially. In wet years, the wells in Saurashtra, which is underlain by hard rock formations, over-flowed, and as a result the water remains in the impounding structures. Some scholars have argued that the economic viability of such structures in terms of cost per cubic metre of water captured would also be very low for the high degree of water development at the basin scale, given the high inter-annual variability in rainfall experienced in the naturally water-scarce regions[61].

2-4-3. Community-managed Water Governance Model

The creation of the Water and Sanitation Management Organization (WASMO) was a significant shift in the role of Government from provider to facilitator by empowering village-level institutions (such as the pani samiti) through extensive capacity-building and facilitation. It has brought about effective citizen engagement through its innovative governance model for community-led water supply program throughout the State of Gujarat. More than 16,700 village water and sanitation committees have been formed in the State and are ready to take responsibility for managing of service delivery and water resources at the decentralized level. More than 6,500 villages have already commissioned infrastructure and water conservation projects in a demand driven mode, with another 4,550 villages currently implementing community-managed rural water supply programs.

The government of Gujarat set up WASMO as an autonomous society to carry forward the concept of decentralized rural water supply management. WASMO acts as a catalyst to promote, develop and strengthen community participation from the stage of planning to operation and maintenance of village water supply schemes. It was conceived to bridge the gap between GWSSB and the community in managing and supplying drinking water to the rural villages and towns of Gujarat. WASMO is a body with representations from almost all stakeholders concerned with rural water supply.

WASMO is different from other water supply organizations that are, by and large, "delivery oriented". This organization demands community, civil society and government participation; it combines software and hardware components of water supply by linking communities and their social concerns with engineering and structural solutions. WASMO uses local as well as bulk water transfer sources, and integrates water conservation into the water supply schemes, since water conserved is water supplied. Finally, it mixes the traditional approach with the modern one by reviving and promoting traditional rainwater conservation systems. In this, WASMO's role is that of a facilitator and an enabler.

These principles have been applied in 82 villages covered under the community-managed Ghogha regional water supply and sanitation project in three blocks of Bhavnagar district and in 1,260 villages in the earthquake-affected districts of Kachchh, Patan, Surendranagar and Jamnagar.

The organization has staff strength of 151 people, of which 42 are based in the head office, and the rest 112 are based in field units. There are four field units: the Ghogha project unit; and three earthquake rehabilitation and reconstruction units, located in Bhuj, Surendranagar and Jamnagar. The staff is dominated by technical personnel (38%), administrative staff (40%) and community

61) *Kumar, M., Patel, A.R., Ravindranath, R., and Singh, O.P. 2008, 30 Aug. Chasing a Mirage: Water Harvesting and Artificial Recharge in Naturally Water Scarce Regions. Economic and Political Weekly*. Aug

mobilisers (12%). The inclusion of community mobilizers in the organization is a major departure from the existing practice in most water supply agencies.

Attempts are being made to ensure genuine participation of the communities through implementing support agencies. WASMO is also working towards total village development by integrating the provision of sanitation facilities, promoting health and hygiene in the community and improving the local ecology. Already, the efforts to raise awareness on hygiene and sanitation issues are bearing fruit as communities slowly adopt cleaner practices.

IV. Performance of Water Management Reforms in Gujarat

The following sections provide empirical and observational evidence of the impacts of the large infrastructure projects and the water management reforms. The first section has results from a study of the Sardar Sarovar Narmada project. It also includes observations from top experts with extensive knowledge of the sector and of Gujarat State. The results of interviews with these experts are included in Annex A. The second section summarizes the performance results from the questionnaires completed by managers and practitioners in the water resources sector.

A few observations on the overall impact of the reforms were made by some of the experts. Mr Sachin Oza, Executive Director of the Development Support Center, Ahmedabad,[62] identified the most important reforms in the Gujarat water sector as: irrigation management transfer (IMT); awareness regarding water recharge (harvesting and pond deepening); formation of the Gujarat Green Revolution Company for the promotion of micro irrigation; electric supply feeder separation; and domestic water supply security. He noted that, while all of the schemes are good, they are not integrated. Different departments are running different programs, but without any coordination among them.

Professor Rohit Desai is of the opinion that in the past few years, the water scenario in Gujarat has improved as a result of good rainfall and water management efforts by the Government of Gujarat through both decentralized water harvesting and large-scale water transfer to poorly endowed regions by SSP. The per capita income in rural areas of water-scarce north Gujarat has improved, owing to additional water for irrigation from Narmada. South Gujarat is getting more prosperous due to soil fertility and ample reliable water supplies from Narmada. He notes that agricultural growth in Gujarat is primarily due to linking of rivers (through SSP) and growth in the area under irrigated cotton and improved yields. The adoption of high yielding hybrid cotton in Gujarat has been very high in the recent past.

The problems of drinking water in the water scarce regions especially in North Gujarat and Kachchh have largely been resolved. Further, because of the awareness created by WASMO, community-centered reverse osmosis (RO) plants have been adopted by many villages in remote coastal areas, and the problem of water scarcity is no longer acute.

1. Economic Performance

1-1. Sardar Sarovar Project and Inter-basin Water Transfer

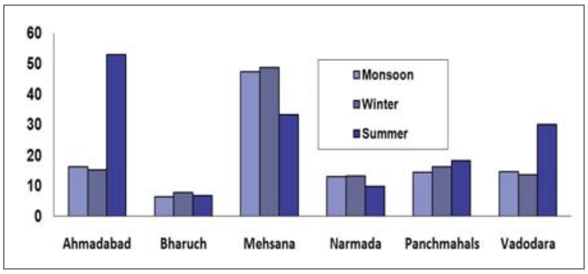
The Sardar Sarovar project is a large modern, multi-purpose water resource project. While complying with the project obligations for the rehabilitation of project-

62) Interview with Mr. Sachin Oza, 30 Jan 2014.

affected people, the dam height was raised incrementally and the storage capacity enlarged. The long delayed 250 MW head power house has been operationalized, and from 2004 to 2010 SSP generated 15,070 million KWh of eco-friendly energy.

A recent study of the impacts of SSP has been undertaken by the Institute for Resource Analysis and Policy (IRAP)[63] for Sardar Sarovar Narmada Nigam Ltd. It shows that an important indirect benefit from canal irrigation is the reduced economic cost of energy used for pumping groundwater for irrigation, estimated to be huge. This was the result of a rise in groundwater levels across the areas benefited by canal water supply (see Figure 6), which occurred due to two major factors: (i) reduction in groundwater pumping owing to availability of surface water for irrigation; and (ii) the increased groundwater recharge in the areas receiving canal water through irrigation return flows. For every hectare that had been irrigated by groundwater in the SSP command area, the economic benefit through energy saving in groundwater pumping ranges from a low of Rs. 768 (US $12.80) in Bharuch to Rs. 9170 (US $152.80) in Mehsana per annum. In addition, the incremental income of well irrigators due to improved sustainability of wells resulting from recharge from canals and gravity irrigation return flows ranged from a low of Rs. 24,000/ha (US $400 per ha) to a high of Rs. 113,000/ha (US $1,884 per ha) of gross cropped area per year.

The introduction of gravity irrigation also benefitted drinking water supply in the command areas, by recharging the shallow aquifers which are tapped for rural water supply. The indirect economic impact of canal irrigation in the form of improved sustainability of groundwater-based drinking water supply schemes in south and east Gujarat parts of Narmada command for a population of five million was estimated to be Rs. 1032.5 million (US $18 million) per annum.



Source: IRAP,2012. Realistic vs Mechanistic: Analyzing the Real Economic and Social Benefits of Sardar Sarovar Narmada Project, Submitted to Sardar Sarovar Narmada Nigam Ltd., Gandhinagar, Gujarat. IRAP.

<Figure 6> Average Rise in Groundwater Levels (Feet) following Narmada Water Release in Six Districts (Measurements Taken in 2010)

As a result of the distribution of Narmada water for domestic supply, the expenditure on tanker supply in the State came down from Rs. 2,168 million (US $36.1 million) in 2002-03 to Rs. 262 million (US $4.4 million) in 2008-09. In addition, a large amount of electricity is being saved every year because of surface water supply, which replaced groundwater pumping in the rural and urban areas of Saurashtra and Kachchh. Moreover, reductions in groundwater pumping for drinking water supply resulted in lower CO_2 emission (16,076.14 ton of equivalent CO_2). The energy savings reached 72 million kWh per annum. With the supply of water free from salts from Sardar Sarovar reservoir to the villages and towns and the consequent reduction in dependence on well water for drinking purpose, the number of villages affected by high levels of fluoride in drinking water decreased from 4187 in 2003 to 987 villages at present.

The indirect economic impact of Narmada canal-based piped water supply to over 24 million people in Saurashtra, Kachchh, and north and central Gujarat was estimated at Rs. 857.7 million (US $14.3 million) per year, owing to the saving in energy used for

63) Realistic vs Mechanistic: Analyzing the Real Economic and Social Benefits of Sardar Sarovar Narmada Project, Submitted to Sardar Sarovar Narmada Nigam Ltd., Gandhinagar, Gujarat. IRAP, 2012, July.

pumping groundwater. The indirect economic impact of clean energy production for an energy-scarce State through hydropower from SSP is estimated to be Rs. 161.1 million (US $2.7 million) per annum (for a total estimated average energy production of 3436 million kWh per annum).

While the State of Gujarat has sharp differences in water endowment among its regions, the SSP has provided a better balance between water availability and demand. The main canal of SSP takes water from relatively water rich south Gujarat to the water-stressed regions of central and north Gujarat and farther up to south-eastern Rajasthan. An inter-basin water transfer project, called the 'Sujalam Sufalam' scheme, was launched in 2004 by the government to use the main canal of SSP to bring excess flows from the Narmada River to the water-stressed regions, which are also facing problems of groundwater mining. The project takes advantage of the fact that the main canal traverses the alluvial aquifers of north and central Gujarat that have storage potential and intersects many rivers of the region that are not perennial. These ephemeral streams can be used to receive water from the canal and spread it over large geographical areas for replenishment of aquifers. A project of this magnitude is almost unheard of in the water management history of the developing world. It was an effort of the government of Gujarat to make judicious use of the waters from Sardar Sarovar reservoir, which is still waiting to be fully utilized for irrigation.

Photo by Nitin Bassi

<Picture 5> Sardar Sarovar Project Branch Canal, Surendranagar, Gujarat

1-2. Performance of Sardar Sarovar Narmada Nigam Ltd. (SSNNL)

According to Dr. M.B. Joshi,[64] the SSNNL is unique in many ways. It is a SPV registered as a company that can generate its own resources through public deposits (deep discount schemes were introduced). Thus, since World Bank support was withdrawn from the project[65], the Government of Gujarat has been able to continue SSP projects by mobilizing its own resources. Further, SSNNL is the only irrigation agency in the country having people in the senior management from multiple disciplines, such as environment, forests, and agricultural economics.

SSNNL's performance has improved because of the reforms related to land acquisition and compensation. In most of the SSP projects (especially related to irrigation), there have been delays in project completion due to problems in acquisition of land. Up until 2010, only 17,000 ha of land (42.5% of the required) were acquired for SSP over a period of 30 years. With the introduction of the new policy in 2010, compensation for land acquisition is being paid as per the market rate. Over and above the existing land prices, 30% extra is paid to

64) Interview with M.B. Joshi, General Manager-Coordination of SSNNL on 30 Jan 2014.

65) The support to the project was withdrawn by the World Bank in the wake of the report submitted by Bradford Morse in 1992 after an independent review of the project. The report criticized the government of Gujarat for the 'not so satisfactory' implementation of the Rehabilitation & Resettlement of the dam oustees. However, this report was heavily criticized by many including NGOs to be highly biased.

the evictee. As a result, in the last 3 years, an additional 17,000 ha of land had been acquired. Now, only 6,000 ha of land remain to be acquired. Before the 2010 policy initiative, there were about 60,000 cases related to land acquisition pending in the courts. After the adoption of the new land acquisition policy, there are no court cases as the farmers and other landowners are satisfied with the compensation being paid.

In Dr Joshi's view, the major reason for non-completion of the tertiary system (sub-minors) is that farmers do not want to give up their land for sub-minors (water courses), as no compensation is paid for it. As a result, farmers are directly lifting water from minor canals.

In order to encourage completion of the tertiary supply system, a new policy approach has been adopted by SSNNL. This gives farmers the option of having either an open channel or an underground pipeline in place of the sub-minor and field channels. In cases where farmers prefer an underground pipeline, they do not have to give up land. Negotiations for laying underground pipeline are done with Water User Associations (WUAs), not with individual farmers. Presently, it is being tested at some locations in the command area.

However, as pointed out by Dr Joshi, in many regions underground pipelines do not work under gravity systems. It is estimated that about 60% of the area is suitable to be irrigated through gravity-flow-based underground pipeline. In the remaining areas, installation of pressurized pipes (underground) is proposed. However, in such areas adoption of micro-irrigations systems has been made mandatory to stop the wastage of water, as pressuring the flow would be expensive. Also, O&M of the underground pipeline is the responsibility of farmers. As a result, there is not much demand by farmers for a pressurized underground pipeline system.

1-3. Impacts of Power Sector Reforms

Mr Sachin Oza notes that in Gujarat, power sector reforms are positive for domestic users. As the quantity and timeliness of electricity supply improve, there is a better management of water and power. While water wastage has gone down as a result of the Jyotigram scheme, groundwater abstraction for irrigation has remained the same.

Mr Divyang Waghela agrees that there is an overall positive feedback from domestic users about getting 24-hour power supply, as they are able to set up small-scale household enterprises that require 3-phase electricity. The farming community still has issues with quality and reliability of supplied power, as 8-hour power supply is not guaranteed.

While the scheme has no impact on groundwater abstraction, metering of farm power supply is there only for 50% of the agricultural consumers. This negates the effectiveness of rational power supply for such consumers, who continue to pay on the basis of connected load.

Prof. PK Viswanathan observes that Jyotigram technical transmission losses have declined, but administrative losses (power theft) have increased. Even after the power sector reforms, the Government has not been able to meter all the well connections. Almost 50% of connections have been metered, but it varies from region to region. In water-scarce regions of the State, farmers are not able to appreciate the positive side of metering. Farmers believe that under the metered regime they have to pay more for the electricity.

Prior to 2003, the farmers in Gujarat were supplied 8-hour, three phase power supply for agricultural uses and 24-hour single phase supply for domestic purposes from the same feeder. This meant that the farmers could tap single phase electricity from the feeder for running low capacity pumps. Jyotigram Yojna involved separating the feeder line for agriculture from that for domestic consumers. Under the scheme, the government wanted to ensure 24 hour, three phase power supply to the domestic sector, in order to encourage rural small industries. But, fearing that a common feeder line for both agriculture and domestic sectors would enable farmers to take advantage of three phase supply to run agricultural pumps, a separate feeder line was established for agriculture.

The JyotigramYojna, which is now being adopted by a few other States with modifications, is being praised for controlling groundwater overdraft. However, the available evidence suggests that such approaches may be counter-productive. It was widely argued that this rationing of power supply to agriculture would cut down groundwater overdraft. But, farmers in many situations were found to be circumventing the problem of restricted power supply, by shifting to higher capacity pumps and under-reporting their connected load to the power supply utility. The ultimate result is that they often use more electricity than in the earlier situation. In order to reduce power thefts, the power distribution companies are resorting to frequent raids in the rural areas by checking the connected load of the pumps used for energizing the wells.

Nevertheless, Jyotigram had a significant positive impact on the quality and reliability of power supply in agriculture, and the number of cases of burn out of motors has come down remarkably. Power supply schedule is maintained, and voltage fluctuations remain quite low. Good quality power supply means better quality irrigation to crops.

2. Environmental Performance

The inter-basin water transfers to the water-scarce regions of central and north Gujarat have had positive impacts in the form of enhanced groundwater recharge, reduced energy use for groundwater pumping, and dilution of minerals in groundwater (with positive health benefits). These results can provide good lessons for other arid and semi-arid regions of the world, particularly where farmers are using groundwater intensively for agriculture, and are struggling to reduce over-exploitation. The ecological and environmental benefits resulting from the perennial flow of water in the region's rivers would surprise many environmentalists. With the introduction of flows in the otherwise environmentally stressed rivers in north and central Gujarat, groundwater table in the surrounding areas have come up, and the TDS levels in the groundwater has reduced significantly.[66)]

Mr Divyang Waghela,[67)] the CEO of Coastal Salinity Cell, Ahmedabad observes that good rainfall recent years has led to good supply of water through canals. He cautions that groundwater quality in command areas for drinking water is questionable and that there is a huge electricity cost in supplying Narmada water to Kachchh and Saurashtra. Also, there is a concern about whether Narmada water supply will meet growing domestic (including livestock) water demand in the region. Therefore, multiple sources of water supply need to be explored in those areas.

Professor Rohit Desai notes that there are issues of sustainability in irrigation services delivered under SSP. The water charges are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Land prices are increasing in the command areas. Agricultural land is difficult to get and getting

66) Modi, N. 2011. Convenient Action: Gujarat's Response to the Challenges of Climate Change. New Delhi: McMillan Press.
67) Interview with Mr. Divyang Waghela, the CEO of Coastal Salinity Cell, Ahmedabad, 01 February 2013.

fragmented because of the growth in industry. There should be ceiling on conversion of agricultural land for non-agricultural purposes, especially for setting up of industries. Land fragmentation can become a major issue for irrigation management in the command area. He added that Narmada water has yet to reach Kachchh. The branch canal for Kachchh is under construction. Once it reaches there, it will improve the agricultural situation.

While there is criticism that the SSNNL is diverting more water to industrial uses in view of the greater willingness of industrial consumers to pay for water, Dr Joshi pointed out that Narmada Water Disputes Tribunal had awarded 9.0 million acre feet (MAF) of water to Gujarat (10,800 million m^3). Out of this 1.06 MAF can be for non-agricultural uses, and the remaining 7.94 MAF for irrigation in the command areas. Considering an irrigation system efficiency of 60%, 4.76 MAF is available at farm level. From 1.06 MAF, 0.86 MAF is given for domestic water supply and the rest for industries. Once demand from industries is greater than their allocation, no additional requests from industries are entertained.

It was further pointed out that, initially water rates from SSP were Rs 1 per 1,000 litre (KL) for domestic uses and Rs 6 per KL for industrial uses. Every year the rates are increased by 10%. Presently, water rates are around Rs 5-6 per KL for domestic uses and Rs 16 per KL for industrial uses. Rates for domestic uses are very low, considering that they are willing to pay more. Even upcoming residential townships are willing to pay for water at industrial rates.

2-1. Impacts of Check Dams for Water Harvesting

Mr Divyang Waghela observed that historically, Gujarat experienced high (spatial and temporal) variability in rainfall, with South Gujarat being the water surplus region. In the last 10 years, as a result of water sector initiatives such as the construction of large numbers of check dams in villages and adoption of MI systems, the water situation has improved, especially in Saurashtra. Many consecutive years of good monsoon helped in bringing sufficient rainfall. However, in 2012, rainfall was below average which led to reduction in cropped area especially in Saurashtra (by over 40%). This resulted in huge set back to agricultural growth especially in Saurashtra and Kachchh. Thus, a single bad rainfall year was able to undo the gains from the initiatives for improving water security in the state. Hence, there are concerns about long-term sustainability of irrigated production in these fragile environments.

Another important issue is the scale at which the water harvesting structures are built in different basins of Saurashtra and Kachchh. The structures are not planned as per the catchment hydrology and regular de-silting is not done. As a result, there are no major benefits from these interventions. In fact it has led to more conflicts between upstream and downstream communities.

Prof. Rohit Desaiis of the opinion that, while water harvesting has done a lot of good to the local farmers, there has to be some optimum level of water harvesting at the basin scale. Some regulation on building of water harvesting structures which capture the natural runoff has to be exercised at the basin level. While several NGOs have participated in the water conservation movement in Saurashtra, they need to be evaluated in terms of their experience and technical expertise for carrying out such works.

Prof. PK Viswanathan[68)] says that check dams have been successful in water harvesting especially during wet years. He noted that tank rehabilitation has not worked. It has been promoted as a uniform approach without understanding the catchment hydrology.

68) Interview with Prof. PK Viswanathan, Gujarat Institute of Development Research, Ahmedabad, 31 Jan 2014.

Wherever rains are good and water is abundant, impacts of water harvesting on groundwater recharge is visible.

There are no scientific data available to show that the groundwater recharge scheme in Saurashtra had actually resulted in improved aquifer conditions in the region. The data on water levels for Saurashtra region (pre and post monsoon) available from Central Ground Water Board (CGWB), which monitors groundwater level trends across the state, shows rise in water levels pre monsoon, during 2008 as compared to the year 2000.[69] However, this analysis did not segregate the effect of good monsoon received in four consecutive years on the natural recharge. Hence, there is no conclusive evidence to the effect that the recharge scheme had actually helped address the region's groundwater depletion problems.

2-2. Performance of Micro Irrigation

Mr Divyang Waghela feels that setting up of GGRC was a major institutional innovation to address the issue of low adoption of MI in the state of Gujarat. GGRC is promoting MI in the State but whether it is used by farmers for the intended purpose of water saving remains questionable. The technology is there, but the demand for MI has not been properly diagnosed. For example, no attention has been paid to the cropping pattern in the target regions, water quality issues and irrigation scheduling. The biggest roadblock in MI adoption is that there are no post-installation services. Mr. Divyang feels that there is some water saving as a result of MI adoption at the field level, but the system is not used properly by about 90% of the farmers, who are not aware of the benefits and the way to go about doing MI.

Further, no major intervention is undertaken on Integrated Nutrient Management. For instance, farmers in Saurashtra spend almost Rs.16-17,000 per acre as input cost for cotton, mainly on fertilizers and pesticides. In Saurashtra, the area under sugarcane, which is a highly water intensive crop, has grown to around 10% of the total cropped area. This is a concern from a resource sustainability point of view. Farmers are not using drips for sugarcane. Crop diversification is also less with almost no area under horticulture crops. Thus there is little scope for further promotion of MI in the region.

Prof. PK Viswanathan notes that post technological adoption services are not provided. He notes that adoption of MI using public/community based tube wells has led to social exclusion.

2-3. Performance of Groundwater Management Initiatives

Prof. Rohit Desai says that to regulate groundwater over-abstraction, a proper institutional mechanism is required. As illegal water trading, though limited in terms of aggregate volume of water transferred, is rampant between rural areas and urban areas, water rights have to be established for different sectors and users within each sector.

Water cooperatives can be formed and some norms for volumetric water withdrawal and use can evolve in the years to come.

Prof. PK Viswanathan adds that groundwater management initiatives in Gujarat have focused only on technical solutions. Groundwater recharge does not mean that those who need water will get it. One's effort might benefit resource rich farmers as groundwater remains in the private domain, attached to land ownership rights.

An increase in surface water allocation through SSP may not lead to a reduction in groundwater usage in some of the over-exploited regions such as north Gujarat.

69) *Shah, T., Gulati, A.K., Jain, P.R.C. 2009, 26 Dec. Secret of Gujarat's Agrarian Miracle after 2000. Economic and Political Weekly.*

When farmers get more water they tend to grow more water intensive high-value crops. Therefore, even adoption of MI may not lead to water saving at the farm level.

In the long run, water rights need to be established in the case of groundwater resources, if sustainability is to be achieved.

3. Social Performance

3-1. Performance of Pani Samiti (PS) and Water Users Associations (WUA)

Mr Divyang Waghela pointed out that in many regions the communities have abandoned traditional water sources because they expect that the Narmada water will meet their requirements. However, the Narmada water is supplied once in every 3-4 days, and the villages have to depend on poor water quality water sources, such as tankers, if they do not take care of their local water sources. The Pani Samiti were formed and given legislative power to manage village water supply. The Committee is supposed to receive 30% of the total O&M cost from the Finance Commission.

He feels that, in order to address inter-village conflicts and to take care of the management of the main system (including prevention of thefts), federations of village water supply committees (PS) need to be formed to manage the regional water supply scheme.

The pani samitis need to be evolved, and they require capacity building on their rights. Presently, PS is like a political entity, as it is a sub-unit of the Gram Panchayat. The PS could be promoted as a local institution for overall water resource management in the village.

Water Tax collection has improved after formation of PS. This fund goes to GP. However, the money is not being used to cover the water supply system maintenance. Water demand management still needs priority in the command areas especially on promoting low water intensive crops.

Prof. PK Viswanathan agrees that policy reforms in surface irrigation are not effective in terms of water distribution and management. While WUAs may be managing the supply, the water pricing system is not proper. There are about 4,000 WUAs in Gujarat, out of which around 10-15% are working well. Each WUA takes care of one minor system serving around 300-400 ha of area. However, there are issues with the scaling up of PIM activities.

Government provides support for carrying out software activities mainly for organizing training program for WUAs. The SSNNL is paying Rs 880 per ha for WUA formation to the NGOs which participate in PIM initiatives. Money for canal rehabilitation comes separately. But, the State Water Resources department is paying less (Rs 400 per ha).

Federation can be involved for capacity building of new WUAs committee. DSC is putting its own resources for second generation capacity building.

The IMT [Irrigation Management Transfer] Act in Gujarat doesn't make it mandatory to have all the farmers served by a single minor to be part of a WUA for getting water. Even if 51% of the farmers are in WUAs, all farmers will get water. Further as the IMT Act, WUAs can charge 30% more than the rates kept by ID. WUAs also get 50% rebate from the irrigation department if they pay the entire irrigation charge on time. As per the Act, 60% of the money saved by WUAs is spent on O&M and the rest on administration.

3-2. Performance of Participatory Irrigation Management (PIM) and Watershed Management schemes

Mr Sachin Oza DSC tried integrated watershed management and PIM in canal command areas. As compared to other States, water sector reforms have led to better results in Gujarat. In watershed programs, there is always competition between livelihoods and natural resources management. For instance, there is a shift in cropping pattern from maize to cotton, using more water and compounding water quality problems (agricultural runoff) after obtaining good results from watersheds. In Sabarkantha, for instance, the number of bore/tube wells has increased with improved recharge in the watersheds. Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having an impact on resource conservation. Thus, the policy needs to better addresses resource sustainability concerns.

There is no clear water allocation from groundwater and surface water irrigation schemes. In the absence of clear water entitlements and water rights, water is inefficiently used or used by those who pay more rather than by who need it more. DSC started a dual accountability system where the Irrigation Department and the WUA give clear information to each other.

While there has not been any initiative from the government to introduce volumetric pricing of water in the command areas, DSC is promoting volumetric pricing of water in its projects. Now farmers pay on the basis of each watering they receive. Fifty-six NGOs are promoting participatory irrigation management in Narmada canal command areas.

However, IMT Act is silent on formation of higher-level institutions, such as at the distributary level and project level committees for irrigation management. These institutions are important for managing irrigation water at system level.

4. Overall Performance

To assess the role of water in green growth in Gujarat, 20 professionals having profound knowledge on the various reforms in the water and energy sectors and projects in Gujarat were selected as respondents to the questionnaire. They were asked detailed questions about their particular water project; state-driven institutions; market-oriented institutions; community-centered institutions; and project performance.

As per the expertise of the respondents, inputs were obtained on the following projects:

1) Sardar Sarovar Project (SSP);
2) Sardar Patel Participatory Water Conservation Project (SPPWCP);
3) Community Managed Water Supply Project (CMWS);
4) Groundwater (GW) Recharge efforts;
5) promotion of Micro-Irrigation (MI);
6) Participatory Irrigation Management (PIM); and
7) Use of wastewater for irrigation (WW-Irri).

Performance results from the analysis of questionnaires are presented below.

As per the existing legal framework in the State, surface and groundwater are treated differently. Further, the water law does not allow private rights over water, and currently water is managed as State or common property.

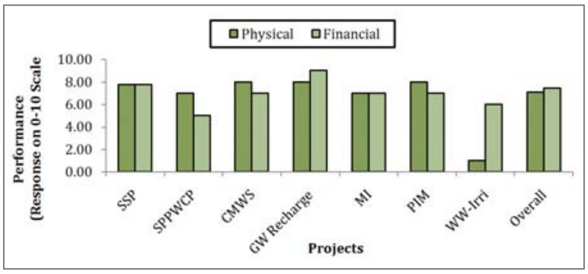
The respondents felt that water laws in the state were effective in promoting green growth, and the State government got a high rating for implementation of various reforms in the water sector. However, the respondents indicated that water laws were less effective in addressing: conflict resolution among stakeholders; ensuring accountability of various stakeholders (officials, water suppliers, users); promoting integrated water resources management; and encouraging private sector participation in the water sector.

The selection of any new water project in the State is guided by multiple criteria that include financial, equity and ecological considerations. In most of the projects, however, water is priced below the production and supply cost, leading to only partial cost recovery. However, water tariffs for industry and the commercial sectors are substantially higher than the irrigation and domestic sectors.

Overall, the respondents indicated that policy initiatives for water resources development and management in the State were effective, as were the water regulation and directives. The respondents also gave a high rating to the State encouragement of inter-basin and inter-sectoral water transfers, as it has really promoted agricultural growth in the state. Policies related to public participation were considered less effective.

Water administration in the State is mainly organized on the basis of administrative divisions (geographical divisions). Though there are several departments in charge of water supply in the State, the overall operational ability of water administration in the State was considered good. The policies and water administration in the state were rated as reasonably good in the following areas: making adequate and reliable data available on projects for water-related decision making; and promoting green or innovative technologies. However, their effectiveness in accountability arrangements both within formal and outside formal water administration was rated less than satisfactory.

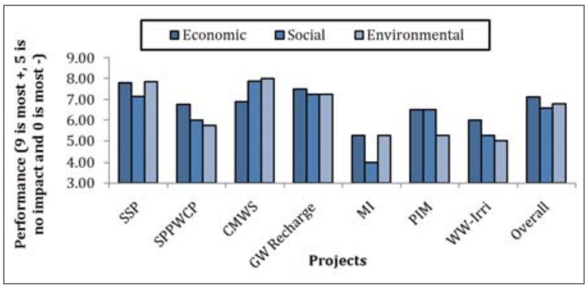
With regard to water projects overall, both physical and financial performances received satisfactory ratings (Figure 7). On these two attributes, projects such as SSP, groundwater recharge intervention, CMWS, MI and PIM were found to be quite effective.



Source: Authors' analysis based on respondents' inputs

<Figure 7> Physical and Financial Performance of Various Water Projects

Overall, all the projects have positive economic, social and environmental outcomes (Figure 8). However, project interventions related to use of MI and use of wastewater for irrigation have not made as significant an impact as compared to other projects. In fact, MI was found to have a negative social impact. Contrary to this, in view of the respondents, SSP and CMWS have had the highest positive impact on economic, social, and environmental outcomes.



Source: Authors' analysis based on respondents' inputs

<Figure 8> Economic, Social and Environmental Performance of Water Projects

V. Lessons Learned and Conclusion

There is no question that access to reliable water supplies for domestic, industrial, and agricultural purposes has fueled a robust economic growth in Gujarat State, India since 2000. To ensure that water has been an engine of growth, the Government of Gujarat implemented exactly the types of policies recommended in the Water and Green Growth policy framework under "water as an engine of growth":

- Promote technology transfer and invest in innovative tools to improve water and energy efficiency
- Revitalize and better use urban waterways and waterfront areas
- Adopt a package of economic instruments, including demand management and incentives for recycling and reuse of water
- Balance green and grey infrastructure among the competing uses – e.g., energy, industry, municipal, domestic, agriculture

In the economic sphere, the case study demonstrates a good example of green growth. However, the other two dimensions of green growth, while present in the policy mix, have not been as strong: protection and conservation of water resources; and water for an improved quality of life.

Some of the lessons learned and challenges still facing the State of Gujarat as it moves forward with its water reforms are described below.

Better coordination is needed among government departments responsible for water management.

The State's multi-pronged approach has been successful in providing domestic water supply security, decentralizing irrigation management and promoting micro-irrigation (MI), raising awareness regarding water recharge, and separating electric supply between domestic and agricultural feeders. However, while all of the schemes are good, and have made a difference where they are working well, they are not integrated. Different departments are running different programs, but without any coordination among them.

There are overlaps of authority and control exercised by various water related line agencies of the State government. For example, the Department of Narmada and Major Irrigation and the Department of Water Resources are responsible for activities related to water conservation and minor irrigation schemes within the canal command areas, including groundwater based schemes. Similarly, the Gujarat Water Resources Development Corporation Ltd. (GWRDC) has a role within the command areas of canals for groundwater development and utilization. This overlap of authority and jurisdiction creates confusion among water resources and services managers, which leads to inefficiency and delay in implementation of the projects. Clear delineation of responsibilities and approaches to better coordination are needed. This could be done at the working level.

Similarly, there is no coordination between the wing of the Dept. of Water Resources, which implements reservoir projects (medium and minor) and the wing which implements the small water harvesting schemes, which leads to over-appropriation of water in the basin. The situation is worse when it comes to coordination between the rural development department, which implements watershed development program, and the Dept. of Water Resources. They work at cross purposes, with the actions of the former affecting the performance of the latter.

Ecosystem needs should be systematically addressed.

In watershed programs, there is always competition between livelihoods and natural resources management.

In treated watersheds, there has been a shift in cropping patterns to more water-intensive crops (from maize to cotton), using more water and causing water quality problems (from agricultural runoff) that impact watersheds. Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having a negative effect on resource conservation.

Moreover, while water harvesting has done a lot of good for the local farmers, there has to be some regulation at the basin level on the number of such structures, so as to obtain the optimum level of water use at the basin scale. The structures need to be planned according to catchment hydrology, and they require regular de-silting. Wherever rains are good and water is abundant, the impacts of water harvesting on groundwater recharge are visible. However, in drought periods adequate flows to meet ecosystem needs have to be maintained. Farmers who are using MI systems need to be trained to conserve water, because they are not aware of the benefits and the ways to go about saving water. Thus, Gujarat needs a policy that addresses resource sustainability concerns over time. This will require engagement of the communities and farmers who live in the watershed and along the rivers. A regulatory framework for development and management of water resources is needed at the state level, with appropriate institutional mechanisms to enforce it at the level of hydrological units.

Water demand management still needs priority in command areas, especially for promoting low water intensive and water efficient crops.

Communities have to be empowered to manage water systems.

The village water committees require capacity building in operation and maintenance, and they need to understand their rights and responsibilities. These committees could be promoted as a local institution for overall water resource management in the village. They need to work closely with WASMO and Water User Associations to get needed support. It is important that there is gender balance in the water committees, as it is the women who can take care of domestic water and sanitation facilities and who care about them most. Skills required for hand pump repair, for example, can be taught to relatively uneducated people.

For a pani samiti to function well it should be formed at the initiative of the people, be able to generate resources, have the skills required, function democratically, be accountable to the people and enjoy a reasonable degree of autonomy. Besides managing the infrastructure installed by the government, the pani samiti should also protect other sources of water that the village relies on, such as ponds, lakes, and wells. The committee should ensure that sufficient water is set aside for drinking purposes, and thereafter allocate water judiciously for agriculture and other uses.

As regards groundwater conservation measures, initiatives such as MI promotion, in Gujarat have generally focused on technical solutions, and have not sufficiently considered the needs of poor farmers. Whereas, groundwater recharge schemes do not necessarily help those who need water, and might end up benefiting resource rich farmers, as access to groundwater is attached to land ownership rights. In cases where MI is based on public/community tube wells, there has been social exclusion. Contrary to this, SSP and community-managed water supply have had a positive impact on economic, social and environmental outcomes. Promotion of MI through the GGRC needs to consider social aspects of micro irrigation schemes, not only economic aspects. Groundwater recharge schemes should also be concerned with equitable distribution of the newly available water amongst the communities. These would be possible only if local community institutions are capacitated and sufficiently empowered to play an effective role in the governance of water at the local level.

Water tariffs should be rationalized.

At the village level, water tariff collection has improved since the formation of the village water committees. However, the fund goes to the gram panchayat, and the money is not necessarily used to cover the water supply system maintenance. The pani samitis should be responsible for collecting the fees and using them for operation and maintenance requirements.

In agriculture, there has not been a government effort to introduce volumetric pricing of water in the command areas. Cost recovery would be greatly improved if farmers paid on the basis of each watering they receive. Moreover, the water charges under SSP are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Water cooperatives can be formed at various levels in the hydraulic system, and some norms for volumetric water withdrawal and use can evolve in the years to come.

Water rights need to be defined.

There are no clear rights or entitlementsfor groundwater or water allocated from surface irrigation schemes. In the absence of well-defined water entitlements and water rights, the opportunity cost of using water is very small in most situations. Water is inefficiently used in agriculture for growing water-inefficient crops, or appropriated by those who pay more rather who need it more. Over and above the issue of efficiency, there are greater concerns of growing inequity, particularly in the context of groundwater. With resource depletion and rising cost of drilling wells, groundwater is increasingly becoming inaccessible to the resource poor small and marginal farmers in arid and semi-arid areas of the state. Water rights need to be established in volumetric terms for groundwater resources, which are still in the open access regime and where the situation is more serious, if equity and sustainability have to be addressed.

Proper follow up is needed after services are provided.

In many cases, adoption of projects, such as MI or PIM, are not followed up by post technological adoption services.

There were many examples of facilities, such as overhead tanks and hand pumps, not functioning, and sanitation facilities not being used. Several respondents indicated that the villagers were not trained in operation, maintenance and repair and did not understand the connection between clean water, sanitation and disease. It is essential that proper follow up (similar to extension services) be provided to ensure that installed facilities are used and maintained. Similarly, farmers, who install drip and sprinkler irrigation systems in their farms, are trained in irrigation scheduling.

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Interview 1

Gandhinagar Domestic Water Supply

There is a three-tier structure for implementing domestic water supply projects in Gujarat. The Gujarat Water Supply and Sewerage Board is the parent body formed in 1978, Gujarat Infrastructure Company limited is its subsidiary formed in 2000 for building the water distribution infrastructure under the Narmada & Mahi Canal based regional water supply scheme, and WASMO is a social mobilizing wing formed in 2002. As per the State policy, surface water has to be supplied for drinking purpose in rural areas as it is far more dependable than local groundwater based sources. Under the state-wide water grid project, development of dual sources is promoted in target villages. They include mini and individual schemes based on groundwater and regional water supply scheme based on surface water. Fifty two reservoirs have been identified in Saurashtra and Kachchh to supply surface water for drinking purpose, which would augment the supplies from Narmada and Mahi. In some instances, tankers were also provided mainly to meet the water demand for livestock. Rainwater harvesting has also been promoted. More than 14,000 tankas (roof top rainwater harvesting tanks) have been constructed. Water harvesting for recharge of shallow aquifer has also been promoted by WASMO, which promotes the village water supply committees. Structures such as check dams and pond de-silting are being promoted to augment the local sources. SCADA (supervisory control and data acquisition) is being implemented for main system management in some parts of the regional water grid to control the pressure, detect leakages etc., but there are problems. Given the fact that there is widespread scarcity of water for agriculture and livestock, water theft from the air valves in the main system along its course has been noticed. This is mainly by the cattle rearing community in Saurashtra and Kachchh. PaniSamitis (PS) are able to manage water supply system within the village; but their involvement at system level (through formation of federation) is not possible as it may lead to conflicts between two different communities (Mainly maldharis who are mostly Hindus and cattle grazers who are Muslims). Further, there is concern that federation of PSs' may become a political entity. According to him, the establishment of water grid has improved the domestic water security in the villages. It has especially helped in increase in dairy production in North Gujarat and Kutch. The Tata Institute of Social Sciences has been given an assignment to study the impact of regional water supply.

Interview 2

Gandhinagar SardarSarovar Project (SSP)

The SSNNL, which is implementing the SSP, is unique in many ways. First: SardarSarovar Narmada Nigam Limited (SSNNL) is a special purpose vehicle registered as a company which can generate its own resources through public deposits (Deep discount scheme were introduced). After the World Bank withdrew its financial support to the project in the wake of the report of Morse Commission, the Government of Gujarat has been able to continue SSP projects by mobilizing its own resources. Further, SSNNL is the only irrigation agency in the country having people in the senior management from multiple disciplines--environment and forests, agricultural economics. Second, is the reforms related to land acquisition and compensation. In most of the projects (especially related to irrigation) there is delay in project completion due to problems in acquisition of land. Till 2010, only 17,000 ha of land (42.5% of the required) were acquired for SSP over a period of 30 years. With the introduction of new policy in 2010, compensation for land acquisition is being paid as per the market rate. Over and above the existing land prices, 30% extra is paid to the evictee. As a result, in last 3 years, 17,000 ha of more land had been acquired. Now, only 6,000 ha land remains to be acquired. Before the 2010 policy initiative with regard to the land acquisition, there were about 60,000 cases related to land acquisition pending in the courts. After the adoption of the new land acquisition policy, there are no court cases as the farmers and other land owners are fully satisfied with the compensation being paid.

According to Dr Joshi, the main problem in land acquisition is that unless farmers see water in parent canal (either branch, distributary, minor or sub-minor) they do not give land. Therefore, once the construction of distributaries is completed, acquiring land for minors would not be a problem. Major reason for non-completion of tertiary system (sub-minors) is that farmers do not want to give up their land for sub-minors (water courses) as no compensation is paid for it. As a result farmers are directly lifting water from minors. In order to encourage completion of tertiary supply system, a new policy approach is adopted by SSNNL. This gives farmers the option of having either an open channel or an underground pipeline in the place of the sub-minor and field channels. In case farmers prefer underground pipeline, they do not have to give land. Negotiations for laying underground pipeline are done with WUAs not with individual farmers. Presently, it is under trial at some locations in the command. However, as pointed out by Dr Joshi, in many regions underground pipeline won't work under gravity. It is estimated that about 60% of the area is suitable to be irrigated through gravity flow based underground pipeline. In the remaining areas, installation of pressurized pipes (underground) is proposed. However, in such areas adoption of MI has been made mandatory to stop the wastage of water, as pressuring the flow would be expensive. Also, O&M of underground pipeline is to be done by farmers. As a result there is not much demand by farmers for a pressurized underground pipeline system.

While there is a criticism that the SSNNL is diverting more water to industrial uses in view of the greater willingness on their part to pay for water, Dr Joshi pointed out that Narmada Water Disputes Tribunal had awarded 9.0 million acre feet (MAF) of water to Gujarat (10,800 MCM). Out of this 1.06 MAF can be for non-agricultural uses, and remaining 7.94 MAF for irrigation in the command areas. Considering an irrigation system efficiency of 60%, MAF is available at farm level. An additional 3 MAF (2.7 MAF from groundwater and 0.3 from en-route rivers) is provided in the command areas. Water allocation and planning is done as per the 12 MAF of water availability. From 1.06 MAF, 0.86 MAF is given for domestic water supply and rest for industries. Once demand from industries become more than allocation, no additional requests for claiming water from industries is entertained. It was further pointed out that, initially water rates from SSP were Rs 1 per KL for domestic uses and Rs 6 per KL for industrial uses. Every year the rates are increased by 10%. Presently, water rates are around Rs 5-6 per KL for domestic uses and Rs 16 per KL for industrial uses. Rates for industries are very low considering they are willing to pay more. Even upcoming residential townships are willing to pay for water at industrial rates. On the issue of handling water theft (by farmers) along the canal alignment, Dr Joshi pointed out the new Irrigation and Drainage Act of 2013. The earlier Irrigation and Drainage Act (when Gujarat was part of Bombay State) was derived from colonial framework. Subsequently, improvements were made in the Bill. Irrelevant provisions were dropped and many more provision, particularly for giving more legal authority to the irrigation departments (mainly to punish those tapping illegal water) have been added. However, though the State Assembly has passed the bill, it has not been notified due to fear of losing votes in the rural areas.

Disclaimer: the views expressed in this interview are the personal opinion of Dr MB Joshi, and do not necessarily represent the views of the SSNNL, Gandhinagar.

Interview 3

Ahmedabad Decentralized Water Harvesting

Historically, Gujarat experienced high (spatial and temporal) variability in rainfall with South Gujarat being the water surplus region. In last 10 years, due to various water sector initiatives (like the construction of large number of check dams in villages and adoption of micro irrigation systems), water situation has improved especially in Saurashtra. Many consecutive years of good monsoon helped in this. The region recorded highest per acre cotton yield in the State. However, in 2012, rainfall was below average which led to reduction in cropped area especially in Saurashtra (by over 40%). This resulted in huge set back to agricultural growth especially in Saurashtra and Kachchh. Thus, a single bad rainfall year was able to undo the gains from the initiatives for improving water security in the state. Hence, there are concerns about long term sustainability of irrigated production in these fragile environments. Another important issue is the scale at which the water harvesting structures are built in different basins of Saurashtra and Kachchh. The structures are not planned as per the catchment hydrology and regular de-silting is not done. As a result, there are no major benefits from these interventions. In fact it has led to more conflicts between upstream and downstream communities.

Micro-Irrigation

MrDivyang feels that setting up of Gujarat Green Revolution Company (GGRC) was a major institutional innovation to address the issue of low adoption of MI in the state of Gujarat. GGRC is promoting MI in the State but how far it is being used by farmers for the intended purpose (water saving) remains questionable. Technology is there but demand for MI has not been properly diagnosed. Especially, no attention has been paid to the cropping pattern in the target regions, water quality issues and irrigation scheduling. The biggest roadblock in MI adoption is that there are no post-installation services. Divyang feels that there is some water saving happening through the use of MI (at the field level), but the system is not used properly by the adopter farmers. About 90% of the farmers are not using it to conserve water because they are not aware of the benefits and the ways to go about doing it. Further, no major intervention is undertaken on Integrated Nutrient Management. For instance, farmers in Saurashtra spend almost Rs.16-17,000 per acre for inputs to the cotton crop, mainly on fertilizers and pesticides. In Saurashtra, the area under sugarcane, which is a highly water intensive crop, has grown to around 10% of the total cropped area, which is a concern from resource sustainability point of view. Farmers are not using drips for sugarcane. Crop diversification is also less with almost no area under horticulture crops. Thus there is no further scope for promotion of MI in the region.

Sardar Sarovar Project

Good rainfall in recent years has led to good supply of water through canals. However groundwater quality in command areas, especially for the purpose of drinking water, is questionable. There is a huge electricity cost in supplying Narmada water to Kutch and Saurashtra. Also, there is a concern about whether Narmada water supply will meet growing domestic (including livestock) water demand in the region. Therefore, multiple sources of water supply need to be explored in Kutch and Saurashtra. WUAs are formed only in about 10% of the command areas. Further, there functional capabilities remain a big issue.

Pani Samiti (PS) and Water Users Associations (WUA)

In many regions, communities have abandoned their traditional local water sources due to the expectation that Narmada water will meet their requirements. But water from Narmada is supplied once in 3-4 days. As a result they have to depend on poor water quality source, such as tankers. Water demand management still needs priority in command areas especially on promoting low water intensive crops. As per the GR 2002, PaniSamiti were formed and given legislative power to manage village water supply. It receives 30% of total O&M cost from the 12th Finance Commission. He feels that in order to address the inter-village conflicts and to take care of the management of the main system (including prevention of thefts), federations of village water supply committees (PS) need to be formed for the regional water supply scheme. PS needs to be evolved and require capacity building on their rights. Presently, PS is more a political entity as it is a sub-unit of the Gram Panchayat (GP). He feels that they could be promoted as a local institution for overall water resource management in the village. Water Tax collection has improved after formation of PS. This fund goes to GP. However, the money is not being used to cover the water supply system maintenance.

Power Sector Reforms (Jyotigram)

Overall, there is a positive feedback from domestic users of getting 24-hour power supply, as they are able to set up small-scale household enterprises which require 3-phase electricity. Farming community still has issues with quality and reliability of supplied power as 8-hour power supply is not guaranteed. The scheme has no impact on ground water abstraction. But, metering of farm power supply is still not available for more than 50% of the agricultural consumers, which negates the whole idea of rationale power supply.

Interview 4

Ahmedabad Overall

The most important reforms in Gujarat water sector relates to: irrigation management transfer (IMT) to users; awareness regarding water recharge (harvesting and pond deepening); formation of the GGRC as a special purpose vehicle for promotion of micro irrigation (MI); electric supply feeder separation; and domestic water supply security. All the schemes are good, but they are not integrated. Things are moving in silos. Different departments running different programs but without any coordination among them.

Participatory Irrigation Management (PIM) and Watershed Management

DSC tried integrated water resources management (IWRM) in canal command areas, integrating watershed management program and PIM. As compared to other States, water sector reforms have led to better results in Gujarat. In watershed programs, there is always competition between livelihoods and natural resources management. For instance, there is a shift in cropping pattern from maize to cotton, using more water and causing water quality problems (agricultural runoff) after obtaining good results from watersheds. In Sabarkantha, for instance, number of bore/tube wells has increased with improved recharge in the watersheds. Thus, policy which addresses resource sustainability concerns is missing.Also, land use changes (especially conversion of agricultural land for non-agricultural uses) are having an resource conservation. No clear water allocation from groundwater and surface irrigation schemes. In absence of proper/clear water entitlements and water rights, water is inefficiently used or used by those who pay more rather who need it more. DSC started dual accountability system where Irrigation department and WUA give clear information to each other. There hasn't been any initiative from the government to introduce volumetric pricing of water in the command areas. But, DSC is promoting volumetric pricing of water in its projects. Now farmers pay on the basis of each watering they receive. Fifty six NGOs are promoting PIM in Narmada canal command areas. There are about 4,000 WUAs in Gujarat out of which around 10-15% would be working well. Each WUA takes care of one minor canal serving around 300-400 ha of area. However, there are issues with the scaling up of PIM activities. Government provides support for carrying out software activities mainly for organizing training program for WUAs. The SSNNL is paying Rs 880 per ha for WUA formation to the NGOs which participate in PIM initiatives. Money for canal rehabilitation comes separately. But, the State Water Resources department is paying less (Rs 400 per ha). Federations can be involved for capacity building of new WUAs committee. DSC is providing its own resources for second generation capacity building. The Irrigation Management Transfer [IMT] Act in Gujarat doesn't make it mandatory to have all the farmers served by a single minor to be part of a WUA for getting water. Even if 51% of the farmers or area is there in WUAs farmers will get water. Further as the IMT Act, WUAs can charge 30% more than the rates kept by the Irrigation Department. WUAs also get a 50% rebate from the irrigation department if they pay the entire irrigation charge on time. As per the Act, 60% of the money saved by WUAs is spent on O&M and the rest on administration. However, the IMT Act is silent on formation of higher level institutions, such as at distributary level and project level committees for irrigation management. These institutions are important for managing irrigation water at system level.

Power Sector Reforms

In Gujarat, power sector reforms are good especially in context of domestic users. As the quantum and timeliness are taken care, there is a better management of water and power. Water wastage has gone down after Jyotigram. However, groundwater abstraction for irrigation has remained same.

Domestic Water Supply

Multi-village water supply schemes are not that successful unless you develop local sources. Water theft is rampant. Reliability of water supply is also a problem. There is a need for developing an institutional mechanism to make multi-village schemes functional.

Interview 5

Ahmedabad Overall

Prof Desai is of the opinion that in the past few years, the water scenario in Gujarat has improved due to good rainfall and water management efforts by Government of Gujarat through both decentralized water harvesting and large-scale water transfer to poorly-endowed regions by SSP. Per capita income in rural areas of water scarce north Gujarat is going up, owing to additional water for irrigation from Narmada. South Gujarat is getting prosperous due to soil fertility and ample reliable water supplies from Narmada. Additionally, Tata power is running a corporate social responsibility initiative, providing help to the rural poor, but their activities have not achieved desired outputs.

SSP and Inter-basin Water Transfer

Agricultural growth in Gujarat is primarily due to linking of rivers (through SSP) and growth in area under irrigated cotton and yield. The adoption of BT cotton and high yielding hybrid cotton in Gujarat has been very high in the recent past. SSP is yet to reach the desired level (water delivery system has not reached at the tertiary level). The problems of drinking water in the water scarce regions especially in North Gujarat and Kutch have been largely resolved. Further, because of the awareness created by WASMO, community-based RO plants have been adopted by many villages in remote coastal areas, and the problem of water scarcity is now not acute. The Sabarmati riverfront development project has created a good urban environment and people are willing to pay for the environmental services. For instance, the people are paying Rs. 10 per person for using the garden which has come up on the bank of the river, as part of the SRFDP. There are issues of sustainability in irrigation services delivered under SSP. The water charges are not in parity with inflation (last revised in 2005-06). These need to be increased or reviewed. Land prices are growing up in the command areas. Agricultural land is difficult to get and getting fragmented because of growth in industry. There should be a ceiling on conversion of agricultural land for non-agricultural purposes, especially for setting up of industries. If it is then equal expanse of agricultural land should be created elsewhere. Land fragmentation can become a major issue for irrigation management in the command area. Narmada water has yet to reach Kachchh. The branch canal for Kachchh is under construction. Once it reaches there it will improve the agricultural situation. Groundwater still remains the main source of irrigation in north Gujarat, Kachchh and Saurashtra regions. The over-dependence on groundwater can be reduced if all the south Gujarat rivers are linked with water-scarce north Gujarat basins. Legal provision for preventing water theft from canal (water lifting) is there but institutional mechanism for monitoring and control of theft etc. is lacking.

Power Sector Reforms

In rural areas, electricity has reached and has helped promote rural entrepreneurship. As a result households have been able to generate more income. However, there is no major impact on the groundwater abstraction for agricultural use.

Water Harvesting

He is of the opinion that while water harvesting has done a lot of good to the local farmers, there has to be some optimum level of water harvesting at the basin scale. Some regulation on building of water harvesting structures which captures the natural runoff has to be exercised at the basin level. While several NGOs have participated in the water conservation movement in Saurashtra, they need to be evaluated in terms of their experience and technical expertise for carrying out such works.

Groundwater Regulations

To regulate groundwater over-abstraction, proper institutional mechanism is required. As illegal water trading is quite rampant between rural areas and urban areas, water right have to be established for different sectors and users within each sector. Water cooperatives can be formed and some norms for volumetric water withdrawal and use can be evolved in the years to come.

Interview 6

Ahmedabad Power Sector Reforms (Jyotigram)

As per the Gujarat Electricity Regulatory Commission (GERC) study, after Jyotigram technical transmission losses has reduced but administrative losses (power theft) have increased. Even after the reforms, Government is not been able to meter all the well connections. Almost 50% metering has been done but it varies from region to region. In water-scarce regions of the State, farmers are not able to appreciate the positive side of metering. Farmers believe that under the metered regime they have to pay more for the electricity.

SSP

It may take more time to complete the tertiary system. Urban water supply has improved especially supply of good quality water and reliability.

Water Harvesting

Check dams have been successful in water harvesting especially during wet years. However, water harvesting becomes effective depending upon the feasibility. Tank rehabilitation has not worked. It has been promoted as a uniform approach without understanding the catchment hydrology. Especially in dark zones nothing has been working. Wherever rains are good and water is abundant, impacts on water harvesting on groundwater recharge is visible.

PIM

Policy reforms in surface irrigation are not effective in terms of water distribution and management. WUAs may be managing the supply but water pricing is not proper. Gujarat doesn't have a proper water policy. Water allocation policy is non-existing.

Groundwater management and MI

Groundwater management initiatives in Gujarat have focused only on technical solutions. Groundwater recharge doesn't mean that those who need will get water. One's effort might benefit resource rich farmers as groundwater remains in private domain (attached to land ownership rights). Increase in surface water allocation through SSP may not lead to reduction in groundwater usage in some of the over-exploited regions such as north Gujarat. When farmers get more water they grow more water intensive crops. Therefore even adoption of MI may not lead to water saving at the farm level. In the long run, water rights need to be established in the case of groundwater resources, if sustainability has to be achieved.

Micro-irrigation and GGRC

Post technological adoption services are not attended to. In case of adoption of MI on public/community based tube wells, lot of social exclusion is happening.

Water and Green Growth Case Study Report 8

Nepal

The Andhikhola Hydel and Rural Electrification Project

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About the Report

This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

AHREP Andhikhola Hydel and Rural Electrification Project
AKP Andhi Khola Project
BPCL Butwal Power Company Limited
CPI Corruption Perceptions Index
ETFC Electricity and Tariff Fixation Commission
GDP Gross Domestic Product
MHP Micro Hydropower
NPC National Planning Commission
NWP National Water Plan
NWRDC National Water Resources Development Council
NEA Nepal Electricity Authority
NER Net Enrolment Rate
NORAD Norwegian Agency for Development Cooperation
OECD Organisation for Economic Co-operation and Development
PPA Power Purchase Agreement
R&D Research and Development
ROI Return on Investment
SSRP School Sector Reform Program
SMEs Small and Medium Enterprises
UMN United Mission to Nepal
USAID United States Agency for International Development
VDCs Village Development Committees
WECS Water and Energy Commission Secretariat
WEC Water and Energy Commission

Executive Summary

This case study report analyses the impact of the Andhikhola Hydel and Rural Electrification Project (AHREP) on Nepal's green growth strategy. Following a New Institutionalist approach, it explores the economic, social, political, environmental, and technical "exogenous" factors which, together with Nepal's water-related institutional framework and relevant policy mix, shaped the successful implementation of this water-related project.

The report begins by placing the AHREP in its historical context and summarizing its basic features. Second, the external environment during the AHREP development period is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Statistics from the World Bank, OECD, and other sources, as well as survey results and expert interviews are used to analyze how exogenous factors influenced policies and institutions affecting the AHREP. Thirdly, the institutional change, focusing on applied policies of the project period, is examined, distinguishing between state-driven, market-oriented, and community-centered policies that framed the development and operation of the project. Consequently, the project's performance is evaluated in terms of economy, environment, and society; and overall lessons are drawn from the foregoing analysis.

Despite its great potential for hydropower production (due to its geographical conditions and ample water resources) Nepal remains in a state of energy crisis. Due to prolonged political instability and the accompanying lack of investment inflows, its energy potential remains largely unexploited. Due to Nepal's political, economic and technological inability to produce electricity on a large scale, several NGOs and aid programs have committed themselves to develop local renewable energy solutions to power the country's rural population. Small hydropower plants producing up to 100kW, called Micro Hydropower (MHP), are an important part of such renewable energy projects, and AHREP is a clear example of this kind of project.

The cost for the installation of AHREP scheme was $280.000, which is a relatively low investment. Sources of revenue for the sustainability of the scheme include electricity selling to the National Energy Agency and financial support from organizations such as the United States Agency for International Development (USAID) and NORAD. Local villagers contributed a 9% of the project's total cost, mainly in the form of labor supply and materials cost for the construction of the dam. The report traces how the initiative for the installation of AHREP scheme was accompanied by strong community engagement. The project team of the scheme was engaged directly with local leaders and population in order to identify their perceptions and views, explain the purpose and stages of the project, achieve strong collaboration and acceptance.Andhi Khola Multipurpose Water Users Association was one of the many local users' organizations and initiatives that were formed around AHREP, aiming to manage the irrigation system and maintain equity in water distribution.

The AHREP installation appears to perform very well in terms of cost efficiency, having the lowest average cost per kilowatt among the major small-scale hydroelectric projects in Nepal. But the socioeconomic improvements resulting from scheme were broader than that. A direct consequence of AHREP's operation since 1991 was an impressive increase of irrigated land in the area from 57 to 282 hectares; and it is expected that after the planned upgrade of the project, the total irrigated area will reach 599 hectares. Access to irrigation and electricity allowed

households and small-businesses to enjoy a wide range of benefits across various fields: (i) better health, (ii) better production quality and income, (iii) better conditions for education, (iv) more employment opportunities, and (v) more opportunities for local community development.

Although there was no formal environmental assessment during the planning of the project, the report finds that the installation of AHREP plant appears to have had little environmental impacts, largely because there is no storage involved and the headrace tunnel, the powerhouse and the tailrace are all beneath the earth. With reference to water status, various tests that were carried out at various locations yielded a satisfactory level of quality. Moreover, the settling basin side to allow free passage of aquatic species had provided a fish ladder. No negative impact has been detected on the river's biodiversity, pest flora, and fauna. Finally, AHREP project has been complying the downstream environmental flow as per government acts and regulations when licenses were released, resulting in a release of adequate environmental flow during the year. No conflict in the downstream flow regime has been detected. Further, no sedimentation problem has been detected in the upstream of the river nor is there erosion problem in the project area and the project included a reforestation program in the project area for erosion control and protection of the environment. As findings from other micro-hydro power schemes have shown, the reduction of firewood consumption resulting from access to electricity improves the indoor as well as the local environment.

The installation of the AHREP scheme resulted in socio-economic and environmental improvements throughout the case study area. However, it should be noted that in order to identify and quantify more accurately costs and benefits in the area, more research in the area is required. The AHREP case illustrates the importance of the consideration of the environmental and social aspects in addition to the economic one in the efficient management of water resources for green growth and the importance of community engagement in the design and implementation of Water and Green Growth projects. Finally, it should be noted that social and political unrest in Nepal has hindered the development of the hydropower sector. Political commitment to institutional reforms along with monitoring and enforcing mechanisms is deemed as extremely necessary in order to implement the reforms in the electricity sector and to attract and retain adequate investments in the sector.

I. Introduction

1. Purpose of the Case Study

In this document, we analyze the impact of the Andhikhola Hydel and Rural Electrification Project (AHREP) on Nepal's green growth strategy from an Institutional Economics perspective. The Water and Green Growth project defines green growth as "a strategy that fosters economic growth and development, protects natural ecosystems and the resources and environmental services they provide, and enhances socially-inclusive development" (WWC, 2012, p.11).This case study also illustrates the importance of the consideration of the environmental and social aspects in addition to the economic one in the efficient management of water resources for green growth.

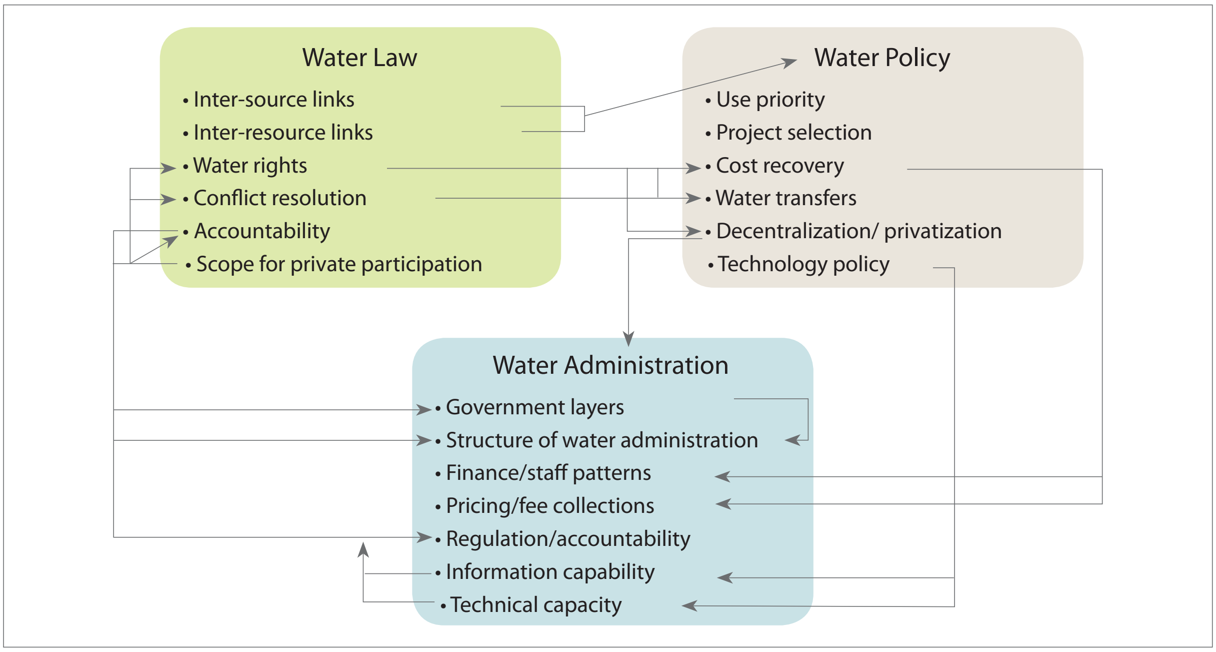
2. Case Study Methodology

2-1. New Institutionalist Approach

Recent developments in the economic theory have focused on the issue of institutions and these developments have contributed to the theories of ownership and transaction costs that build the core body of New Institutionalism (see for example Coase, 1998; Williamson, 2000; Jacobides and Winter, 2005; North, 2005; etc.). A New Institutionalist Approach is used in this document to analyze how AHREP contributed to Nepal's green growth from an institutional perspective. The behavioural rules that establish what is permitted and prohibited define the concept of institutions. Therefore, the analysis of the construction and change of institutions can be used to understand social change (North, 2005). This approach is used to analyze the outcomes resulting from water related institutions and policies involved in AHREP. This document assesses how the economic, social, political, environmental, and technical exogenous factors together with Nepal's water-related institutional framework and relevant policy mix led to the success or failure of the AHREP green growth project.

2-2. Analytical Framework

The report follows the analytical framework developed by Saleth and Dinar (2004) *The Institutional*

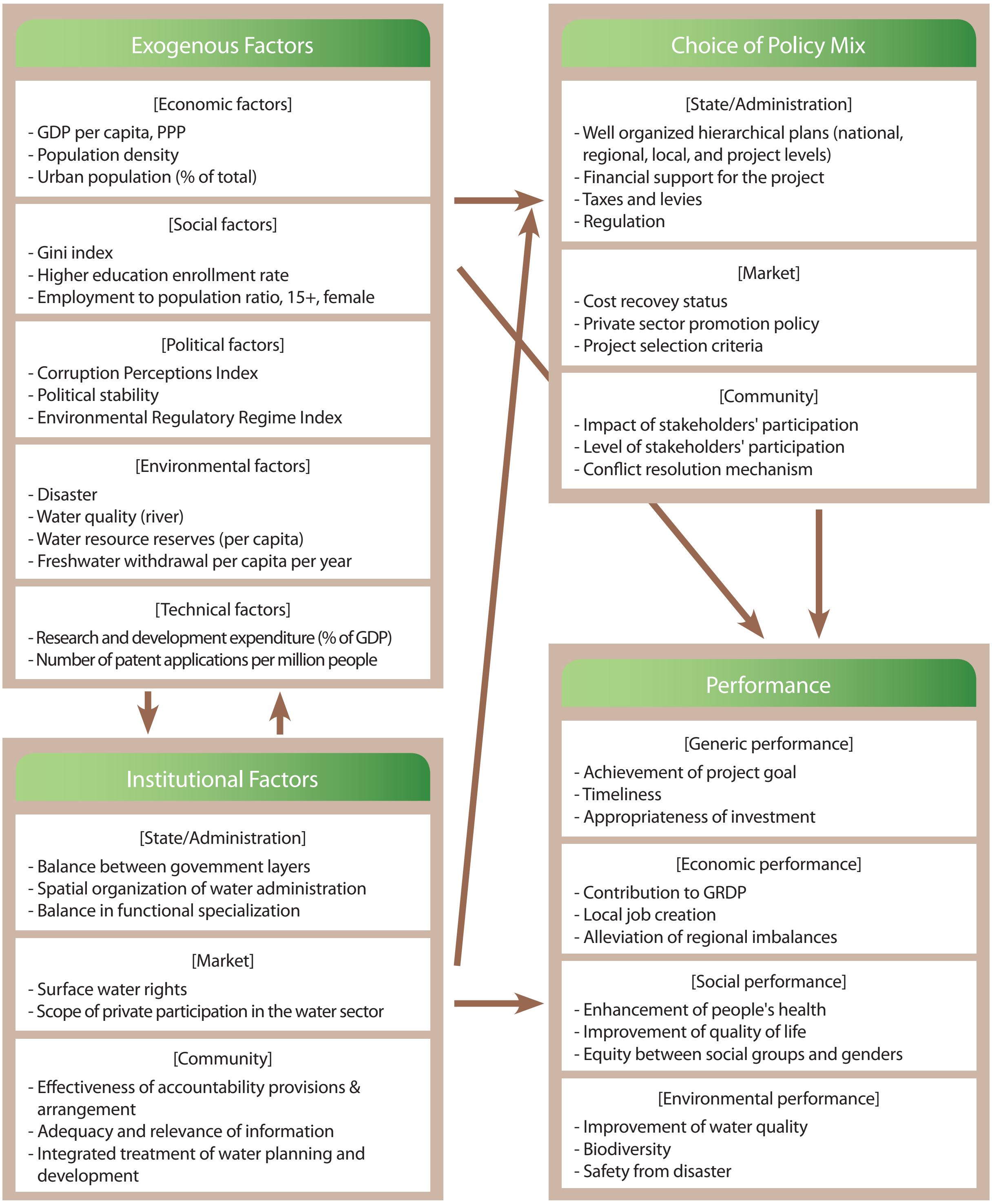


Source: Saleth and Dinar (2004)

<Figure 1> Saleth and Dinar's (2004) Analytical Framework

Economics of Water (see Figure 1). In order to analyze the interaction between institutions and water sector performance, endogenous and exogenous factors of change are identified and assessed. Exogenous factors refer to national or regional political systems, legal systems, populations, economic factors, and natural and environmental factors.

In a Water and Green Growth context, exogenous political factors are important since they shape regulatory



Source: Modified from Saleth and Dinar (2004)

<Figure 2> Institutional Framework Modified from Saleth and Dinar (2004)

and administrative settings through legislation on water and green growth that reflect the real levels of political commitment. They are also important for the design and implementation of coordinating mechanisms among ministries and may allow or hinder cross-sectoral collaboration between diverse bureaus in the water and green growth fields. Economic factors influence the establishment of rational water tariffs and the provision of safety nets. Other factors like financial incentives for water saving users, tax breaks, and subsidies for green technology developers; and users are also relevant for water and green growth. Finally, technological factors are important since technology contributes to green growth by cleaning the environment, conserving water, and providing alternatives to large-scale infrastructure projects. The water sector comprises all water sources and uses (both consumptive and non-consumptive), and all major water issues ranging from quantity-quality conflicts to drought-flood conditions. Water institutions are defined as "an entity defined interactively by three main components: water law, water policy, and water administration" (Saleth and Dinar 2004, p.95) and include the legal framework, policy regime, and administrative or organizational arrangements. Saleth and Dinar's institutional framework is re-categorized into state, market, and community (see Figure 2) to take into account the arguments about the drivers and instruments of economic and social development and environmental conservation based on the state, the market, and the community. Clearly, the outcomes of a water-related project will differ if its institutional framework was predominantly state-driven, market-oriented, or community-centred. The AHREP is mainly community centred (as it will be discussed through this document).

3. Organization of the Report

This report analyzes the economic, social, political, environmental, and technological levels in which the AHREP took place. Further analysis on the policies and institutions that mark the project's course and the changes in those policies and institutions over that time is presented. The project's performance is analyzed and lessons are drawn. The detailed structure of the report is the following: first, the main features of AHREP are summarized; and secondly, the external environment during the project's development period is characterized in terms of its economic, social, political, environmental, and technological aspects (i.e. exogenous factors). Statistics from the World Bank, OECD, and other sources, as well as survey results, and expert interviews are used to analyze how exogenous factors influenced policies and institutions affecting the AHREP. Thirdly, the institutional change, focusing on applied policies of the project period, is examined across state, market, and community dimensions. Fourth, the project's performance is evaluated in terms of economy, environment, and society. Lastly, overall lessons are drawn from the foregoing analysis.

II. An Overview: The Andhikhola Hydel and Rural Electrification Project (AHREP)

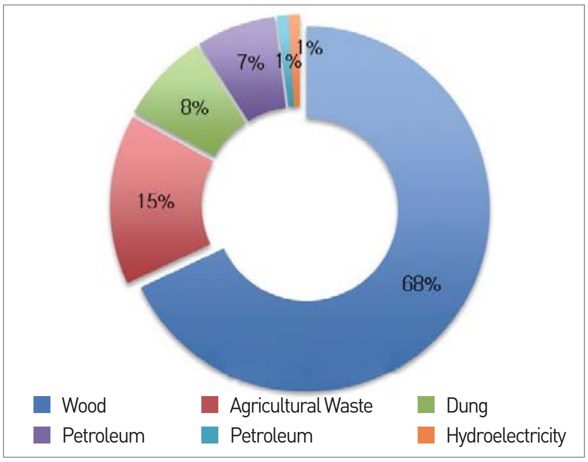
1. The Need for Hydropower in Nepal

Nepal is facing a severe energy shortage particularly in rural areas. On one hand, the demand for energy is increasing due to its population growth. On the other hand, current electricity supply can be characterised as "unreliable, expensive, and insufficient" (Bergner, 2013, p.8). For example, in 2011, Nepal's peak power demand was 950 MW exceeding the total installed capacity of 705 MW. Figure 3 shows that most of the energy supplies in Nepal originates from traditional sources: 68% wood, 15% agricultural waste, and 8% dung. The remaining is produced with petroleum (7%), coal (1%), and only 1% corresponds to hydroelectricity. Due to its geological conditions, Nepal has a vast potential for hydropower

<Table 1> Hydropower Potential and Percent Exploited in South Asian Countries

Country	Hydropower Capacity (MW)			
	Gross	Commercially Feasible	Installed	% Harnessed of commercially feasible capacity
India	148,700	84,044	39,060	46.48
Pakistan	100,000	59,000	6,555	11.11
Nepal	80,000	43,000	659	1.53
Bhutan	30,000	24,000	1,488	6.20
Sri Lanka	-	2,550.70	1,401	54.93
Bangladesh	-	755	230	30.46
Total	365,006	213,350	49,394	23.15

Source: Bergner (2013, 8)



Source: Bergner (2013, 9)

<Figure 3> Nepal's Energy Profile

production. Nepal's annual hydropower output barely exceeds 700 MW (far below the level other South Asian countries, see Table 1) although its theoretical hydroelectric potential is 83,000 MW and the production of 42,000 MW is technically and economically viable (Barr, 2013; Bergner, 2013). In consequence, the Nepalese government has ambitious plans for hydropower development. Nevertheless, due to a number of reasons that will be discussed later in the text (mainly political turmoil and weak governance) the progress of large-scale projects is not fast enough to satisfy the needs of the population; and within the past few decades, the Nepalese government, foreign donors, and NGOs have recognized the importance of micro hydropower (MHP).

2. About AHREP

The Andhikhola Hydel and Rural Electrification Project (AHREP) is located in the Nepalese mid-hills, near Galyang Bazaar in the Syangja District close to the Siddhartha Rajmarg Highway (the main north-south road between Pokhara and Butwal). It is 280 km southwest of Kathmandu, 80 km southwest from Pokhara and 80 kilometres to the north from Butwal (see Picture 1). The waters of the Andhikhola River flow westward into the Kali Gandaki River, eventually changing direction, and finally flowing eastward, covering a distance of 65 kilometres before returning to a point south of Galyang Bazaar but at an elevation of 250 meters lower. The significant drop in elevation from one river to the other in a short distance makes it an ideal place for hydropower production. The hydropower plant generates 5.1 MW of electric power and distributes it up and down the valley to rural areas in need of electricity. The population within the project area can be categorized as semi-urban

Source: BPCL (2005)

<Picture 1> AHREP's view

and rural. The semi urban population lives in Galyang Bhanjyang and its neighboring villages located on or near the Siddhartha Rajmarg Highway. Approximately 70% live in households constructed of permanent materials and a gravity-fed water system provides water through a network of public taps. The rural population lives in Aserdi, a village an hour walk away from Galyang, across the Kali Gandaki River. The majority of the inhabitants of Aserdi are involved in agriculture. The village is also served by a gravity-fed water system feeding a number of public water taps. Most of the households in the region have a source of cash income, through casual labor, sale of agricultural produce, or other commercial activities. An average household in the project area has five resident members (Inversin, 1994; BPCL, 2005). AHREP's direct precedent was the Tinau Hydropower Project. In 1966, the United Mission to Nepal (UMN)[1)] created the Butwal Power Company Limited (BPCL) in partnership with the Nepalese Government. Its aim was to develop the 1 MW Tinau Hydropower Project in order to provide electricity to the town of Butwal and the Butwal Technical Institute. The construction of AHREP began in 1982 and in July 1991 came into full commercial operation. A 33 kV transmission line connecting the AHREP with the existing Nepal Electricity Authority (NEA) line was finalized in mid-1988, and the local distribution system for electrification was completed in mid 1989. When the commercial operation started, 90% of all households in the project area subscribed to the energy services (Inversin, 1994).The Nepalese Government, the Norwegian Agency for Development Cooperation (NORAD) and the UMN funded the project. In January 2003, BPCL was privatized and the new owners (that comprise a group of the following Nepal based

Source: http://www.bpc.com.np/

<Figure 4>AHREP's Location

1) The UMN (www.umn.org.np) is a Christian Protestant organization established in 1954 and now comprising nearly forty member bodies representing the mission boards of churches and independent mission societies. UMN has been involved in health, education, engineering, industry, and rural development in Nepal (Inversin, 1994, p.2)

companies and institutions: Shangri-La Energy Ltd., Interkraft Norway, UMN, NEA, and Government of Nepal (GoN)) are leading the company towards increased efficiency and with a vision to be a leader in the sector. BPCL is registered with the Securities Board of Nepal and listed in Nepal Stock Exchange Limited. In the year 2013, BPCL had 296 employees, 265 male, and 32 female. The Company had an employee turnover of about 4.05%. It should be noted that in order to ensure good corporate governance in the company BPCL established a "corporate value framework". BPCL's corporate value framework comprises of vision, mission, values; business principles and policies; and corporate governance code, code of conduct and ethics. Compliance to corporate governance standards is reported annually in a *Corporate Governance Report* (BPCL, 2014). Currently, BPCL owns AHREP. AHREP's construction allowed the creation of innovative, sustainable rural electrification approaches and developing local capacity, all of which have had a huge impact on Nepal's hydropower sector. AHREP's most important feature was the "development of appropriate technology, suitable methods, and tariffs for rural electrification" in order to bring benefits of rural electrification to low-income farmers in the mid-hills of Nepal (BPCL, 2005, p.3).

3. Services Provided and Technical Specifications

3-1. Services Provided and Tariffs

The Nepal Electricity Authority (NEA) is a public utility that acts as a single power buyer via bulk buying from different producers at a purchase price enough to cover total investments in 25 years after accounting for depreciation costs (Nepal and Jamasb, 2012). The NEA purchases from AHREP approximately 27 GWh of electricity in bulk sale each year as per the Power Purchase Agreement (PPA) and about 10 GWh is locally distributed in Syangja and Palpa districts for rural electrification. In April 2003, AHREP had 16,700 domestic consumers (13,526 unmetered and 3,174 metered) and 174 industrial consumers (Bastakoti, 2006). In 2005, the total number of consumers of electricity increased to 17,871 and spread over 22 Village Development Committees (VDCs), 1 municipality in Syangja, and 10 VDCs in Palpa district.Each year about 10% additional rural households are electrified (BPCL, 2005). At the beginning of the project, it was decided that the electrification scheme would be non-profit. One of the most important objectives during the phase of design was to reduce costs in order to set a tariff that would be affordable to the local consumers and at the same time would generate enough income to cover operation and maintenance expenses, with some remaining for reinvestment (Inversin, 1994).

Households and firms determine their decision to contract electricity services mainly based on the tariffs and costs of connection. In turn, socio-economic parameters determine the public utility's decision on whether to supply power to a community.

In order to make electricity services more affordable for low-income customers a tiered tariff structure is used in AHREP. Customers are divided into two categories:

1. Household customers that are sub-divided into cut-out and metered:
   a) Metered customers have an energy usage-based tariff under which they pay as per their consumption recorded in kWh meters installed in their homes.
   b) Cut-out customers are supplied 25W up to 400W of electricity through current-limiting devices (whenever a customer's load exceeds his/her subscribed peak demand of power, the limiting device automatically trips until it is corrected by switching off part of the load) and have a demand based fixed tariff.
2. Industrial customers that are small and medium enterprises (SMEs).

The availability of hydropower-based electricity at a low marginal cost allowed the project designers to implement the power-based (kW) tariff to reduce equipment and operations costs associated with an energy-based (kW/h) tariff. Cut-out devices were used to limit the maximum consumption at each household (and they are less costly than electricity meters). Since the tariff is based on the installed capacity of these devices, periodic meter readings are not required and bill collection and accounting are simplified (Inversin, 1994).Cut-out connections enable the company to serve the poorest customers who have minimal energy needs. BPCL's cut-out connections range between NPR 19 for a 25W monthly subscription to NPR 179 for a 400W subscription. This fixed tariff system also reduces costs by eliminating meter reading. Cut-out customers have the option to upgrade to metered electricity if their energy demand increases, in which case they pay between NPR 89 for 500W to NPR 178 for 1000W. These different tariff structures allow electricity supply to different strata of the rural communities. AHREP has a power-based tariff to suit the specific socio-economic setting of the area, as described in Table 2 (Bastakoti, 2006; BCPL, 2013).

3-2. Optimal Tariff for Electricity

Electricity has two characteristics that affect the tariff set on its consumption. The first refers to the economic inefficiency to store electricity in high quantities. The second characteristic concerns its transmission. While it can be conveyed to the consumers, it cannot be resold. Combining the two characteristics, it is concluded that it is not possible to charge consumers with prices that do not correspond to their actual consumption (Houthakker, 1951).

<Table 2> BPCL Tariff Rates

A. Cut-out consumers

Subscribed demand (Watts)	Rs./month*	End-use
25	19	Lighting, radio/cassette player
50	39	Lighting, radio/cassette player
100	66	Lighting, radio/cassette player, TV
250	116	Lighting, radio/cassette player, TV, low-wattage cooking
400	179	As above

B. Metered consumers

Subscribed demand (Watts)	Monthly charge Rs./month*	Energy Charge (Rs./kWh)*	Excess Energy Charge (Rs./kWh)*	End-use
500	89	1.75	5.2	Lighting, radio/cassette player,TV, low-wattage cooking, business
600	107	1.75	5.2	As above
700	125	1.75	5.2	As above
800	142	1.75	5.2	As above
900	160	1.75	5.2	As above
1,000	178	1.75	5.2	As above

C. Industrial consumers

Demand (kVA)	Off peak consumers		Peak consumers	
	Monthly Demand charge Rs./month*	Energy Charge (Rs/kWh)*	Monthly Demand charge Rs./month*	Energy Charge (Rs/kWh)*
Up to 5	75	1.7	135	1.75
5 to 15	90	1.7	135	1.75
Above 15	100	1.7	135	1.75

* The average conversion rate for 1 USD was 93.16 NPR in July 2013
Source: BCPL (2013) and Bastakoti (2006)

Moreover, the tariff policy is associated with the costs that electricity supply yields. Such costs are related to the actual cost of electric current, costs of operation (wages, depreciation, interest, etc.), consumer costs and other costs such as management expenses. Nevertheless, due to the nature of the resource, the prices of electricity fluctuate a lot, according to the changes in the demand (for example, low-demand at night and high demand in the afternoon). Usually, the consumers pay an average price that is not the same as the wholesome price of electricity (Allcott 2009). The simplest tariff system is the flat rate, where the charges are proportional to the total consumption. This scheme however, does not allow the industry to adjust its capacity to the preferences of the consumers.

Nevertheless, the two-part tariff includes two components; the standing charge and the unit price, which is related to the actual consumption. This kind of tariff is usually accused for economic inefficiency, due to the peak load difficulties. Finally, the block tariffs refer to "blocks" of consumption with different charges each. Similarly, a common practice is the inclining block rate (IBR) pricing, where the charge remains flat up to a certain threshold (over a day month or other time frame) and increased after this is surpassed. This allows the consumers to adjust their consumption to avoid facing higher costs. It has been argued that the lack of knowledge on how to respond to time varying prices does not allow capture the benefits that this systems is designed to entail (Piete et al., 2009). The decision for the optimal tariff on electricity should take into both the consumer and the producer side. The level of the charges should correspond to securing the vitally of the producer, in terms of covering the costs for maintenance, overhaul and production. On the other hand, the level of the tariff should secure that consumers have access to resource and they can obtain suffice amount of energy to meet the needs of their household. If the tariff for electric power is low, the efficient use of energy will be discouraged. Evidence is provided by Kaiser (2000), with reference to the low price of electricity in Armenia.

3-3. Problems Experienced with the Present Tariff Rates

In 2013, BPCL sent a new tariff proposal to the NEA (see BPCL, 2013). In this document, BPCL states that the present tariff rates are well below the average cost of distribution and claims that most of the metered consumers are willing to adapt to the standard NEA tariffs. On the other hand, tariffs have not been increased in the last 16 years. The problems experienced with the present tariff rates that BPCL enlists are:

1. BPCL is experiencing financial losses because of its low tariff rates;
2. BPCL considers that it is necessary to align its tariff structure with NEA's tariffs since it is planning an expansion to areas where the NEA is providing services; and
3. There is an excessive demand for energy services.

BPCL estimated a loss in revenue of Rs. 5.24 per kW/h and a financial loss even in operation. BPCL sells electricity at an average billing rate of Rs. 4.52 per kW/h. Nevertheless, its production costs are Rs. 9.76 per kW/h. On the other hand, BPCL claims that the need to increase the electricity tariff is not only to finance its electrification expansion in licensed areas but also to achieve a 16% return on investment (ROI). The revenue per unit required to achieve this ROI is Rs. 11.87. Currently, the tariffs are based on wattage subscribed, but the company is proposing a tariff based on Amps subscribed in order to encourage costumers to improve their own power factor. The Amps have been calculated for a nominal voltage of 220 V. The proposed new tariffs are shown in Table 3. Note that the 25 and 50 watt current categories cater for rural consumers with the lowest income levels. BPCL is proposing an increase of 57.89% and 58.97% respectively and for consumers using more energy more than 100% increases are proposed since high-energy consumers prefer the meter option rather than the cut-out option.

3-4. Technical Specifications

Figure 5 presents a cross-sectional view of the hydropower and rural electrification projects in the AHREP area. A concrete gravity diversion weir 6 metres high and 60 meters long founded on rock was constructed across the Andhikhola river in order to divert water through the intake structure on the left bank of the river (see Picture 2). This water passes through a short intake canal, 33.5 m long settling basin, and a 16.8 meter long close transition section before it enters into a 1.3 kilometre-long horizontal tunnel, and through the penstock pipe along the vertical drop shaft 4 meters in diameters (see Picture 3) and 234 meters down to the underground power-house (36.9 m × 6.6 m × 10.9 m) (see Picture 4). A 1.1 km long horizontal tailrace tunnel conveys the tail water into the Kaligandaki River. The power from three 1.7 MW Pelton turbines and generators is transmitted through 33 KV transmission line connecting the existing NEA line to Butwal Substation and to 12 MW Jhimruk Hydropower Project through a 33 kV line and the local distribution system for rural electrification. It should be noted that this is a multipurpose project where water is tapped off before the penstock and is provided for agriculture, which irrigates 309 hectares of land in Tulsi Bhanjyang area of Syangja District and Asardi area of Palpa District. The headrace tunnel carries water for irrigation (max 0.688 m^3/s) the off-take for which is at the surge shaft (see Picture 5) and diverted to the gravity irrigation system (see Picture 6). The excess water from the headrace is used for irrigation and benefits around 800 households. The plant generates 5.1 MW at design flow of 2.7 m^3/sec and 246 m design gross head. BPCL has started an upgrade the project because the residual life of the electromechanical equipment is short and is in the final stages of construction. After the upgrade, the installed capacity of the project will be 9.4 MW. Additional water will also be released for irrigation increasing the total irrigated area to 599 hectares. A *Detailed Project Report* has been completed and the contractors for all the project components have been selected. A power generation license has been obtained and a Power Purchase Agreement has been signed with the NEA. The power generated from the plant will be released through a 33 kV line with interconnection at1 32 kV at Syangja Substation near Rang Khola. Rs. 774 million has been spent in the project till the end of FY 2069-70. The International Financing Corporation (IFC) and Mega Bank Ltd. are financing the upgrade project. Originally, the commissioning of the upgraded plant was planned for April 2013. Due to unforeseen circumstances on the account of certain technical and geological issues, the project was delayed and has led to increment in the project cost. The construction works continue and the commencement of commercial operation for the upgraded plant is expected by mid- 2014 (BPCL, 2014).

<Table 3> BPCL Proposed New Tariffs

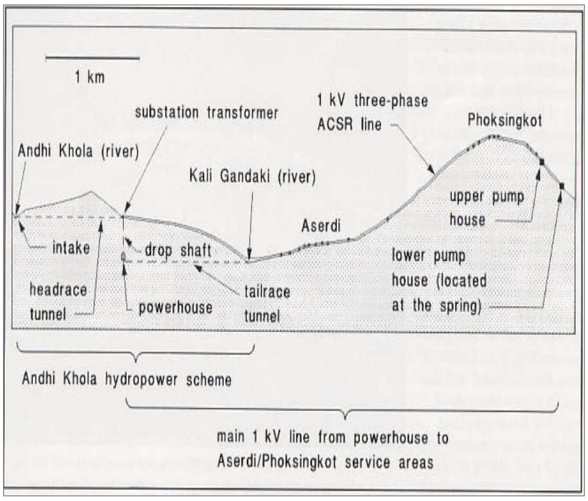
A. Cut-out consumers

Wattage (proposed Amps)	Present Rs./month*	Proposed for Amps Rs./month*	Percentage increase (%)
25 (0.15)	19	30	57.89
50 (0.3)	39	62	58.97
100 (0.6)	66	130	96.96
250 (1.5)	116	300	158.62
400 (2.5)	179	480	168.156

B. Metered consumers

Minimum monthly charge: Meter Capacity	Minimum charge
Up to 5 Ampere	121.6
15 Ampere	554.8
30 Ampere	1,208.4
60 Ampere	2,682.8
Three Phase Supply	
Up to 10 kVA	6,688.0
Above 10 kVA	10,488.0

* The average conversion rate for 1 USD was 93.16 NPR in July 2013
Source: BCPL (2013)



Source: Inversin (1994); BPCL (2005)

<Figure 5> General Design of the Scheme

Source: BPCL (2005)

<Picture 4> Power House

Source: BPCL (2005)

<Picture 2> Intake and the Settling Basin

Source: BPCL (2005)

<Picture 5> Shaft

Source: BPCL (2005)

<Picture 3> Drop Shaft for Penstocks

Source: BPCL (2005)

<Picture 6> Irrigation System

III. The Case Study

1. Exogenous Factors

In this section, we provide an overview of Nepal's national-level economic, social, political, environmental, and technological dimensions. These exogenous factors will allow the understanding of the general context in which the project has been carried out.

1-1. Economic Factors

1-1-1. Economic Growth and Structural Change

According to the World Bank, the Nepalese Gross Domestic Product (GDP) was 19.21 billion US dollars in 2012. Nepal's GDP value represents 0.03 of global GDP value. Specifically, the average country GDP for the period between 1960 and 2012 was 4.29 USD Billion from 1960 until 2012, reaching an all time high of 19.123 USD Billion in 2011 and a record low of 0.50 USD Billion in 1963. The GDP value for the decade is reported in Table 4.

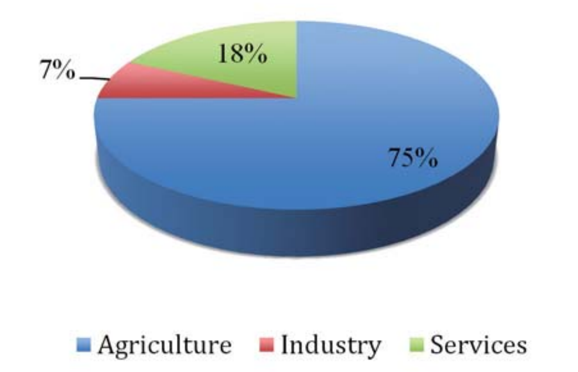
<Table 4> GDP of Nepal between 2004 and 2013

(current million USD)

2004	2005	2006	2007	2008
7,274	8,130	9,044	10,326	12,545
2009	2010	2011	2012	2013
12,900	15,994	18,850	19,207	19,294

Source: World Bank Indicators

As shown in Figure 6 and Table 5, the majority of Nepal's (approximately 75% in 2010) population is employed in agricultural sector, providing a 35.7% of country's GDP. Agriculture is Nepal's principal economic activity, with rice and wheat being the main food crops. With reference to land use, roughly 20% of the total area can be cultivated, 25% is forested and most of the rest is mountainous (FAO, 2010). All these figures are important to assess the impact that AHREP has had in the local communities. The economic activities at local level reflect the trends in employment and production at the national level. Agriculture is the most important economic activity and provides employment to a high proportion of the population in the region. Let's not forget that one of the important features of the project is that part of the water is used in irrigation activities that (as it will be explained later) increase the agricultural output, levels of income, employment, and food security.



Source: CIA World Factbook

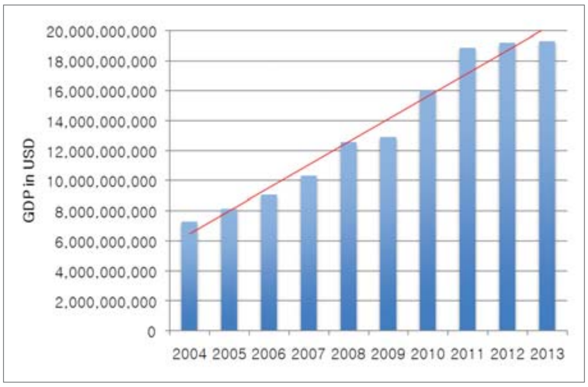
<Figure 6> Nepal's Labor Force Percentages by Occupation (2010)

<Table 5> Nepal's GDP by Sector

Agriculture	35,7%
Industry	14,9%
Services	49,4%

Source: Asian Development Bank

On the other hand, Nepal's economy is heavily dependent on the Indian economy (especially in terms of remittances of foreign workers). In fact, it has been documented that in AHREP's project area a number of men (mainly young ones) have migrated either permanently or temporarily outside the community in search of employment (Inversin, 1994). In terms of economic development in social services and infrastructure, Nepal has not made dramatic progress. However, the operation of AHREP (and other MHPs) in the local level implied the construction of much needed infrastructure for energy production. Figure 5 depicts how Nepal's GDP has evolved between 2004 and 2013. It is evident that there is a positive and stable trend. Producing more goods and services implies that the demand for energy is also increasing. As discussed in the first section, AHREP and similar projects are needed to cover the increasing demand for energy in Nepal.

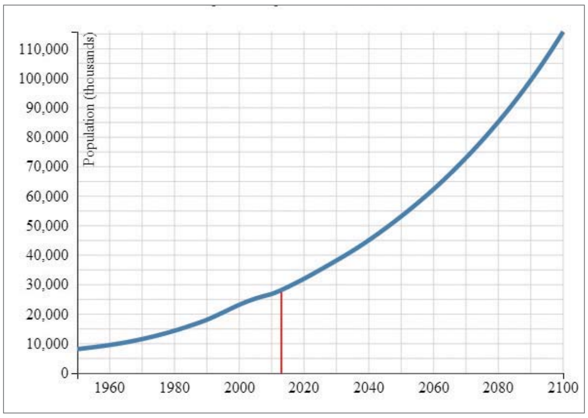


Source: World Bank Indicators

<Figure 7> Nepal GDP Trend between 2004 and 2013

1-1-2. Population Movement and Urbanization

Based again on the World Bank statistics, the total population of Nepal is estimated to be 27,474,377, with population growth rate being 1.596% and the median age 21.6 years. More specifically, female and male median age is 22.5 years and 20.7 years respectively. Nepal has a large young population, with only 4.4% of the total population being more than 65 years old. In absolute numbers, there are 681,252 females and 597,628 males over 65 years old. With reference to other age groups, 61% percent of the population is between 15 and 64 years old, and 34.6% is less than 15 years old. Birth rate is estimated to be 22.17 births per 1,000 people, whereas the infant mortality rate has been estimated to bee 44.54 deaths per 1,000 live births. Moreover, life expectancy at birth is estimated to be 67.44 years and 64.94 years for females and males accordingly, with death rate being 681 deaths per 100,000 people. Figure 8 depicts Nepal's population growth over the last four decades and a projection of population growth till 2100, while Table 6 contains information about urban and rural distribution. It is evident that more jobs, energy and food production will be required overtime in Nepal. It can be expected that projects like AHREP will play an important role in the satisfying increasing population's needs.



Source: World Population Review

<Figure 8> Nepal Population Chart

<Table 6> Rural Urban Population

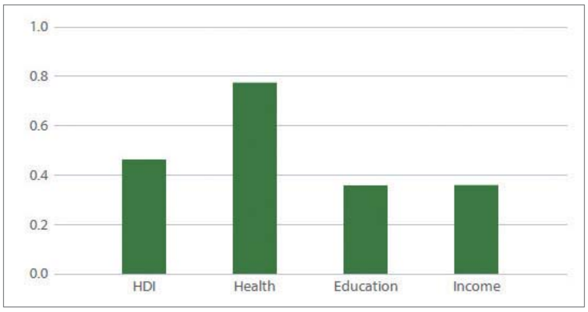
Area	Population	Percentage
Rural	22,803,732	83.0
Urban	4,670,644	17.0
Total	27,474,377	100

Source: CIA World Factbook

1-2. Social Factors

1-2-1. Income Inequality

Nepal remained in the same ranking position in the latest *Human Development Report* (2012). Specifically, it remained in the 157th position among the group of South Asian countries, while Sri Lanka achieved the best (92nd place) position. Although human development ranking did not change, a decrease – from 64.7 % in 2012 to 44.2 % in 2012 - has been observed in the percentage of Nepali population living under multi-dimensional poverty, according to the report prepared by the United Nation Development Program (UNDP) (2012). Figure 8 shows Nepal's HDI total score and the three tiers of human development, i.e. education, health and income.



Source: United Nations Development Program / Human Development Report

<Figure 9> The Human Development Index (HDI) of Nepal

In addition, it is indicated in the report that there is some improvement in the Gini coefficient. Nepal's income Gini coefficient for 2010 was 32.8, while it was 47.3 two years ago. The Gini coefficient shows the extent to which individual and household income distribution deviates from a perfectly equal distribution. A decrease in Gini index implies an improvement in income distribution.

1-2-2. Education Level and Equality of Opportunity

Over the last few years, a considerable improvement has been observed in educational conditions across the country. Literacy for people over 15 years old has been reported to be 60.3% overall, 46.3% for females and 73% for males (Census 2010). It is worth mentioning that there were about 300 schools and two colleges with approximately 10,000 students in 1951, whereas nowadays the number of the schools has been increased to 49,000 (including higher secondary). The number of the colleges has been increased to 415, whereas there have been established five universities and two academies of higher studies. Approximately 7.2 million students are enrolled in those schools and colleges, served by more than 222,000 teachers. Despite the improvements, there are still significant problems and challenges, mainly with regards to education management, quality, relevance and access. Issues of social disparities (gender, ethnicity, location and economic class) are yet to be eliminated, whereas the problem of resource crunch needs yet to be resolved. Based on the World Bank statistics, a total number of 105,685 children (45,740 males and 59,945 females) remained out of school in 2011. The numbers of uneducated children fell significantly in 2012 and 2013 with 81,526 and 45,137 children being out of school respectively. The main reason for this change has been the School Sector Reform Program (SSRP) Project for Nepal 2009-15. Its aim is to improve access and quality of school education (mainly basic education) particularly for children from marginalized groups. The project has three components:

1. *Basic education*: Its goal is to guarantee access to and quality basic education for all children in age group 5-12, prepare pre-school-age children through Early Childhood Education and Development for basic education and deliver basic numeracy and literacy to youths and adults.
2. *Secondary education*: Its goal is to improve access to secondary education by financing the expansion of physical facilities and targeted scholarship schemes.
3. *Institutional capacity strengthening*: Its goal is to improve the capacity of SSRP implementation agencies and its partners to enhance delivery and monitoring of educational services and products.

Overall, the program has made good progress in all its key performance indicators: a) starting from a 2008-2009 baseline of 73%, the Enrolment Rate (NER) for basic education has increased to 86.3 %, surpassing the end of program target of 85% for the year 2015; the NER for primary education is 95.5%, and is approaching the target of 99%; b) the completion rates for primary and basic education (77.6% and 63.8%, respectively) are on track to reach the end of program targets; and c) Nepal has achieved gender parity in net enrollment forprimary, basic and secondary education (Bhatta, 2014). Although there is no evidence available linking education to the AHREP, there is an evidence in the literature that lighting provided by the MHP electricity allows school-going children to study more comfortably and conveniently than to do so with kerosene based lighting (see Banerjee et al. 2011).

1-3. Political Factors

Political instability can be identified as one of the most serious obstacles for Nepal's growth and development. In recent years, Nepal has faced a number of major political changes. In 2008, the monarchy was abolished after the civil war that started in February 1996 when the Communist Party of Nepal-Maoist led an insurrection against the monarchy aiming to install a one-party communist regime. The king of Nepal transferred power to a political coalition called the Seven Party Alliance in April 2006. The Maoists and the Seven Party Alliance reached a peace agreement in November 2006 and established a coalition government. In May 2012, the constitutional assembly was dissolved after a four-year disagreement in relation to fair representation of ethnical and political ideologies within the draft constitution. Between May 2012 and March 2013, Nepal's government remained without a parliament (Nepal and Jamasb, 2012; Bergner, 2013; Biggs et al., 2013).

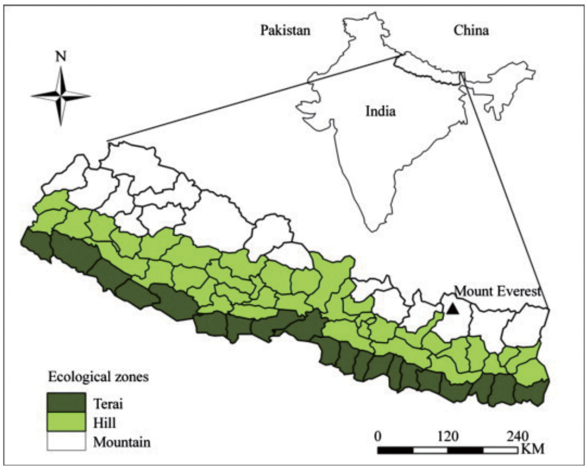
As indicated by the relevant Corruption Perceptions Index (CPI), produced by Transparency International, in 2013 Nepal has experienced an important decrease in corruption levels. Nepal gained 23 positions in the CPI ranking; from the 139th place in 2012 to the 116th place in 2013, achieving score 27 and 31 respectively.[2] The report included 176 countries in 2012 and 177 countries in 2013. According to the report of Transparency International, 90% of Nepal's population considers that political parties are more than average corrupted (corrupted or highly corrupted), whereas an 85% of the population considers public officials and servants as corrupted or highly corrupted. The lack of transparency and well defined and protected property rights (being undermined by the judicial system, which is significantly affected by corruption and political influence), together with the existence of bureaucracy and corruption cause significant obstacles for private investments, establishment of businesses, and production. Nepal's unstable political situation during the previous years has been another serious constraint for companies to get involved with business activities in Nepal.

1-4. Environmental Factors

1-4-1. Environmental Pollution

Nepal can be divided into three broad ecological zones: (i) lowlands, (ii) midlands, and (iii) highland.

The lowland region of Terai produces an agricultural surplus, supplying the food-deficient hill areas as well. Himalayan Region (highlands) ranges between 4877 - 8848 m, including 8 of the highest 14 in total summits in the world, with an altitude of more than 8000 meters. The mountainous region covers about 64% of the whole country. On the other hand, the lowland region of Terai covers a 17% of the total land area approximately (see Figure 10).



Source: Chhetri et al. (2012, p.146)

<Figure 10> Map of Nepal Showing the 3 Ecological Zones (Mountains, Hills, and Terai)

Nepal is characterized by a wide number of environmental issues, the most important of which can be summarized as follows: (i) water pollution, mainly due to sedimentation

2) Higher scores and ranking positions imply lower levels of corruption.

and discharge of industrial effluents, and firewood consumption as a main source of energy; (ii) deforestation and land degradation, mainly due to firewood consumption, floods, soil erosion, stagnant agricultural output, population growth, and infrastructure projects; and (iii) air pollution, with indoor pollution from firewood consumption being a significant problem for households' health. Regarding deforestation, it is worth mentioning that the forest cover declined from 45% of the total land area in 1966 to 29% in 2000 (USLC, 2005). Moreover, it has been estimated that about 1.5 million tons of soil nutrients are lost annually as a result of soil erosion and flooding.

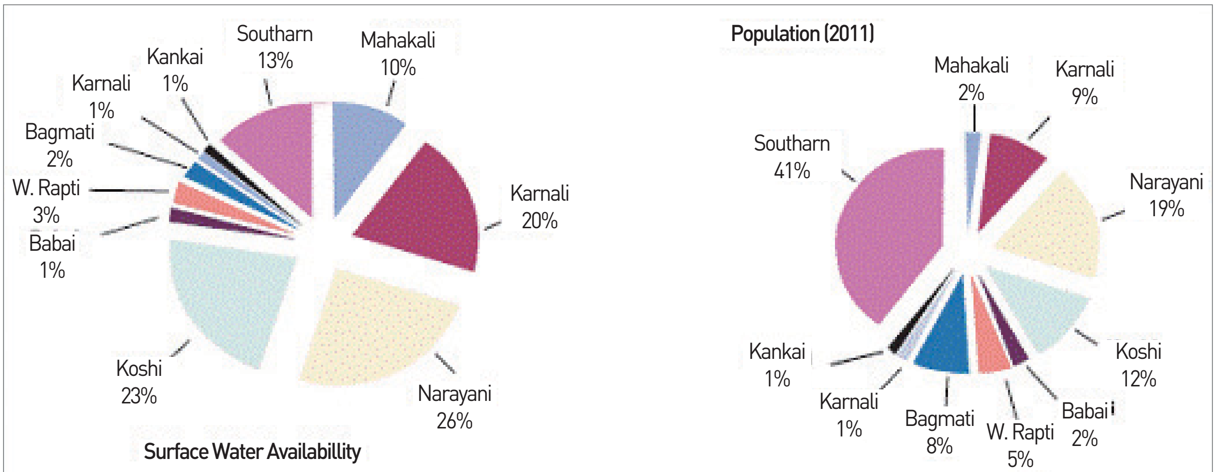
1-4-2. Water Resources

According to the Government of Nepal, the country has a water availability of about 225 billion m^3 per annum, which is equivalent to an average flow of about 7,125 m^3/s. Table 7 reports the total drainage area and the estimated runoff from the main rivers of Nepal. It is estimated that all rivers has a drainage area of 194,471 km^2, 76% of which lies within the country of Nepal (WECS, 2003). However, it should be noted that despite the abundant availability of water, access to water resources might vary in terms of time and space (WECS, 2011). Therefore, the demand of water from basic sectors (such as residential, industrial, and hydropower generation) cannot necessarily be covered by the – temporally and spatially – available water supply. According to the available statistics, approximately 78% of the country's average flow is available in the four major basins, whereas another 9% and 13% is available in the medium basin areas and the numerous small southern rivers of the Terai respectively. Time-wise, it is estimated that about 74% of the total annual surface flow occurs between June and September. Figure 11 illustrates the distribution of water availability and population in the basin areas of Nepal. As it can be seen, due to the imbalanced distribution of water

<Table 7> Drainage Area and Estimated Runoff from Nepal's Main Rivers

River	Length (km)	Drainage area(km^2)		Estimated runoff(m^3/sec)	
		Total	Nepal	From all basins	From Nepal
Mahakali	223	15,260	5,140	698	247
Karnali	507	44,000	41,890	1,441	1,371
Babai	190	3,400	3400	103	103
West Rapti	257	6,500	6,500	224	224
Narayani	332	34,960	28,090	1,753	1,409
Bagmati	163	3,700	3,700	178	178
Sapta Koshi	513	60,400	31,940	1,658	878
Kankai	108	1330	1330	68	68
Other		24,291	24,291	1,001	1,001
Total		194,471	147,181	7,125	5,479

Source: WECS (2011, p.8)



Source: WECS (2011, p.9)

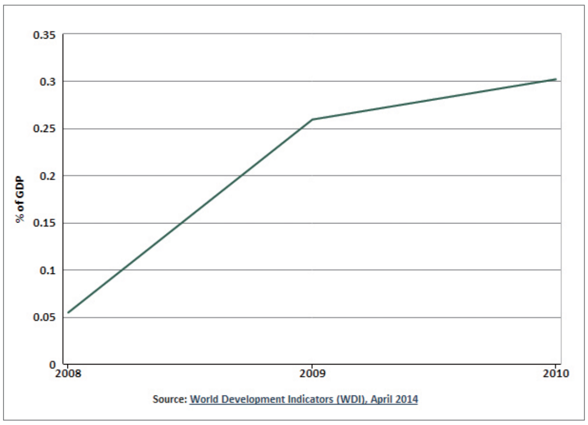
<Figure 11> Basin-wise Distribution of Water Availability and Population in Nepal

availability and population, an excessive availability of water is observed in some basins, whereas other basins are characterized by significant deficit.

On the other hand, limited access to drinking water is one of the main health hazards in the country. It has been estimated that approximately one-third of the nation's city inhabitants and two-thirds of all rural dwellers do not have access to clean water. In addition, an average of 0.4 million tons of solid waste per year is released by the urban areas mainly because of untreated sewage. Despite pollution and supply issues, water is the most important natural resource of Nepal. Nepal has ample water resources, being the second richest country in water resources after Brazil worldwide. These are freshwater resources, mainly from glaciers, lakes, and rivers, since Nepal has no access to sea. Water is used mainly for household and agricultural purposes, whereas hydro-electricity plans are constantly constructed across the country.

1-5. Technical Factors

In 2011, Nepal had a percentage of 0.3 % as a share of GDP for Research and Development (R&D) expenditures, compared to an only 0.05% of the GDP in 2008 (see Figure 12). However, according to World Bank data, Nepal has a minimal contribution to high-technology product exports in sectors such as aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. This is one of the main reasons of the economy’s slow growth.



Source: World Development Indicators (2014)

<Figure 12> R&D as GDP% for 2008-2010

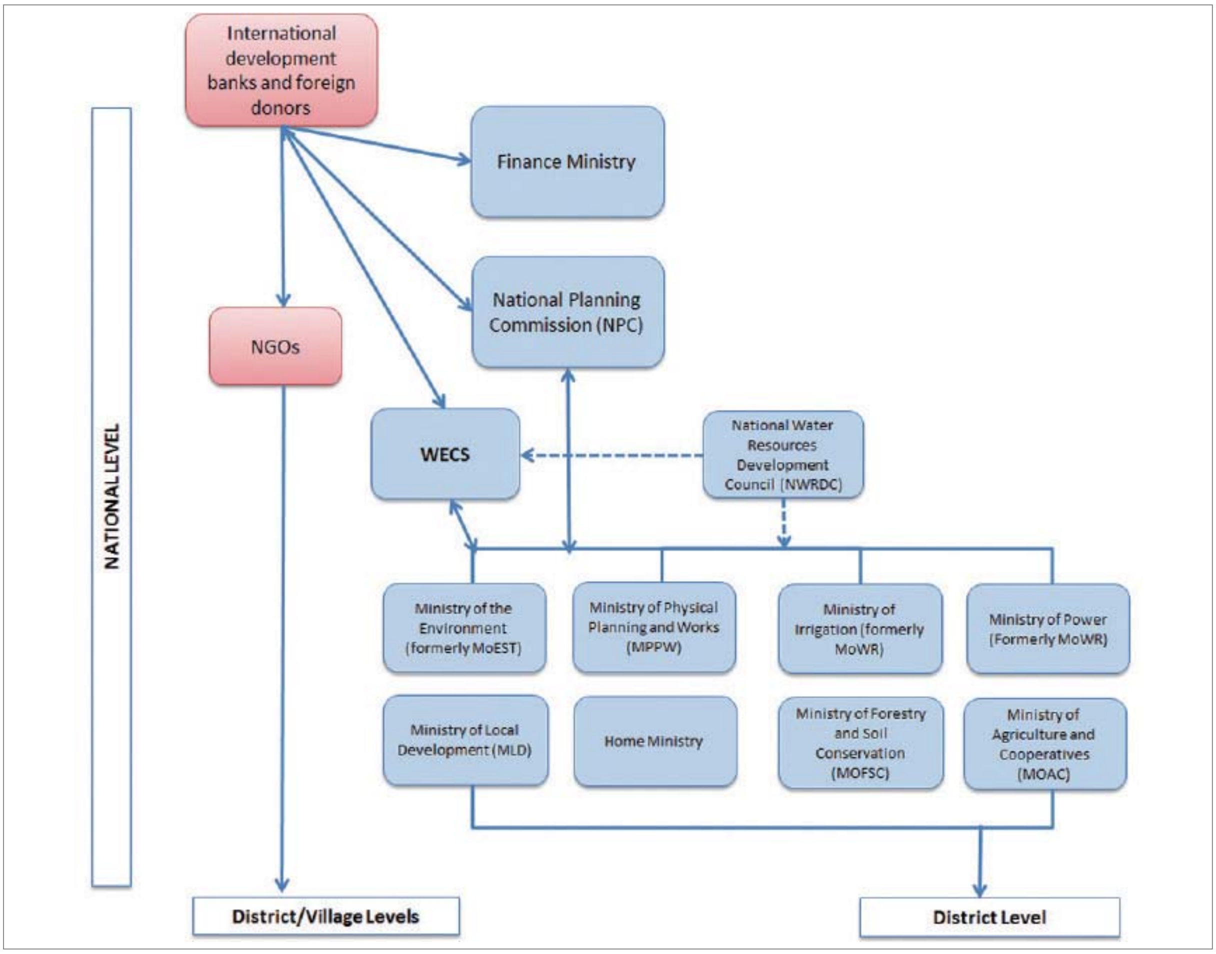
2. Water and Energy Governance and Institutions

In this section, the direct and indirect influences that institutional factors have on the project are analyzed. These institutional factors can be divided into legal, administrative, and policy elements (Saleth and Dinar, 2004). The evolution of these factors is assessed and the influence of such institutional factors on the Andhikhola Hydel and Rural Electrification Project is investigated.

2-1. State/Administration

The role of the state as originator and decider of key policies in relation to the water sector in Nepal has been rather weak. Political instability has provoked lack of enduring government and a record of changing institutional structures. Thus, the structure of ministries and departments is not very well-defined and the exact responsibilities of specific institutions are not clear (Barttlet et al., 2010; Nepal and Jamasb, 2012; Biggs et al., 2013).

The process of policy and project implementation in the water sector follows a top-down approach. Approximately 70% of the annual budget of the government comes from bilateral and multilateral donors in the form of loans and grants. The finance ministry distributes the budget and dictates what the National Planning Commission (NPC) can plan for. The NPC and the line ministries define the expenditure program and then implement it at district level. The Water and Energy Commission Secretariat (WECS) is concerned with water and energy policy at the national level. Its intended role was to work in the design of policy (e.g. for irrigation, energy, environment, agriculture, and livestock) to be



*Note: Government institutions are in blue and private institutions are in red. Two-way arrows indicate communication/cooperation on budgets, projects and policy frameworks.
Source: Barttlet et al. (2010, p.10)

<Figure 13> National Development and Water Institutions in Nepal

implemented by other relevant ministries with each of the Secretaries sitting on the Water and Energy Commission chaired by the Minister of Energy. The National Water Resources Development Council (NWRDC) sets policy guidelines both for the line ministries and WECS on water resource issues. The WECS communicates with all relevant institutions, including the donors (see Figure 13). The WECS was in charge of writing the Nepal's National Water Plan (NWP) published in 2005. In paper, the NWP provided the WECS with greater authority in policy formulation, implementation, inter-agency planning related to water resources, as well as budgetary oversight. Nevertheless, implementation of the NWP remains minimal and its mandate remains weak due to continuous changes in the government structure, continuing political uncertainty and a lack of capacity. According to Barttlet (2010), the WECS has in reality no budgetary power, and in order to approve projects it has to go through other ministries. In addition, several institutional measures and reforms at local level stated in the plan have not been implemented.

At the national level, political parties have made commitment to prioritizing the hydropower sector. Nevertheless, at local level, the commitments are not fully understood and by local political actors. Local communities expect from the hydropower developers to play the role of the State at the local level (e.g. the promotion of infrastructure development like support to school, road, irrigation, electricity supply, etc.) that increases the costs and renders the projects unfeasible (BPCL, 2014).

2-2. Laws and Administration

2-2-1. Water Sector Legislation

The current water legislation in Nepal entails customary rights and statutory laws. The 1854 Civil Code (Muluki Ain) was the first statutory law regulating water resources policies in Nepal. In order to avoid disputes, this law defined rules on water distribution by linking water usage rights to land ownership and prior appropriation rights of existing irrigation systems over newly constructed systems. In the mid 1950s, five-year plans of planned development were introduced in Nepal and triggered a number of policy interventions in water resource sectors including irrigation. For example, the Irrigation Act of 1961 was the first legal framework specifically for irrigation (later replaced by the Canal, Electricity and Water Resource Act 1967). Since the 1990s, water related policies have allowed community participation and private sector involvement in decision-making and the participation of users in the management of their water supply and irrigation systems in clear contrast to the previous centralized system of governance that primarily satisfied the interests of ruling elites. One of the most important pieces of legislation in Nepal is the Water Resources Act of 1992. This Act provides the legal framework for the utilization, conservation, management, and development of water resources (Nepal and Jamasb, 2012). Table 8 presents the policies, acts, and regulations that comprise

<Table 8> Water Legislation in Nepal

Act or policy	Features
The Civil Code 1853	a. First comprehensive statutory law providing administrative procedures and legal frameworks
	b. Linked water usage rights to land ownership within canal command area
	c. Provisioned 'prior appropriation rights' of existing irrigation canals over newly constructed canals
Irrigation Act 1961	a. Laid foundation for legal framework specifically for irrigation
Canal, Electricity and Water Resources Act 1967	a. Introduced the concept of water tax and licensing
Water Resources Act 1992	a. Specified that ownership of all water resources including irrigations rests on the state and its use should be permitted by the state
	b. Provisions for water users' organizations (WUOs) and recognized them as autonomous bodies with perpetual succession
	c. Enabled agency-managed irrigation systems and farmer-managed irrigation systems to sustain their irrigation systems through cost-recovery mechanisms particularly 'operation and maintenance (O&M) costs
Water Resource Regulation 1993	a. Provisions for formation and registration of WUOs; information to be furnished in WUO constitution and provisions for necessary amendments
	b. Promotion and regulation of judicious and beneficial use of water resources and paying of water fee to the government for obtaining permission to provide services for irrigation
	c. Provisions for water resource utilization disputes
Irrigation Regulation 1999	a. Prohibits other use of irrigation water in the system except agricultural purposes
	b. Provides procedures for registration, election and dissolving of WUO executive committee
	c. Sets remits of WUOs including functions, responsibilities and rights and renewal of WUO license
	d. Defines procedures for establishment of O&M fund and delineate procedures and conditions for management transfer of irrigation systems to local users including joint management
Irrigation Policy 2003	a. Prioritizes development of storage type of irrigation for agricultural diversification, intensification and commercialization
	b. Adds emphasis in developing institutional capacity of water users for sustainable use of irrigation resources and enhancing knowledge, skills and technical capabilities of human resources
	c. Strengthening capabilities of WUOs and effective participation of users in planning, construction, and management of irrigation systems
National Water Plan 2005	a. Provides the WECS with greater authority in policy formulation, implementation, interagency planning related to water resources, as well as budgetary oversight

Source: Bastakoti and Shivakoti (2012)

the current legislation of water resources in Nepal (Bastakoti and Shivakoti, 2012). Government legislation lacks uniformity to establish a coherent development procedure and consistent water resources policy (Biggs et al., 2013).

2-2-2. Electricity Sector Legislation

One of the most important milestones for the Nepalese electricity sector was the establishment of the Nepal Electricity Authority (NEA) in 1985. The NEA Act of 1984 created this important institution by merging the Electricity Department, Electricity Boards and the Nepal Electricity Corporation. The hydropower development policy of 1992 established a legal framework and corporatized the power sector. The Water Resources Act of 1992 and the Electricity Act with amendments made to the NEA Act of 1984 enforced this policy.

The aim of the Electricity Act 1992 was mainly the promotion of private sector participation in hydropower production. For instance, any individual or corporation generating, transmitting and distributing up to 1000 KW volume is exempted frou license charges under this Act. Obtaining a license is mandatory for any volume above 1 MW. Licensees are allowed to export electricity subject to the payment of an export duty. Although a monopoly was retained in the licensee distribution services areas, third-party entry is possible if the performance of the licensee is unsatisfactory. The Electricity and Tariff Fixation Commission (ETFC) was established and NEA was made a licensee. The ETFC is formed by at least five persons including a representative of the Government, an economist and those involved in the generation, transmission and distribution of electricity and supply. The Industrial Enterprises Act 1992 was aimed to encourage industrial investment and the Foreign Investment and Technology Transfer Act 1992 promotes foreign investment and technology transfer by making optimum use of natural and human resources in the transition towards industrialization (Nepal and Jamasb, 2012). Table 9 presents a timeline of the major electricity reforms in Nepal.

<Table 9> Timing of Major Electricity Reforms in Nepal

1992	2001	2003
Hydropower Development Policy	Water Resources Development Policy	Community Electricity Distribution by Laws
· Water Resources Act		
· Foreign Investment and Technology Transfer Act 1992		
· Electricity Act		
· Industrial Enterprises Act		

Source: Nepal and Jamasb (2012, p.244)

2-3. Institutional Reform

There is an evident need for deep institutional reform in Nepal both in the water and in the electricity sector.The political turmoil of recent years has provoked discontinued policies, uncertainty, and weak implementation of reforms. There is an overreliance on foreign aid. Water policy frameworks in Nepal are fragmented and incoherent, and water governance is ineffective (Biggs et al., 2013). On the other hand, despite the efforts to reform the Nepalese electricity sector itsorganisation and structure remains uncertain and unsustainable. The lack of political commitment to reform along with a poor implementation of required measures have halted the much-needed reforms in the electricity sector (Nepal and Jamasb, 2012). In consequence, Nepal is less attractive to potential foreign investors (like China and India) that are interested in developing energy projects, but are unwilling to risk lost investments. In consequence, the development of hydropower sector is far below the expectation, and Nepal is still a long way from a position where it is able to attract and retain adequate investments for the sector (Bergner, 2013; BPCL, 2014). The transmission network (i.e. the sector's pillar) lacks the generation capacity and appropriate planning. Local disputes related to land acquisition and environmental impact related to building transmission lines are the major obstacles for the expansion of the electrical network. There is a disparity between the licenses provided for hydropower development and the means for power evacuation, which has led to conflicts between the developer and the utility company. On the other hand, high financing costs and demands from the local populations are identified as the major deterrents to the development of even the small projects being developed by domestic developers. Finally, huge paperwork requirements and significant delays in the approval process further add to the slow development of the hydropower sector (BPCL, 2014).

IV. Performance of the AHREP

1. Generic Performance

Nepal remains in a state of energy crisis despite its huge potential for hydropower production due to its geographical conditions (e.g. the Himalayas stretch across north of the country and, as discussed in Section 1-4-2 in chapter III, Nepal has ample water resources). Due to its inability to produce electricity on a large scale, several NGOs and aid programs are dedicated to developing local renewable energy solutions, to supplying power Nepal's rural population. Small hydropower plants producing up to 100kW, called Micro Hydropower (MHP), are an important part of renewable energy projects (Barr, 2013; Bergner, 2013). AHREP is a clear example of this kind of projects. Inversin (1994) explains that the UMN, which was responsible for AHREP's development, was interested both in developing Nepal's human resources and in the construction of energy infrastructure. Thus, the UMN planned it as a major component of an integrated rural development project. The UMN estimated that the substitution of fuel-wood for electricity would reduce pressure on the forests. On the other hand, using electricity for irrigation and agro-processing could increase the agricultural output of land in the region and at the same time, generate more employment. Another interesting feature was that the UMN developed at the same time what is known as the Andhi Khola Project (AKP). This project is concerned with irrigation development, resource conservation, drinking water and sanitation, adult literacy, and non-formal education. AHREP and AKP operate side by side in the same geographical area. AHREP's focus is on rural electrification, and AKP's focus is to provide supporting activities that contribute to the broader development of the region.

Overall, the installation of AHREP scheme resulted in socio-economic and environmental improvements throughout the case study area. With regards to socio-economic improvements, access to irrigation and electricity allowed households and small-businesses to enjoy a wide range of benefits across various fields: (i) better health, (ii) better production quality and income, (iii) better conditions for education, (iv) employment opportunities, and (v) more opportunities for local community development. Before the installation of AHREP plant, 57 hectares of land were irrigated mainly from natural springs (van Etten, van Koppen, and Pun, 2002). After the installation of the scheme, the coverage of irrigated land increased to 282 hectares. After completion of AHREP's planned upgrade the expected coverage of irrigated land is 599 hectares. Access to irrigation yielded considerable benefits for farm households, mainly through the considerable increase in the agricultural production. At household level, household gained access to water and electricity that allowed important activities such as washing, cleaning, bathing, and cooking. Access to electricity allowed a decrease in the consumption of "dirty" energy such as kerosene and firewood, which in turn resulted in the reduction of indoor pollution. Of course, decreased consumption of these sources of energy yielded substantial benefits mainly for the local environmental conditions. In the following sections, we will provide a more detailed description of the main economic, environmental, and social benefits.

2. Economic Performance

The cost for the installation of AHREP scheme was $280,000, which is a relatively low investment. Sources of revenue for the sustainability of the scheme include electricity selling to NEA and financial support from organizations such as the United States Agency for International Development (USAID) and NORAD. Local villagers contributed a 9% of the project's total cost, mainly in form of labor supply and materials cost for the construction of the dam. The scheme offers low tariff access to electricity to about 100,000 people across the case study area, including many low-income households (Martínez and van Hofwegen, 2006), whereas another 4,000 people have gained access to irrigation, leading to a substantial growth in production and income levels. The royalty paid by the project is estimated to be approximately Rs 2.5 millions per year. This is equally shared between the central and local government. Table 10 shows the capacity and cost per Kw (adjusted to 2013 price levels in US $) for the major small-scale hydroelectric projects in Nepal. As stated, AHREP has been estimated to have the lowest average cost, i.e. $655.62 per Kw. Thus, AHREP installation appears to perform very well in terms of cost efficiency.

<Table 10> Cost per kW for Small-scale Hydropower Projects in Nepal

Project Name	Installed Capacity (MW)	Cost per kW (adjusted to 2013) price levels, US $)
Indrawati 3	7.5	3442
Andhikhola	5.1	655.62
Khudi	3.5	2665.61
Piluwa Khola	3	1830.99
Sunkosi Small	2.5	2012.15
Thoppalkhola	1.7	2988.03
Chakukhola	1.5	3452.79
Phemekhola	1	1838.54
Sisnekhola	0.8	1471.91
Sangekhola	0.1	1692.97
Mailun Khola	5	2386.38
Belkhu Khola	2.2	1793.15
Rahughat	27	3322.05
Sunkosi	10	778.55
Puwakhola	6.2	3416.12
Chatara	3.2	964.02
Panauti	2.4	1063.23

Source: Adapted from Bergner (2013, 50)

According to van Etten, van Koppen, and Pun (2002), production was increased from two to three crops per year, leading in turn into significant improvements in food security and household income. Subsequently, the increase in the household's wealth and quality for life resulted in a corresponding increase in the number of livestock. Also, cropping intensification forced mainly large-scale land and farm owners to hire more labor or leasing out more land in favour of small-scale poorer farmers. Business-wise, access to electricity benefited the operation of small businesses, since surplus daylight generation became available for a variety of activities, such as milling, husking, spinning, agro-processing techniques, and pump irrigation. In general, although the installation of the new scheme had a positive impact on all classes of the population, relatively more benefits were observed for higher incone businesses and households.

3. Environmental Performance

Although there was no formal environmental assessment during the planning of the project, the installation of AHREP plant appeared to have little environmental impact, because it did not have storage (BPCL, 2005), whereas the headrace tunnel, the powerhouse and tailrace are all beneath the earth. With reference to water status, various tests that were carried out at various locations yielded a satisfactory level of quality. Moreover, the settling basin side to allow free passage of aquatic species had provided a fish ladder. Overall, there has not been detected any negative impact on river's biodiversity[3] and pest flora and fauna. Finally, AHREP project has been

3) There are not any recorded rare endangered species across the project area.

complying the downstream environmental flow as per government acts and regulations when licenses were released, resulting in a release of adequate environmental flow during the year. No conflict in the downstream flow regime has been detected. Further, no sedimentation problem has been detected in the upstream of the river nor is there erosion problem in the project area and the project included a reforestation program in the project area for erosion control and protection of the environment. In addition, BPCL has extended its certification scope from Quality and Environmental Management System ISO 9001:2008 and ISO 14001:2004 to Occupational Health and Safety Management System ISO 18001:2007. BPCL is the first hydropower company that has been certified for occupational health and safety management system (BPCL, 2014).

With regards to positive environmental impacts, although there is no evidence on the specific project, findings from other micro-hydro power schemes have shown that benefits occur for the condition of the local environment mainly through the reduction of firewood consumption. Due to limited access to electricity, firewood is the main source of energy for cooking, heating, and lighting across the country. In turn, increased use of firewood worsens the problem of deforestation. For example, the installation of a MPH electricity plan in a rural area of Nepal resulted in increased “greenery”, through the decrease in firewood consumption (Gurung, Gurung, and Oh, 2011). The significant reduction of firewood (among other “dirty” sources of energy) use can be observed in Table 11 in the case study area of Tangting.

<Table 11> Fuel Used for Cooking, Heating, and Lighting before and after the Installation of the MPH

Category	Before	After	Change	Percentage change
Firewood (bhari/month)	9	4	5	55.55
Agriculture residue (bhari/month)	3	1	2	66.66
Animal dung (kg/month)	1	0	1	100
Kerosene (L/month)	3	0	3	100
Alkaline battery (US $/month/household)	30	5	25	83.33
Toilet	0	20	20	100
Plantation (%)	0	30	30	100

Source: Gurung, Gurung and Oh (2011)

To mention another example, the installation of MHP plants has a strong mitigation effect on climate change. According to a study carried out by Banerjee, Singh, and Samad (2011), approximately 10 million kg of CO_2 are reduced every year by MHP connected households in Nepal that switch from biomass sources of energy consumption such as kerosene and firewood to hydro-electricity. This is a rather significant amount given that there are still only a small percentage of households connected with hydro-electricity plants.

4. Social Performance

The initiative for the installation of AHREP scheme was accompanied by strong community engagement. The project team of the scheme was engaged directly with local leaders and population in order to identify their perceptions and views, to explain the purpose and stages of the project, and to achieve strong collaboration and acceptance. In 1982, a base line survey of the project area was carried out "to ascertain people's need and attitudes and potential areas of development for use in planning the project" (BCPL, 2005, p.7). The project team engaged directly with the surveyed households during the survey to explain the project. This allowed a process of consultation and generated community acceptance of the project. Further, in an attempt to reduce the cost of electrification in rural areas, BPCL decided to involve the local communities in the construction and operation of their energy distribution system. Thus, the creation of electricity users' organizations (UO) was encouraged. It was established that BPCL would deal only with UOs rather than within dividual consumers on all matters related to the supply of electricity to communities. Thus, it was the responsibility of the members of communities that were interested in receiving power services to organize themselves into a UO (the BPC provides assistance if this is required). The UOs would use local labor and material inputs in the construction, maintenance and management of village-wide systems. They would also stimulate local initiatives and ensure community commitment to the project. The UOs were responsible for gathering and submitting applications for connections to BPC; organizing contribution of local materials (e.g. wooden poles) and labor; collecting bills and fees from consumers; routine control and maintenance of the distribution system; and serving as communications link between the community and BPCL. There is an evidence that this strategy also encouraged women's participation in the electrification process of their community (see Picture 8), as well as in the collection of fees and other administrative issues (Inversin, 1994; BPCL, 2005).

Source: BPCL (2005)

<Picture 7> Women's Participation in Electrification

Within this context, Andhi Khola Multipurpose Water Users Association was formed in order to manage the irrigation system and maintain equity in water distribution, whereas a wide range of local users' organization were involved with the distribution of electricity. Finally, it should be mentioned that AHREP did not require a single household to be displaced. It only required minimum land acquisition, mostly uncultivated land, the compensation for which were provided with little complications (BCPL, 2005).

The installation of AHREP provided "clean" and affordable electricity that assisted important activities such as cooking and heating, and offered increased quantities of drinking water supply. Those improvements had a direct impact on important aspects of the society such as public health, formal and informal education, and engagement in social activities. Although, to the best of our knowledge, there is no specific data on the impact of AHREP on health and education, evidence from other case studies may justify the aforementioned benefits. For example, with reference to health, the existence of affordable micro-hydro electricity resulted in a significant decrease in indoor pollution in the area of Tangting, mainly through the reduction of household's dependence on use of firewood, candles, and kerosene for daily household needs such as cooking and lighting (Gurung, Gurung, and Oh, 2011). As presented in Table 12, a reduction has been observed to all indoor pollution-related diseases.

<Table 12> Incidence of Diseases/Health Problems by Gender after the MHP Plant Installation in Tangting

Particulars	Diseases	Increased	Decreased	No Change	No disease
Male	Eye infection	1 (0.66)	75 (50.00)	15 (10.00)	59 (39.33)
	Respiratory	0 (0.00)	70 (46.66)	18 (12.00)	62 (41.33)
	Cough	0 (0.00)	68 (45.33)	22 (14.66)	60 (40.00)
	Headache	2 (1.33)	55 (36.66)	35 (23.32)	60 (40.00)
	Back problem	3 (2.00)	50 (33.33)	25 (16.66)	72 (48.00)
Female	Eye infection	0 (0.00)	85 (56.66)	15 (10.00)	50 (33.33)
	Respiratory	1 (0.66)	80 (53.33)	10 (6.66)	60 (40.00)
	Cough	0 (0.00)	78 (52.00)	20 (13.33)	52 (34.66)
	Headache	2 (1.33)	65 (43.33)	25 (16.66)	58 (38.66)
	Back problem	0 (0.00)	56 (37.33)	35 (23.33)	59 (39.33)

Values without and with parenthesis show the number of respondents and percentage respectively.
Source: Gurung, Gurung, and Oh (2011)

Using again data from Tangting, access to electricity-supported schools' function, promotes children's performance (through increase in reading hours) in school and both children and adult's participation in informal education and various social activities. According to van Etten, van Koppen, and Pun (2002), benefits were gender-biased in case of AHREP project, since women's traditional tasks such as weeding, transplanting, and harvesting were intensified together with the production intensification frow improved irrigation. On the other hand, as it can be seen in Table 13, there is evidence from

Tangting area that women and children may benefitted significantly from the reduction of workload for firewood collection and the increased time availability for productive personal and social activities.

<Table 13> Utilization of Saved Time in Various Activities after MHP Installation in Tangting

Activities	Male	Female
Income generating activities	80 (53.33)	70 (46.66)
Attending adult literacy	0 (0.00)	60 (40.00)
Social/community work	70 (46.66)	80 (53.33)
Recreation/watching TV	55 (36.66)	95 (63.33)
No of student increased	50 (33.33)	35 (23.33)

Values without and with parenthesis show the number of respondents and percentage respectively.
Source: Gurung, Gurung and Oh (2011)

With regards to social activities, although there is no specific evidence – to the best of our knowledge – for the case of AHREP, outcomes from other studies provide strong signals about the beneficial effects of these schemes to the increase of local community's social well-being. To mention one example, in the village of Pokhari Chauri, the arrival of MPH electricity was accompanied by community programs that informed and encouraged village members to get involved in a wide range of community development activities through the formation of 22 community organizations – 11 male and 11 female in order to promote gender equity and participation – by the Rural Energy Development Program (Yadoo and Cruickshank 2012). Activities included, among others, training in soap-making, off-season vegetables, poultry farming, bee keeping, forest nursery, building of pit latrines, and permanent toilets and garbage bins. As a result, among others, community members became more aware and responsible of environmental issues.

V. Lessons Learned and Conclusions

The Andhikhola Hydel and Rural Electrification Project is a suitable illustration of Nepal's water and green growth strategy. AHREP is a successful Micro Hydropower project. The plant generates 5.1 MW that is used for irrigation activities and local electricity supply. Based on the available literature on both AHREP region and other areas with similar schemes, it appears that there are a number of benefits arising from these schemes for the economic, social, and environmental development of the region. Access to irrigation and electricity services had a positive impact on food security since the area irrigated land increased to 282 hectares and this provoked an increase in the agricultural production and had a positive impact on the communities health, levels of income, employment opportunities, and opportunities for local community development. Further, water for washing, cleaning, bathing, and cooking was now available to more households. Based on evidence from other case studies only, the reduction in the consumption of kerosene and firewood appears to diminish indoor pollution and related illnesses.This explains the proposal to change the tariff scheme into one that allows the viability of the project and the efficient use of electric power. Finally, it should be noted that the project was accompanied by strong community engagement (through User Organisations). One of the most important lessons to be learned from this scheme is that direct engagement with the local community is crucial for the success of water and green growth project. In this case, such engagement allowed a strong community collaboration and acceptance of the project that was a necessary precondition for its development and implementation. Nevertheless, it is evident that profound institutional reforms in the water and in the electricity sectors are required. The social and political unrest has occasioned an overreliance on foreign aid, discontinued policies, uncertainty, and weak implementation of reforms. Political commitment to institutional reforms along with monitoring and enforcing mechanisms are required to implement the reforms in the electricity sector and to attract and retain adequate investments in the sector.

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Interview 1

Respondent 1 was required to provide his expert opinion about “the Andhikhola Hydel and Rural Electrification Project”. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers, and users. In his opinion, those legal provisions are more effective for officials, than for water suppliers and users. About the way that legal provisions of accountability are translated administratively and how effective they are in practice, he mentioned that within formal water administration, there is administrative supervision, financial auditing, work auditing, and grievance cells. He considers that water data is adequately collected, managed, and publicized by the Department of Hydrology and Meteorology. He considers that the data is very much open to the public through printed materials, upon request, on company reports, external audit, and on government audits. He stated that this data is adequate for the planning, implementation, evaluation, and research. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policiesm he declared that there are well-organized plans related to water management; but the project is not very well aligned with the plans. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the project was only possible with grant financing, which enhanced agricultural production making irrigation possible. Rural electrification was possible, with road access to areas surrounding project. The project is subject to income tax and custom tax exemptions. Finally, he stated that there are not specific regulations directly affecting the project. In the case of market policies, he stated that there is full subsidy for irrigation. In relation to private sector promotion policies, he considers that users are favorable toward private sector involvement in the project. Finally, he mentioned that equity factors and agricultural production were the criteria used in the project selection.

In the case of community policies, in terms of stakeholder participation he mentioned that the central government and firms participated in important decision-making and residents were consulted. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the local administration/govt. and water user associations (WUAs) such as AKWUA could intervene in conflict resolution regarding the case in question. He mentioned that government to government negotiations are legally specified mechanisms for transboundary conflicts. When asked about the overall performance of the project, he identified important factors that contributed to the success of the project the rural electrification: irrigation, and local people's participation, many development areas supported, local skill development. On the other hand, energy pricing favored grid supply to rural electrification. Overall, he considers that the intended objectives of the project have been achieved 100%.

In terms of economic performance, he considers that there was a positive impact on local development and the gross regional domestic product, a very positive impact on the technological performance, and the most positive impact on job creation in the local economy. In terms of social performance, he reckons that the project had a marginal positive impact on improving citizen participation in decision-making or in gender equality and people's health. However, he considers that there was a positive impact on quality of life. In terms of environmental performance, he considers that there was a marginal positive impact on water quality improvements; a positive impact on maintaining or restoring biodiversity and in increasing environmental awareness; and a marginal negative impact on disaster safety.

Interview 2

Respondent 2 was required to provide his expert opinion about "the Andhikhola Hydel and Rural Electrification Project" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials, water suppliers, and users. In his opinion, those legal provisions are more effective for officials and water suppliers than for users. About the way that legal provisions of accountability are translated administratively and how effective they are in practice, he mentioned that within formal water administration, there is administrative supervision and financial auditing. He considers that water data is adequately collected, managed and publicized by the Department of Hydrology, and Meteorology. He considers that the data is not very much open to the public. He mentioned that data is available through printed materials, upon request, on company reports, external audit, and on government audits. He stated that this data is adequate for the planning, implementation, evaluation, coordination, and conflict resolution and research. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies he declared that there are well-organized plans related to water management, and the project is somehow well aligned with the plans. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the impacts of the financial support are rural electrification, irrigation to non-irrigated areas, increase in agricultural production and improvement in health and education, awareness creation, education, and health. The project is subject to: sales tax – project cost increase, income tax- decreased profit to company, increased cost to company, income tax holiday for first 15 years, and customs exemption countered this to a degree. Finally, he stated that there are not specific regulations directly affecting the project. In the case of market policies, he stated that there is full subsidy for irrigation. In relation to private sector promotion policies, he considers that users are favorable toward private sector involvement in the project. Finally, he mentioned that equity factors and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, he mentioned that the local government, NGOs, residents, and firms participated in important decision-making and the central government and political parties were consulted. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the local administration/government, judicial/legislative/constitutional, and water user associations could intervene in conflict resolution regarding the case in question. He mentioned that government to government negotiations are legally specified mechanisms for transboundary conflicts. When interrogated about the overall performance of the project, he identified important factors that contributed to the successes of the project: the local participation, less political interference, dedicated foreign volunteer experts, and localized technologies. On the other hand, increasing community expectations caused more demands for water and electricity. Overall, he considers that the intended objectives of the project have been achieved 90%.

In terms of economic performance, he considers that there was a marginal positive impact on the gross regional domestic product; a positive impact on local development; and a very positive impact on technological performance and on job creation in the local economy. In terms of social performance, he reckons that the project had a very positive impact on improving citizen participation in decision-making; and a positive impact on gender equality, people's health, and on quality of life. In terms of environmental performance, he considers that there was a positive impact on water quality improvements, on maintaining or restoring biodiversity, and on increasing environmental awareness and no impact on disaster safety.

Interview 3

Respondent 3 was required to provide his expert opinion about "the Andhikhola Hydel and Rural Electrification Project". In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for officials than for users. About the way that legal provisions of accountability are translated administratively and how effective they are in practice, he mentioned that within formal water administration, there is work auditing and grievance cells. Outside formal water administration, there are local user groups, NGOs, and local administration (government). He considers that water data is adequately collected, managed, and publicized by the Department of Hydrology and Meteorology. He did not answer any question related to data collection and dissemination because he mentioned that he does not know about that. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies, he declared that there are well-organized plans related to water management; and the project is not very well aligned with the plans. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the impacts of the financial support are the creation of the pioneering project and encouragement of private sector development. The project is income tax exempt for 15 years. Finally, he stated that there are not specific regulations directly affecting the project. In the case of market policies, he stated that there is full subsidy for irrigation. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that equity and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, he mentioned that the central government and firms participated in important decision-making, and the local government and the residents were consulted. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the local administration/government, and water user associations could intervene in conflict resolution. He did not identified mechanisms for transboundary conflicts. When interrogated about the overall performance of the project, he identified important factors that contributed to the successes of the project: the need based activities, multipurpose use of water, equity in water sharing, and technology. Overall, he considers that the intended objectives of the project have been achieved 80%.

In terms of economic performance, he considers that there was a positive impact on the gross regional domestic product, on technological performance, and on job creation in the local economy; and a very positive impact on local development. In terms of social performance, he reckons that the project had a very positive impact on people's health and on quality of life; a positive impact on improving citizen participation in decision-making; and a marginal positive impact on gender equality. In terms of environmental performance, he considers that there was a positive impact on restoring biodiversity and on disaster safety; a marginal positive impact on water quality improvements; and a very positive impact on increasing environmental awareness.

Interview 4

Respondent 4 was required to provide his expert opinion about "the Andhikhola Hydel and Rural Electrification Project" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for water suppliers and officials than for users. About the way that legal provisions of accountability are translated administratively and how effective they are in practice, he mentioned that within formal water administration, there is financial auditing, administrative supervision, and work auditing. Outside formal water administration, there are local user groups. He considers that water data is adequately collected, managed, and publicized by the Department of Hydrology and Meteorology.

He considers that the data is somehow open to the public. He mentioned that data is available through websites, printed materials, and upon request. He stated that this data is a little adequate for the planning, implementation, evaluation, coordination, and conflict resolution and research. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies, he declared that there are well-organized plans related to water management; and the project is well aligned with the plans. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the impacts of the financial support are rural electrification, irrigation, employment, and industries. He does not know if there are tax exemptions in place for the project. Finally, he stated that there are not specific regulations directly affecting the project. In the case of market policies, he stated that there is full subsidy for irrigation. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that equity and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, he mentioned that the central government and firms participated in important decision-making, the local government, and the residents were consulted; and NGOs were informed. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. However, he mentioned that the local administration/government and water user associations could intervene in conflict resolution. He did not identif mechanisms for transboundary conflicts. When questioned about the overall performance of the project, he identified important factors that contributed to the successes of the project: the energy focus, technology transfer, low cost technologies, local participation, education and motivation. On the other hand, high community expectation and unrest by communities caused unexpected results in the case's implementation. Overall, he considers that the intended objectives of the project have been achieved 90%.

In terms of economic performance, he considers that there was a very positive impact on the gross regional domestic product, on local development, and on job creation in the local economy; and a positive impact on technological performance. In terms of social performance, he reckons that the project had a very positive impact on quality of life; a positive impact on people's health; and a marginal positive impact on improving citizen participation in decision-making and on gender equality. In terms of environmental performance, he considers that there was a very positive impact on water quality improvements; a positive impact on restoring biodiversity and on increasing environmental awareness and no impact on disaster safety.

Interview 5

Respondent 5 was required to provide his expert opinion about the "Andhikhola Hydel and Rural Electrification Project" project. In terms of community institutional factors, he stated that there are explicit legal provisions for ensuring the accountability of officials and users. In his opinion, those legal provisions are more effective for officials than for water suppliers and users. About the way that legal provisions of accountability are translated administratively and how effective they are in practice, he mentioned that within formal water administration, there is financial auditing and administrative supervision. Outside formal water administration, there are local user groups and local administration (government). He considers that water data is adequately collected, managed, and publicized by the Department of Hydrology and Meteorology. He considers that the data is somehow open to the public. He mentioned that data is available through printed materials, company reports, and government order, and upon request. He stated that this data is a somehow adequate for the planning, implementation, evaluation, coordination and conflict resolution, and research. Finally, he considers that the project represents an IWRM approach.

In relation to the choice of policy mix, in the case of state/administration policies, he declared that there are well-organized plans related to water management; and the project is not aligned with the plans. He mentioned that the project has received financial support such as subsidies or Official Development Assistance (ODA). He explained that the impacts of the financial support are benefits channeled to beneficiaries, local participation, efficient use of funds, and strong management. He does not know if there are tax exemptions in place for the project. Finally, he stated that there are not specific regulations directly affecting the project. In the case of market policies, he stated that there is full subsidy for irrigation. In relation to private sector promotion policies, he considers that users are favorable overall. Finally, he mentioned that equity and ecological factors were the criteria used in the project selection. In the case of community policies, in terms of stakeholder participation, he mentioned that NGOs, residents, and firms participated in important decision-making; the local government was consulted and the central government was informed. On the other hand, he mentioned that there are no clear conflict-resolution mechanisms explicitly specified in the law. He mentioned that the local administration/ government and water user associations could intervene in conflict resolution. He identified government to government mechanisms for transboundary conflicts. When questioned about the overall performance of the project, he identified important factors that contributed to the successes of the project: the need based approach, strong management, grant funding availability, and the focus on local participation. On the other hand, high community expectation by local communities caused unexpected results in the case's implementation. Overall, he considers that the intended objectives of the project have been achieved 90%.

In terms of economic performance, he considers that there was a very positive impact on the gross regional domestic product and on local development; a positive impact on technological performance; and a marginally positive impact on job creation in the local economy. In terms of social performance, he reckons that the project had a very positive impact on quality of life, on people's health, and on gender equality; and a positive impact on improving citizen participation in decision-making. In terms of environmental performance, he considers that there was a positive impact on increasing environmental awareness; a marginal positive impact on water quality improvements; and no impact on restoring biodiversity and on disaster safety.

Water and Green Growth Case Study Report 9

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About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth 2015 follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

Disclaimer
This report is an output of the staff of Research Center for Water Policy and Economy at K-water Institute. The findings, interpretations, arguments and conclusions expressed in this report do not necessarily reflect the views of K-water Institute, K-water, their Board of Directors, and World Water Council.

Prepared for
Ministry of Land, Infrastructure and Transport, Republic of Korea and K-water (Korea Water Resources Cooperation) in cooperation with the World Water Council.

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I. Executive Summary

Purpose of the Case Study

Ulsan is a microcosm of Korea's industrialization history: from the industrialization of the Ulsan area and environmental damage as a consequence, followed by restorative measures to its transformation to an ecological city. This report presents policy lessons drawn from the green growth case of Ulsan (with Taehwa River at its heart), which was able to transform into an eco-city from once heavily polluted city as a result of growth-centric industrialization and urbanization.

Case Overview

Ulsan has a number of geographical advantages for an industrial city. Being located by the sea, it meets the conditions for a bay and harbor. With its location on the Taehwa River, it has a readily accessible supply of water for industrial use. There are no high mountains in coastal area. Therefore, it has the possibility to expand the area of land for development. Given these advantages, Ulsan was designated in 1962 as Korea's first industrial zone in 1962.

After the designation, population growth and industrialization progressed rapidly with the entry of large-scale heavy and chemical industries including petrochemicals, automobiles, and shipbuilding. However, the insufficient environmental facilities led to the discharge of domestic sewage into the Taehwa River. Also, construction of dams for industrial use led to water shortage for maintaining adequate river flow. As a result, the water quality of Taehwa sunk to its worst in 1996, with a BOD of 11.3ppm.

In an attempt to address water quality problem that was reported daily by the press, citizen groups and the local government engaged in a scattered and uncoordinated measures to improve the situation. However, these efforts were not enough.

In the early 2000s, Ulsan adopted "The Ecopolis Ulsan Declaration" for ecological restoration. The aim was to go beyond environmental movement and to build an eco-city, where the environment, industry, and residents could coexist. To put the declaration into effect, in 2005, Ulsan adopted the Taehwa River Master Plan, which organized all the water quality improvement and riverfront development projects that had been undertaken to date. Also, an implementation body to carry out the work was established.

The ecological restoration project mainly consists of: (1) the water quality improvement project that focuses on sewage pipe maintenance, sewage plant construction, and the expansion of sewage treatment facilities generally; and (2) the riverfront development projects that includes the Taehwa River Grand Park and ecological space sub-projects. The total project costs over the 12-year period from 2002 to 2013 amounts to 629 billion won for the water quality improvement project, and 336.6 billion won for the riverfront development project, amounting to a total of 965.6 billion won.

The city of Ulsan played a leading role in the ecological restoration project, while building a cooperative network between environmental groups, local experts, local enterprises, and the local community. It formed the "Green Ulsan 21 Environmental Committee" consisting of 50 members representing the region's education, press, environmental, and other related organizations and legally guaranteed policy participation and budget support. Furthermore, the environmental awareness was raised thanks to the education programs for citizens and formation of environmental watch group for the Taehwa River consisting of local residents. The citizens contributed to the task of monitoring the river's environment, which could not be adequately undertaken by an administrative body alone. Local enterprises also actively participated in the restoration project, promoting corporate social responsibility (CSR) by providing financial support.

As a result, the Taehwa River Ecological Restoration Project was a success. Today, Ulsan has earned the reputation of being an ecological city rather than a polluted city. After the Ecopolis Ulsan Declaration was made, the sewage system comection rate of 72.1% in 2001 has risen to 97% in 2012. The water quality of Taehwa in terms of BOD has consistently remained below 2ppm since 2011, which is the best among Korea's rivers. The river water quality improvement has carried over into coastal water quality improvement. These efforts and the creation of the Taehwa River Grand Park and other waterfront areas has increased the quality of life for residents. This is shown in resident surveys on satisfaction of the Taehwa River, in which the percentage of satisfied respondents rose from 8.7% in 2004 to 72.8% in 2013.

Lessons Learned

Ulsan, the city that drove Korea's economic development, was successfully transformed into an eco-city thanks to the will and the efforts of the municipality and its close cooperation with the local community. The Taehwa River was the primary focus of these efforts, and as such, this is a case of Water and Green Growth from which the following lessons can be learned:

- An industrial city can change into ecological city.
  - Ulsan transform from an economic growth-focused industrial city lacking environmental infrastructure into an ecopolis through the adoption and implementation of environmental conservation policies, including the ecological restoration of the Taehwa River.

- Water and Green Growth must be pursued holistically and with the long term perspective to ensure sustainability.
  - In the Taehwa case, the goals were not only to improve the water quality, but were also raising the quality of life through measures such as riverfront space creation and cultural and historical restoration. Given these aims, the long-term inclusive plans of both tangible and intangible aspects such as the expansion of basic environmental facilities, building of the Taehwa River Grand Park, hosting various festivals, and educating the public about the environment were adopted and undertaken. In result, sustainability has been secured.

- The realization of Water and Green Growth requires a strong leadership.
  - Due to disaggregated nature of the authority in the project, an opposition to and delay in its implementation were very likely. However, Ulsan Metropolitan City set the Taehwa River Restoration Project as its policy priority and resolutely pushed it, making Water and Green Growth Project possible.

- Engaging in public-civilian cooperation with stakeholders can increase the project’s performance.
  - The Green Ulsan 21 Environmental Committee legally guaranteed participation of citizens in policy making. It also delegated to citizens, activities such as raising awareness and environmental monitoring that were difficult for an administrative organization to manage. Citizens became direct participants from being mere beneficiaries of the project. By doing so, the performance of the Taehwa River Restoration Project was increased.

- Proactive public relations efforts are necessary to raise the participation of residents.
  - In order to raise concern for the need of an ecological restoration project and gain the residents support, the city of Ulsan had documentaries made and engaged in other public relations efforts, which resulted in increased residents' interest and participation.

- Water quality improvement in rivers contributes to the water quality improvement in the sea.
  - With the Taehwa River flowing into the East Sea, the improved water quality from the river improved the water quality in the sea.

II. An Overview: The Taehwa River Ecological Restoration Project

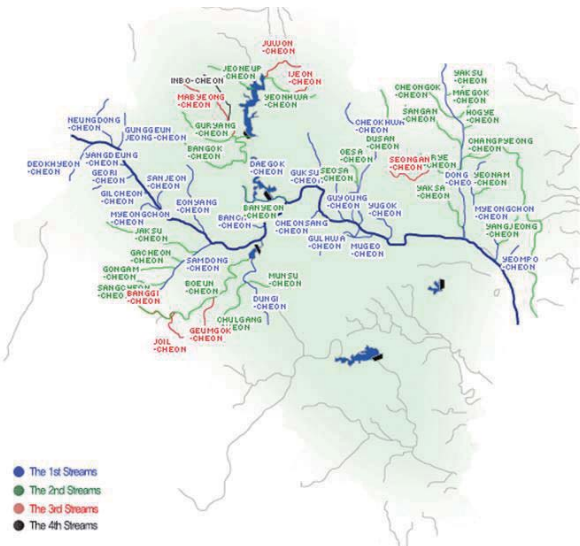
1. About the Taehwa River

Taehwa has been at the center of Ulsan's economic growth. With development of roads around the river and the formation of an industrial zone, commerce and population spurred around Taehwa.[1] The river basin stretches from west to east with an east longitude of 129°0'–129°25' and a north latitude of 35°27'–35°45'.

The Taehwa River is divided into one nationally administered section and 57 locally administered sections. The administratied districts within the basin consist of Ulsan Metropolitan City and Oedong-eub in Gyeongju, North Gyeongsang Province. Living conditions in the Taehwa River Basin are advantageous due to the natural conditions afforded by the river. Taehwa has been at the center of Ulsan's economic growth. With development of roads around the river and the formation of an industrial zone, commerce and population spurred around Taehwa.

Source: http://en.wikipedia.org/wiki/Ulsan (Jul. 7, 2014)

<Figure 1> Location of Ulsan



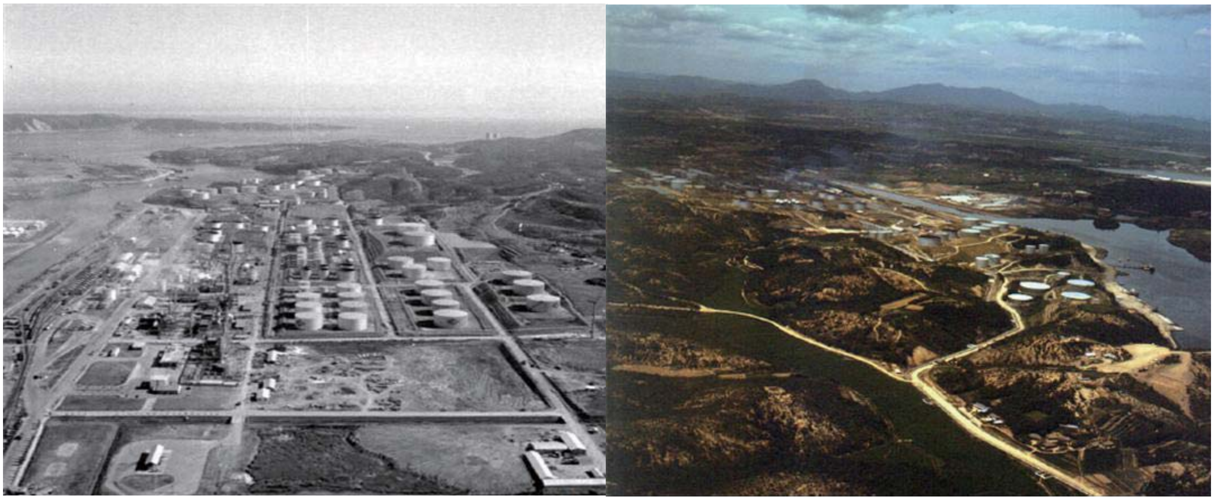
Source: http://taehwagang.ulsan.go.kr/story/story04_01.htm

<Figure 2> Taehwa River Basin

1-1. Stage 1: The Environmental Pollution Caused by Ulsan's Industrialization ('62–'02)

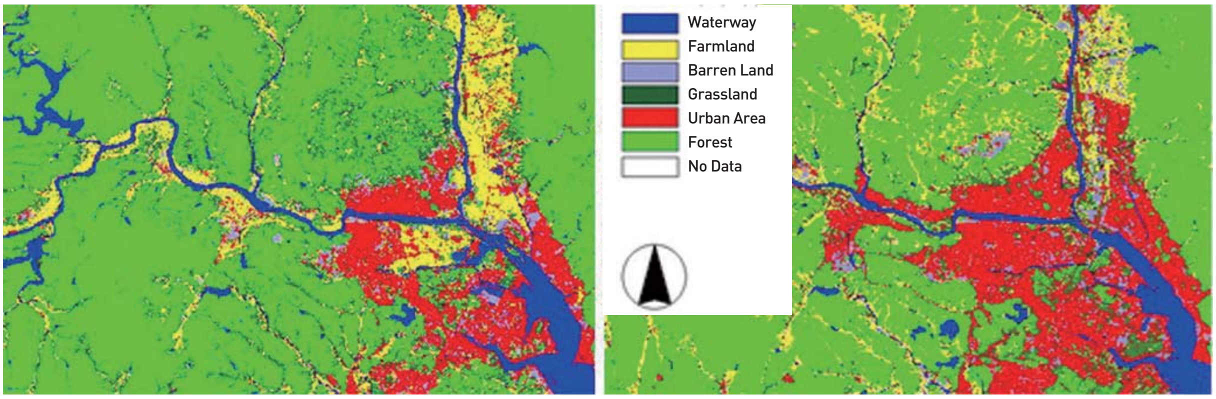
In January 1962, under Korea's first Five-Year Economic Development Plan, the agrarian town of Ulsan—64% of the economically active population engaged in farming in 1961—was designated as Ulsan Special Industrial Zone, by the Korean government. Ulsan is located on the coast, meaning harbor could easily be formed for imports and experts. Its location on the Taehwa River ensured ready access to water for industrial use. The coastal area meant there were no high mountains, and a developable land could easily be secured. Additionally, the East Sea Southern Line meant that goods could easily be transported across land by rail. These favorable

1) http://taehwagang.ulsan.go.kr/story/story01_01.htm



Source: National Archives of Korea

<Picture 1> Ulsan Industrial Complex (1969)



Source: Ulsan Metropolitan City Web site

<Figure 3> Map of Land Use in the Taehwa River Basin (Left: 1985, Right: 2000)

conditions led to Ulsan's recognition as a special industrial zone. Subsequently, in 1964, Ulsan saw the completion of Korea's first oil refinery, and in 1968, the entry of Hyundai Motor Company's Ulsan factory and a large-scale petrochemical industrial complex. As large industrial complexes formed at the mouth of the Taehwa River, job-seeking people from different regions flowed into Ulsan in large numbers, and Ulsan urbanized rapidly.

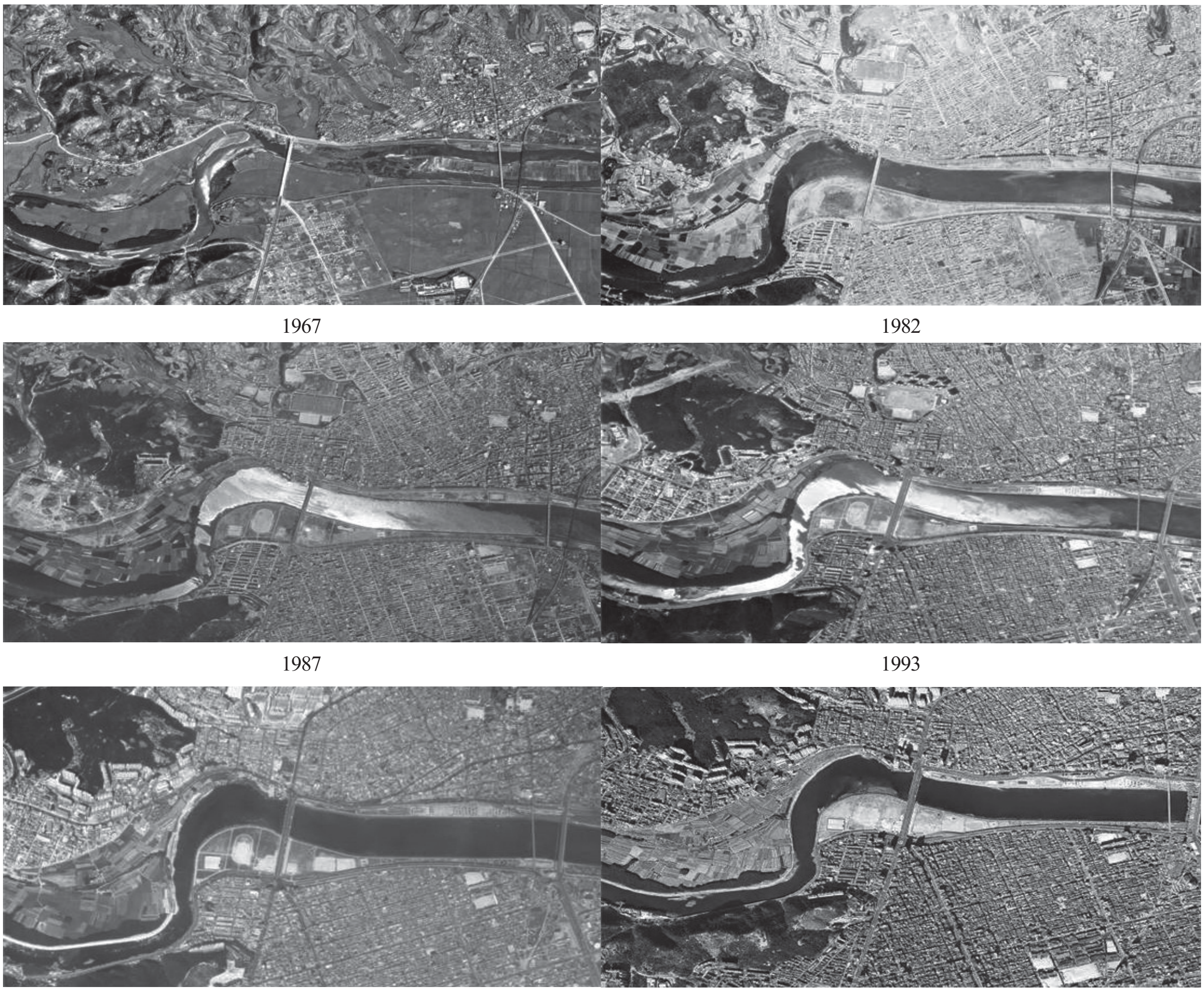
The process of urbanization progressed under the policies of the national government. Poverty reduction driven by industrialization was a national priority at the time, meaning environmental awareness was extremely low. Domestic wastewater from the city was indiscriminately discharged into the river. Moreover, the need for industrial water grew as the industrial structure shifted from the primary industries to manufacturing-based secondary industries. The Sayeon and Daeam Dams were constructed to meet this need, but this led to a downstream shortage of water downstream to maintain adequate river flow, exacerbating water pollution. Taehwa soon becam a "sewer" for Ulsan.

Source: Taehwa River White Paper, 91

<Picture 2> Inflow of Household Wastewater (Early 1990s)

The pollution in the Taehwa River gave Ulsan its name as a polluted city which decreased the number of visitors to Ulsan and the quality of life for Ulsan residents. In response, in the late 1980s, the environmental groups led several movements to stop further pollution of the river and to return it to its original status.

In addition to the rapid population growth and dense residential areas, farming and livestock raising zones were promoted under the farming community stimulation policy. As a consequence, the factory and farm wastewater added to the the domestic sewage into the river which further aggravated the river's water quality.



1967 1982

1987 1993

1996 2001

<Picture 3> Aerial Photographs of the Taehwa River

<Table 1> Main Policies, 1962–2000

Period	Main Policies
Jan. 1962	Announcement of 1st Five-Year Economic Development Plan & designation of Ulsan Special Industrial Zone.
1964	Korea's first oil refinery built (the Korea Oil Corporation Ulsan Oil Refinery).
1968	Hyundai Motor Company's Ulsan factory, petrochemicals, & other industrial complexes built.
Late 1980s	Movement for pollution prevention in & restoration of Taehwa River begins led by local environmental groups.
1990s	Rapid population growth, dense residential zones, & entry of farming zones compound pollution of Taehwa River through agricultural and factory wastewater.
1996	Taehwa River records worst water quality (11.3ppm BOD).
1997	1st Environmental Improvement Medium-Term Comprehensive Plan adopted; Ulsan begins full-scale steps to restore and preserve air & water quality & ecology.
Jun. 2000	Mass fish death televised nationally; awareness of Taehwa River's severe pollution spreads.

Fishes died in mass numbers (five incidents in 1992 alone), and the BOD of the river reached its worst ever level of 11.3ppm in 1996. Again in June 2000, another mass fish death occurred. The broadcast of this incident on national television gave rise to nationwide recognition on the seriousness of the Taehwa River's pollution, and became the background of spurning the River Revival Campaign. Despite this movement, contaminated water continued to flow into the river, and the press to reported the problem day in, day out.

1-2. Stage 2: Building an Eco-City through the Taehwa River Restoration Project ('03–'Present)

At the beginning of 2000s, the city of Ulsan began its efforts to improve the environmental pollution problem. Going beyond mere pollution reduction, Ulsan adjusted its development course toward building an ecological city in 2004. This paradigm shift was marked by the adoption of the Ecopolis Ulsan Declaration and the Ecopolis Ulsan Plan, which emphasized the coexistence of environment, industry, and residents. The year 2004 was proclaimed as the founding year.

<Picture 4> Ecopolis Ulsan Declaration Monument

To put this into effect, the Taehwa River Master Plan was adopted in 2005. Saving Taehwa River was its highest priority. As a result of the restoration project undertaken based on the Master Plan, the Taehwa River was gradually transformed into a clean river and became widely recognized as Ulsan's representative landmark.

As the short-term target year in the Phase 1 project (2004–09) approached, the Phase 2 Comprehensive Plan was adopted to ensure the continuation of the Taehwa River environmental policy. The plan consisted building treatment facilities for water quality improvement, the development of waterfront space such as the Taehwa River Grand Park, and projects for cultural value restoration such as creating the Taehwa River Observation Walk; all of which aimed to turn the river into a safe, ecologically health, and culturally enjoyable space.

In 2003, the city of Ulsan formed the Taehwa River Water Quality Improvement Planning Team within its environmental policy division, and was assigned to draft a water quality improvement comprehensive plan, coordinating the first phase of the water quality improvement project, and implementing some of the water quality sub-projects. But as the work grew in scope, the city in 2006 founded the Taehwa River Management Body as a separate entity to carry out the project, tasking its 100 members with the river's management.

The Taehwa River Restoration Project was carried out under the leadership of Ulsan Metropolitan City, a municipal-level authority. Within this process, Ulsan built and worked in a close cooperation with structure with the local community. Thanks to the efforts of Ulsan's environmental groups, local experts, local volunteer projects by K-water and other companies, citizen participation, and the local press, the Taehwa River was reborn from a state almost uninhabitable for life in 1996 (11.3ppm BOD) into a river of life boasting the best water quality of all the nation's rivers by 2011 (1.9ppm BOD).

This miracle is considered the fruition of the efforts of the municipal government, local residents, and area businesses, who realized that Ulsan would have no future without a clean river.

1960s (with island)

2002

2011

Source: Taehwa River White Paper, 11

<Picture 5> Changes in the Downstream of the Taehwa River

<Table 2> Main Policies, 2001–2013

Period	Main Policies
2003	Adoption of 2nd Environmental Preservation Medium-Term Comprehensive Plan (2004–2008)
May 2003	Taehwa River Water Quality Improvement Planning Team formed
Dec. 2003	Taehwa River Citizen's Environmental Watch Group formed
Jun. 2004	Ecopolis Ulsan Plan adopted & Ecopolis Ulsan Declaration made; 2004 declared as the founding year of ecological city of Ulsan
Jan. 2005	Ulsan hosts citizen discussion on drafting Taehwa River Master Plan; 250 citizens & members of environmental groups & NGOs participate
Jul. 2005	Taehwa River Master Plan (2005–2014) adopted; Phase 1 begins
Jul. 2005	Taehwa River Master Plan implementation set & undertaken (10 years from July 2005 starting point)
2006	Taehwa River Management Body formed as an independent body & given full responsibility for implementing master plan
2010	Taehwa River Master Plan Phase 2 (2010–2014) adopted
2011	River water quality rises to 1b status (1.9ppm BOD)—best among nation's rivers
Dec. 2013	Selection as one of nation's 12 eco-tourism sites

III. The Case Study

1. Exogenous Factors

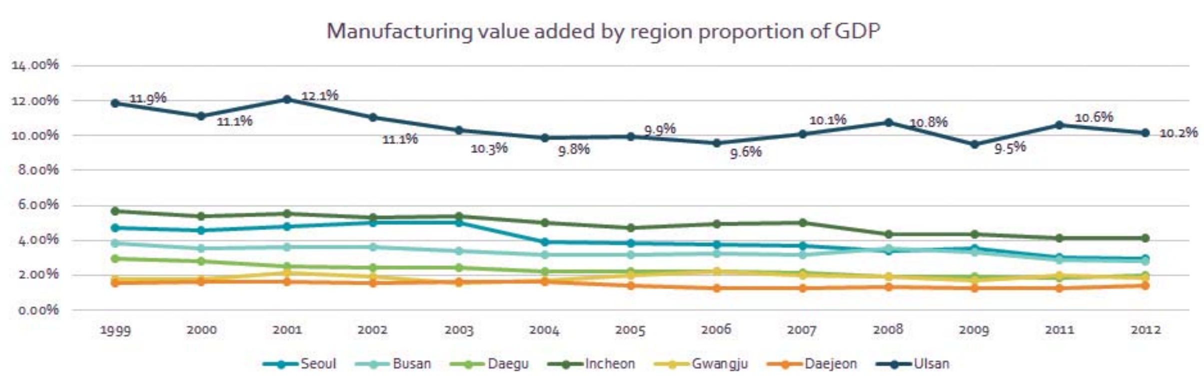
The exogenous factors present a picture of the general context in which a project is carried out. This section presents the general nationl level context in which the project occurred across the economic, social, political, environmental, and technological dimensions.

1-1. Economic Factors

1-1-1. Economic Growth and Structural Change

Ulsan was a coastal farming and fishing community before its designation as a special industrial zone in 1962. With the designation. Ulsan experienced population inflows as well as the entry of shipbuilding and oil refining industries and developed to its current state today. The goal of making the Ulsan Industrial Zone was to nurture heavy and chemical industries through large-scale oil-refinery, petrochemicals, automobiles, and shipbuilding; and through the construction of related industrial complexes, the upgrading of industrial structure, balanced development among industries, and attracting high-tech industries.

Since the 1990s, Ulsan has accounted for about 10% of value added for manufacturing companies (both light and heavy) in Korea employing at least 10% of workers, showing that Ulsan plays a core role in Korea's manufacturing value creation.



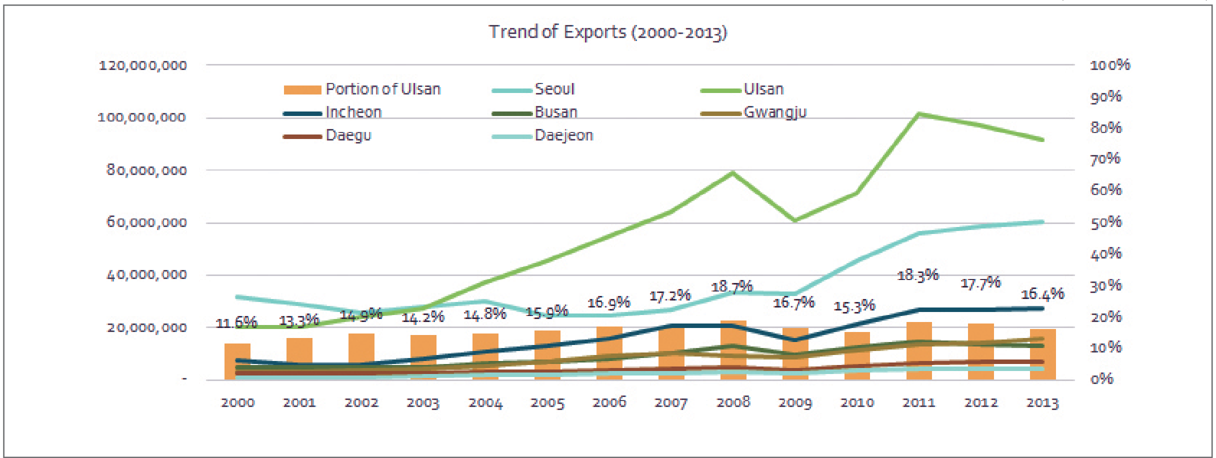
Source: Statistics Korea[2)]

<Figure 4> Share of Manufacturing Value Added of Metropolitan Cities

In the 1960s, Korea's economy began to experience rapid growth, with remarkable growth in manufacturing. During the period from 1960 to 1972, as the share of primary industry decreased greatly, the share of manufacturing grew from 10.8% to 25.2% (KDI, 2012). The development of manufacturing arose mainly from the increase in exports. From 1963 to 1973, the share of exports in manufacturing rose 12.7% from 2.8% to 15.5%.

Not only does Ulsan play a leading role in Korean production, it does so in Korean exports as well, having recorded 16.4% of Korea's exports in 2013 (see Figure 5). Compared to the 11.6% recorded in 2000, this is about a 5% rise. While Ulsan's exports rose an average of 12.4% annually between 2000 and 2013, the GRDP rose 7.7% from 2000 to 2012, showing that exports drove the growth of Ulsan's local economy. Ulsan's export structure shows concentration in particular product groups, with petrochemicals, automobiles, and shipbuilding comprising 80% of exports. Ulsan's balance of trade (in goods) Fro 2000s, Ulsan's balance of trade (in goods) rose from $15.7 billion surplus to an all-time high of $15.7 billion surplus in 2011 and recorded a surplus of $7.6 billion in 2013 (see Figure 7). The national trade balance has moved within a broad range of $13.3 billion deficit to $44.0 billion surplus from 2000 to 2013 due to the influence of global sporting events and currency exchange rates. However, Ulsan's trade balance has risen comparatively in a stable manner.

(Unit: USD 1,000)

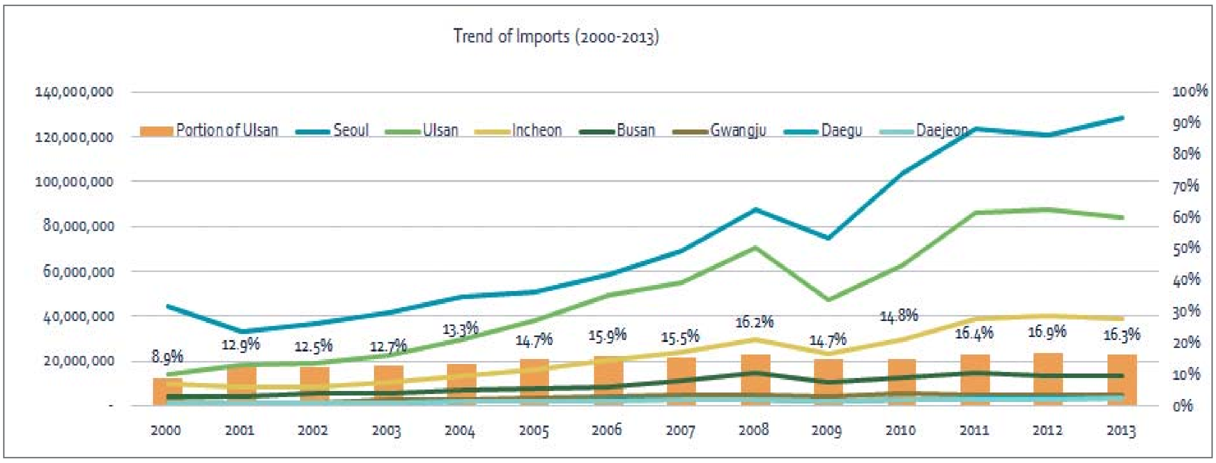


Source: Korea International Trade Association

<Figure 5> Exports of Metropolitan Cities (2000–2013)

2) http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1F160622&conn_path=I3

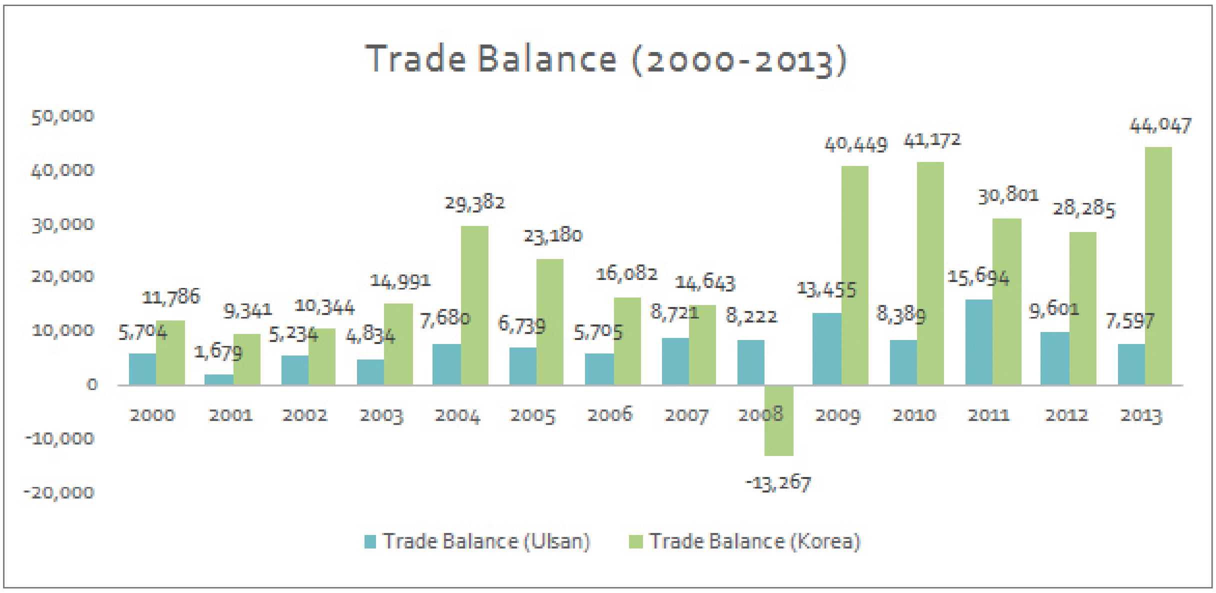
(Unit: USD 1,000)



Source: Korea International Trade Association

<Figure 6> Imports of Metropolitan Cities (2000–2013)

(Unit: USD 1 million)



Source: Korea International Trade Association

<Figure 7> Trade Balance of Ulsan (2000–2013)

1-1-2. Population Movement and Urbanization

Even up to Ulsan's promotion from town to city in 1962, the population did not exceed 210,000, the size of a small provincial city. However, when Ulsan was designated as a special industrial zone, Ulsan's industrial center began to form and population flows increased greatly.

From the 1970s, Ulsan's population began to grow rapidly. Whereas the population in 1966 was 233,471, in 1970 it was 275,449, and by 1980 it exceeded half a million at 534,739 (see Table 3). The ever growing population surpassed 800,000 by 1990 and reached 1 million by the mid-1990s.

In 2010, Ulsan's population of 1,071,673 accounted for 2.2% of the national population of 47,990,761. Ulsan's population grew by 4.6 times from 1966 to 2010. During the same period, the national population grew 1.6 times, showing that Ulsan's population growth was comparatively very fast.

<Table 3> Ulsan Metropolitan City Population Trend

(Unit: persons)

	Total population	Male	Female	Gender ratio
1966년	233,477	117,597	115,880	101.5
1970년	275,449	139,333	136,116	102.4
1975년	368,223	188,634	179,589	105.0
1980년	534,739	275,629	259,110	106.4
1985년	668,898	344,052	324,846	105.9
1990년	804,968	416,939	388,029	107.5
1995년	966,628	500,192	466,436	107.2
2000년	1,012,110	520,656	491,454	105.9
2005년	1,044,934	538,031	506,903	106.1
2010년	1,071,673	550,869	520,804	105.8

Source: Statistics Korea, Population and Housing Census
Note: The population data before 1995, when Ulsan became a metropolitan city, combines both the city of Ulsan and Ulju County.

1-1-3. Effect of Economic Factors

Korea, as it adopted the first Five-Year Economic Development Plan (1962–1966), designated Ulsan as a special industrial zone and developed it at the national level as an industrial city. In 1966, Ulsan's population was a mere 233,000. With the designation as a special industrial zone, many moved to Ulsan making its population 1.1 million. Along with this designation, Korea's export policy is thought to have contributed to the rapid growth of the heavy and chemical industries and of the whole economy.

1-2. Social Factors

1-2-1. Income Inequality

Compared to other metropolitan cities, the Ulsan wage level in 2012 was relatively fair (see Figure 8). While Ulsan had the greatest proportion of its population earning an annual wage of over 40 million won, it also had the smallest proportion earning below 30 million won (see Table 4). In 2012, Ulsan's low-income working population distribution across year-end tax adjusted income brackets was 20.3% earning below 10 million won, 10.5% earning between 10 and 15 million won, 8.9% earning between 15 and 20 million won, and 13.7% earning between 20 and 30 million won, represening the lowest distribution across the low-income brackets for metropolitan cities. In contrast, the high-income distribution of Ulsan was 4.4% earning between 40 and 45 million won, 3.7% earning between 45 and 50 million won, 6.3% earning between 50 and 60 million won, 7.8% earning between 60 and 80 million won, and 6.4% earning between 80 and 100 million won, the highest distribution among metropolitan cities. The proportion of Ulsan residents earning in the high income bracket of 100 to 200 million won stood at 7.3%, the highest among the seven metropolitan cities.

<Table 4> Population Ratio by Bracket in 7 Metropolitan Cities

(Unit: 10,000 KRW)

	Total	Seoul	Incheon	Daejeon	Gwangju	Daegu	Busan	Ulsan
Below 1,000	24.1%	23.6%	25.3%	24.1%	24.8%	25.1%	25.1%	20.3%
Below 1,500	14.0%	13.3%	14.0%	14.3%	16.7%	16.2%	14.9%	10.5%
Below 2,000	10.8%	10.4%	11.8%	10.7%	11.2%	11.7%	11.4%	8.9%
Below 3,000	15.6%	15.2%	17.6%	14.4%	15.3%	15.7%	16.3%	13.7%
Below 4,000	10.4%	10.2%	11.4%	9.7%	9.5%	10.3%	10.7%	10.3%
Below 4,500	4.0%	4.1%	3.9%	4.0%	3.5%	3.9%	4.1%	4.4%
Below 5,000	3.4%	3.5%	3.2%	3.4%	3.2%	3.2%	3.5%	3.7%
Below 6,000	5.3%	5.5%	4.6%	5.8%	5.1%	4.8%	4.8%	6.3%
Below 8,000	6.4%	6.9%	5.0%	7.9%	6.2%	5.7%	5.7%	7.8%
Below 10,000	2.7%	3.1%	1.8%	3.2%	2.7%	1.7%	1.7%	6.4%
Below 20,000	2.8%	3.6%	1.2%	2.3%	1.7%	1.6%	1.5%	7.3%
Below 30,000	0.2%	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%
Below 50,000	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Below 100,000	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Over 100,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Statistics of national tax in 2012, National Tax Service
Note: Based on reported end-of-year taxable earned income and place of residence.

Source: Statistics of national tax in 2012, National Tax Service

<Figure 8> Comparison of Lorenz Curves of Ulsan, Metropolitan Cities, and Seoul

When earned income is broken down into 5 million won brackets, the rate of cumulative earned income over cumulative population ratio as given by the wage brackets is the most gradual. In Lorenz curve, which is used to measure the degree of income inequality, Ulsan Metropolitan City most closely approaches the line of perfect equality (see Figure 8).

1-2-2. Education Level and Equality of Opportunity

In 2011, Korea's high school education completion rate was 81%, above the OECD average of 75%. However, for those aged 55 to 64, the high school education completion rate was 45%, and the rate for those aged 45 to 54 was 75%, showing that the high school education completion rate has increased markedly within a short period of time (see Table 5).

<Table 5> High School Education Completion Rate (2011)

Country	25-64	25-34	35-44	45-54	55-64
Korea	81	98	96	75	45
OECD Countries	75	82	78	73	64
Canada	89	92	92	88	83
Finland	84	90	89	86	71
France	72	83	78	68	58
Germany	86	87	87	87	84
Italy	56	71	60	52	40
Russia	94	94	95	95	91
England	77	84	80	75	67
United States	89	89	89	89	90

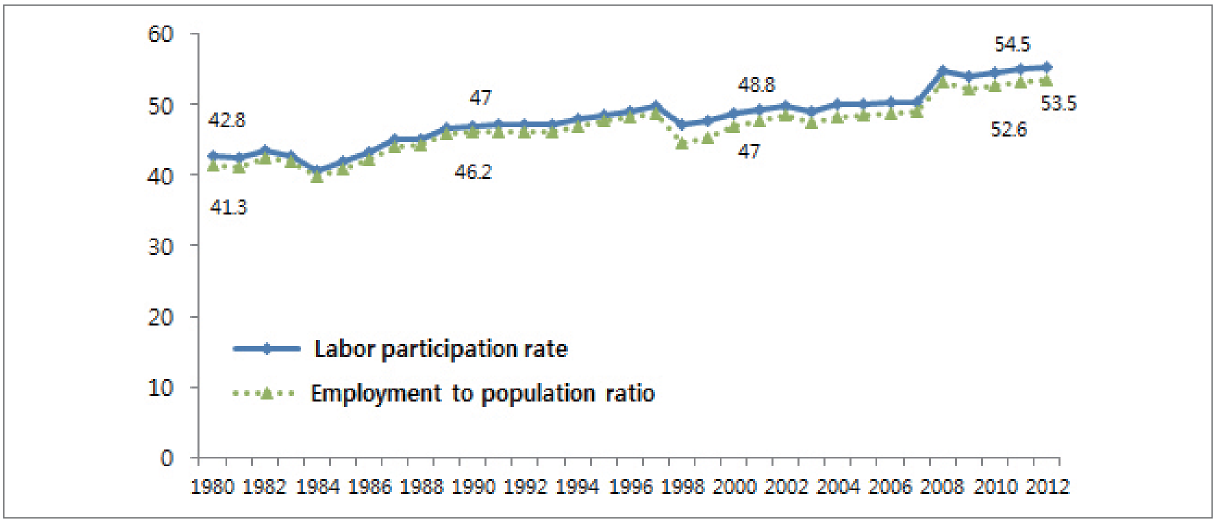
Source: Korea Education Development Institute, http://kess.kedi.re.kr/index (Education Statistics Service)

The women's participation rate in the Korean economy rose from 42.8% in 1980 to 55.2% in 2012. The women's employment rate also rose significantly from 41.3% in 1980 to 53.5% in 2012 (see Figure 9).

The women's employment rate for Ulsan falls far short of the national average. This is in contrast with the men's employment rate, which is the opposite case (see Figure 10). Ulsan is a heavy and chemical industries-centered city consisting largely of industrial zones, meaning that it hires a higher-than-average proportion of male workers and therefore indicates a lower-than-average proportion of female workers.

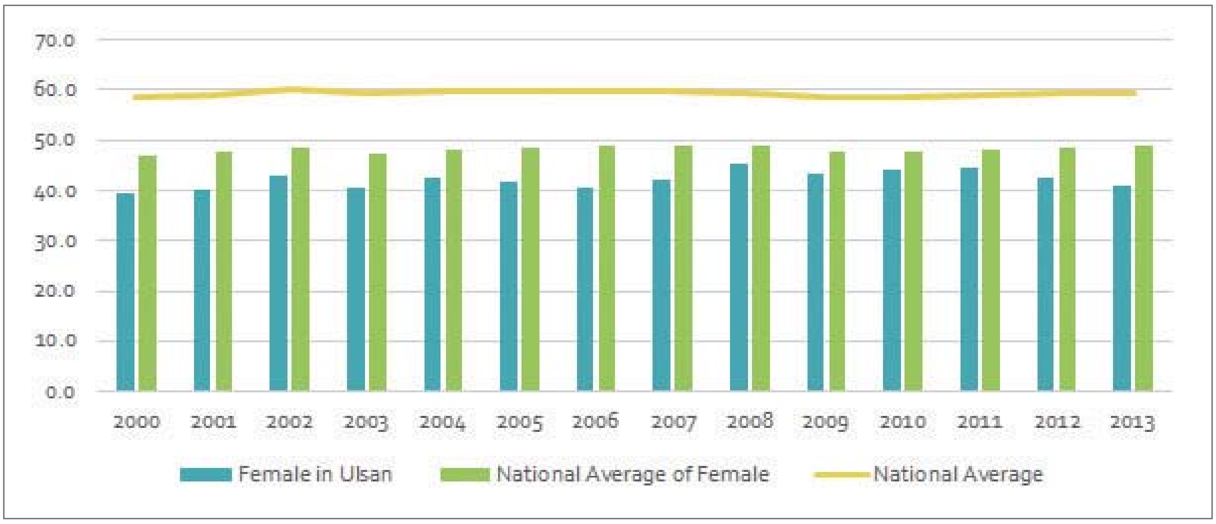
1-2-3. Effect of Social Factors

Ulsan enjoys a higher average income than other regions and the income of its lower income classes is relatively high. Therefore, Ulsan enjoys a high degree of fairness in terms of income distribution. In research relating to income inequality and the quality of the



Source: Statistics Korea
Note: Economic participation rate: the ratio of those aged 15 and over of the economically active population (employed and unemployed)* For data up to 1999, the standard of 1 week for time spent seeking employment was used for unemployment data, while for data since 2000, the standard was 4 weeks. For 2009 economic participation rate, unemployment rate, and employment rate, 2009 standards were used.

<Figure 9> Women's Economic Participation and Employment Rate Trends in Korea (1980–2012)



Source: Statistics Korea, Economically active population[3)]

<Figure 10> Female Employment Rate Trend in Ulsan (2000–2013)

environment, Boyce (2003), Scruggs (1998), and others showed the possibility that assuming the environmental demand as a function of change in income has a convex shape; transferring wealth from the poor to the rich (i.e. worsening income inequality) can improve the quality of the environment. However, Borghesi (2000) argued that because cooperation among all classes is necessary to solve many environmental problems, worsening income inequality has an adverse effect on the quality of the environment. Additionally, while Scruggs (1998), Ravalion et al. (2000), and others found evidence that income inequality can improve environmental quality, Boyce (1994), Toras and Boyce (1998), and others observed that income inequality has a negative effect on the environment (Environmental Policy, vol. 21, no. 4). Accordingly, in the case of Ulsan, it is possible to view Ulsan's low degree of social inequality as having played a positive role in improving the Taehwa River.

3) http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1DA7014&conn_path=I3

1-3. Political Factors

1-3-1. Corruption Perceptions Index

According to Transparency International's Corruption Perceptions Index,[4] or CPI, Korea has had a CPI of around 5 out of score of 10 since 1995 (see Table 6). In 2012, Korea's CPI was 5.6, placing Korea 45th among 176 countries. This is part of a continuously improving trend since Korea's scored 4.29 in 1995.

1-3-2. Political Stability

Korea's political stability, after recording 62.98 in 1996, fell before rising to 62.98 in 2007, and it recorded 51.66 in 2012 (see Table 7). After 2000, the level has remained in the 50s excluding 2004, 2005, and 2007. Korea has been known for having a relatively low level of political stability. Korea improved its political stability through institutionalization, but this has been inadequate. Since the establishment of the Government of the Republic of Korea, the government structure has undergone reorganization and change about 60 times. Thus, changes has occurred nearly every year. Laws and institutions also changed frequently with each new administration. Changes that fit the times are needed, but the circumstances that have magnified instability and uncertainty in the political sphere have been significant.

In the case of Ulsan, the mayor, elected by the citizens, served three consecutive terms from 2002 to 2014. As a result, the Taehwa River Master Plan could be drafted and its implementation carried out almost to completion without any interruption or wavering of commitment for 10 years.

1-3-3. Effect of Political Factors

Political stability, the representative measure of the stability of life for citizens as affected by political instability or terrorism, has a direct influence on economic growth. A rise in political instability leads to low economic

<Table 6> Korea's Corruption Perceptions Index (CPI)

1995	1996	1997	1998	1999	2000	2001	2002	2003
4.29	5.02	4.29	4.2	3.8	4	4.2	4.5	4.3
27th	27th	34th	43th	50th	48th	42th	40th	50th
41 countries	54 countries	52 countries	85 countries	99 countries	101 countries	91 countries	102 countries	133 countries
2004	2005	2006	2007	2008	2009	2010	2011	2012
4.5	5	5.1	5.1	5.6	5.5	5.4	5.4	5.6
47th	40th	42th	43th	40th	39th	39th	43th	45th
146 countries	159 countries	163 countries	180 countries	180 countries	180 countries	178 countries	183 countries	176 countries

<Table 7> Political Stability and Absence of Violence

	1996	1998	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Estimate	0.518	0.422	0.301	0.168	0.208	0.404	0.454	0.376	0.528	0.395	0.380	0.286	0.279	0.166
P-Rank	62.98	60.10	58.17	48.08	50.48	61.06	61.06	58.17	62.98	57.89	58.29	55.19	55.66	51.66

Source: World Bank Worldwide Governance Indicators1[5]
Note: (P-Rank): 90–100 (highest), 75–90 (high), 50–75 (medium-high), 25–50 (medium-low), 10–25 (low), 0–10 (lowest)

4) Transparency International annually publishes the Corruption Perceptions Index, an index of the perceived degree of corruption among public officials and politicians in a given country. A score of 7 indicates that a society is generally free of corruption, while a score of 3 indicates that a society's leadership is on the whole corrupt.

5) http://info.worldbank.org/governance/wgi/index.aspx?fileName=wgidataset.xlsx#home (Accessed 9 Aug 2014)

growth (Barro, 1991; Mauro, 1995).[6] Because political stability has a reciprocal relationship with economic growth, it can serve as a main factor to economic growth.

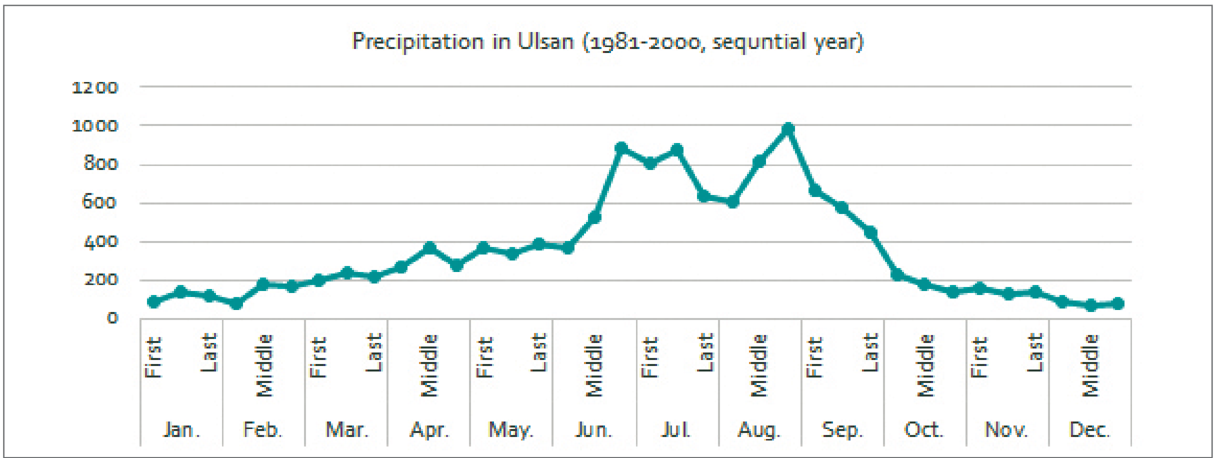
Relatively, positive political stability contributed to the growth of Ulsan's economy as well as to the national economy and has contributed to the performance of Taehwa River Restoration Project. In other regions, there are cases where development projects that unilaterally planned and executed under the leadership of the national government without engaging public opinion, have caused division and conflicts within society. However, Ulsan's Taehwa River Restoration Project, having started after the 1995 launch of the local popular election and local-level administration system, involved the municipal government and local residents as the main actors rather than the national government. Consequently, engaging the public was a necessary part of the project, as conflicts between the residents and the municipal authority were resolved over the course of the project's implementation. Furthermore, the mayor at the time served three consecutive terms from 2002-2014, maintaining the political will to carry out the project until the end. As a result, the project was completed successfully without interference from political changes or other challenges.

1-4. Environmental Factors

1-4-1. Water Resources

The average annual precipitation of Ulsan measures 1,277.1mm and is concentrated in the three months of June to August (see Figure 11). This is nearly identical with the national average annual precipitation of 1,277mm.

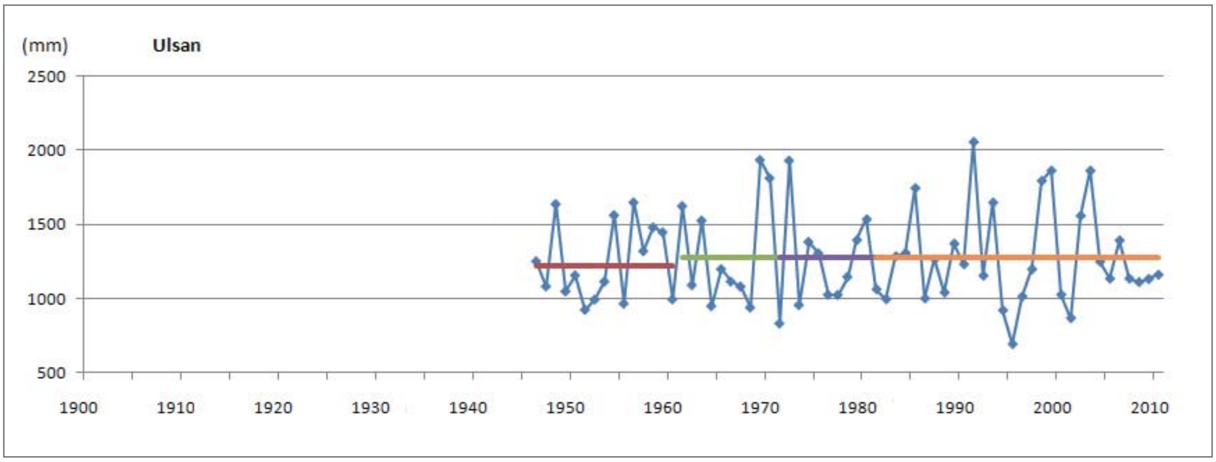
According to the National Water Resources Plan, Korea's annual precipitation trend over the past 100 years shows a 2.3-fold difference between the highest yearly precipitation volume of 1,756mm recorded in 2003 and the lowest volume of 754mm recorded in 1939. With a national average annual precipitation of 1,277mm, Korea's precipitation trend over the past century shows a generally increasing trend. In the case of Ulsan as well, the respective periods around 1995 and 2000 were times of severe droughts while 1991 was a year of concentrated rainfall measuring over 2,000mm; this shows that volatility of precipitation is quite large (see Figure 12).



Source: Korea Meteorological Administration http://www.kma.go.kr/

<Figure 11> Precipitation in Ulsan

6) Barro, R. 1991. Economic Growth in a Cross Section of Countries. The Quarterly Journal of Economics, 106: 408-443. Mauro, P. 1995. Corruption and Growth. The Quarterly Journal of Economics, 110(3): 681-712.



Source: Korea Meteorological Administration, http://www.kma.go.kr/

<Figure 12> Changes in Precipitation in Ulsan (1950–2010)

1-4-2. Water Disasters

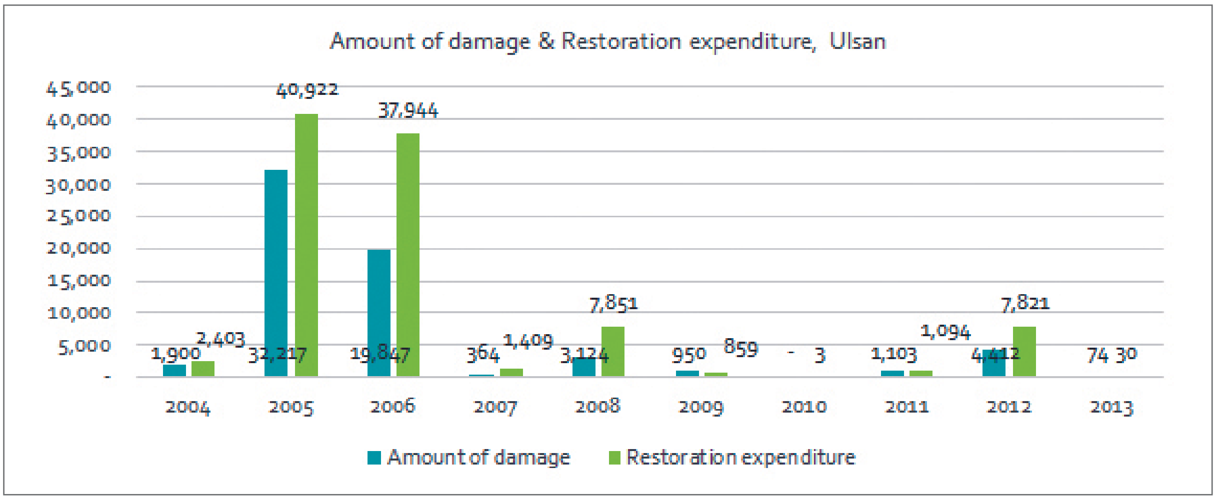
Among metropolitan cities, Ulsan suffers a relatively large amount of damages from heavy rains. In the years 2005 and 2006, rain-related property damages in Ulsan amounted to 32.2 billion won and 19.8 billion won respectively. In the past ten years, the damages totaled 64.0 billion won, ranking Ulsan second behind Busan for rain-related property damages (see Table 8). The reason for this large rain-related damages is that the disaster prevention budget is small compared to those of other cities, and the primary industries of farming and fishing have been especially vulnerable.

As shown in the Tables 8 and 9 below on suffered damages and recovery expenditure, while Seoul, which experienced a similar level of damages as Ulsan, invested 140 billion won on recovery costs, Ulsan spent only 100 billion won.

1-4-3. Change in River Water Quality

While Ulsan grew rapidly due to its rapid industrialization and urbanization, it paid little attention to water quality management, allowing the Taehwa River's water quality to degrade to 5, the worst grade defined by the Ministry of Environment, with an all-time high biochemical

Unit: million KRW



Source: Korea International Trade Association

<Figure 13> Rain-Related Damages and Restoration Expenses in Ulsan

<Table 8> Rain-Related Damages in Metropolitan Cities

Unit: million KRW

	Seoul	Busan	Daegu	Incheon	Gwangju	Daejeon	Ulsan
2004	419	1,581	1,710	181	9,833	68,151	1,900
2005	101	18,191	6	90	30,803	40	32,217
2006	5,734	9,120	744	1,283	195	131	19,847
2007	-	1,790	79	1,530	594	360	364
2008	45	773	-	388	-	-	3,124
2009	24	34,303	-	1,529	2,839	1,086	950
2010	22,207	301	-	12,500	340	56	-
2011	31,317	10,043	63	4,279	125	3,483	1,103
2012	1,203	8,901	26	5,233	18,446	395	4,412
2013	896	10	-	270	2	4	74
Total	61,946	85,013	2,628	27,283	63,177	73,706	63,991

Source: Disaster Yearbook of National Emergency Management Agency, various years

<Table 9> Rain-Related Restoration Costs in Metropolitan Cities

Unit: million KRW

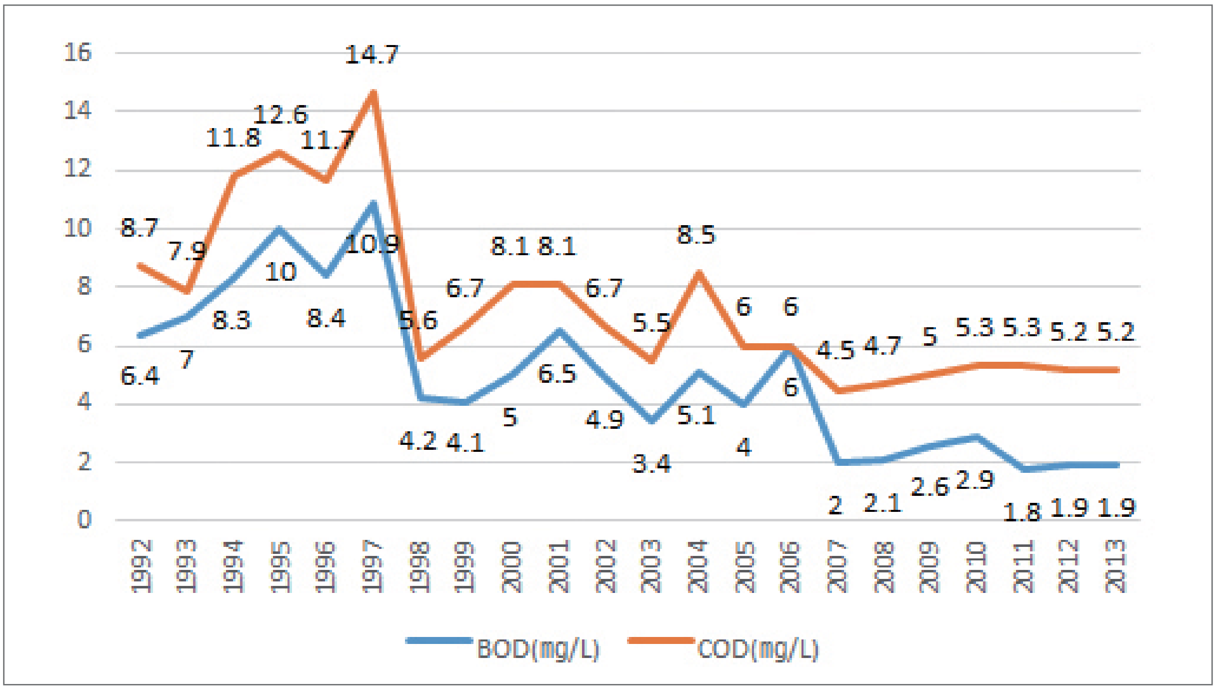
	Seoul	Busan	Daegu	Incheon	Gwangju	Daejeon	Ulsan
2004	351	1,418	1,775	441	19,920	83,858	2,403
2005	124	23,372	11	267	40,397	212	40,922
2006	6,391	16,171	1,048	2,393	167	69	37,944
2007	15	834	33	2,076	176	191	1,409
2008	70	925	-	779	-	20	7,851
2009	415	81,104	-	323	4,262	1,474	859
2010	40,999	298	14	18,504	517	22	3
2011	91,934	32,397	404	9,640	95	6,210	1,094
2012	1,396	7,763	47	5,812	14,316	590	7,821
2013	1,404	4	-	180	71	2	30
Total	143,099	164,286	3,332	40,415	79,921	92,648	100,336

Source: Disaster Yearbook of the National Emergency Management Agency, various years

oxygen demand (BOD) of 1.9 ppm (see Figure 14). With an explosion in population growth in the mid-1990s, the population was concentrated around the river in Ulsan's Central and South Districts. Consequently, the combination of domestic, factory, and livestock-raising waste discharge greatly degraded the water quality of the river.

The water quality of the Taehwa River caused five instances of mass fish deaths in 1992 alone. These mass deaths were caused by lack of water for maintaining the river's environmental flow and lack of dissolved oxygen during the dry season and by the worsened water quality due to accumulated pollutants in the riverbed during the rainy season. In addition, due to low environmental awareness, some factories and livestock barns and sheds dumped waste into Taehwa on occasions of heavy rains. (Taehwa River White Paper, 2013).

On the other hand, the servicing of the Taehwa River sewerage pipes and the purification project in the 2000s and the Taehwa River Master Plan adopted in 2005 played a large role in the water quality improvement, water security of the Taehwa River, restoration of the aquatic ecosystem, and creation of waterfront space. By 2013, the BOD of the Taehwa River had significantly improved to 1.9 ppm.



Source: Ministry of Environment

Note: The water quality point spot: Shinjeong-dong (Taehwa Bridge), Nam-gu, Ulsan

<Figure 14> Progress of Water Quality in the Taehwa River (1992–2013)

1-4-4. Effect of Environmental Factors

Among the environmental factors, increased environmental awareness from the degradation of the Taehwa River's water quality and aquatic ecosystem had the biggest impact on the river's ecological restoration. The phenol leak into the Nakdong River and the pollution of Lake Sihwa had already begun to anger the public. The Environmental Administration was elevated to the ministry status, and was delegated responsibilities over drinking water quality and wastewater management. It also played a leading role above other ministries and departments in the joint implemenion of water quality improvement measures of the Four Major Rivers Restoration Project. This was a time to use public awareness on the environmental issues. Naturally, the pollution of the Taehwa River became recognized as one of the greatest environmental failures along with the Lake Sihwa and Nakdong River incidents in Korea. As a result, it easily became a public agenda, allowing the formation of consensus among local residents demanding water quality restoration.

1-5. Technical Factors

1-5-1. Korea's R&D Level

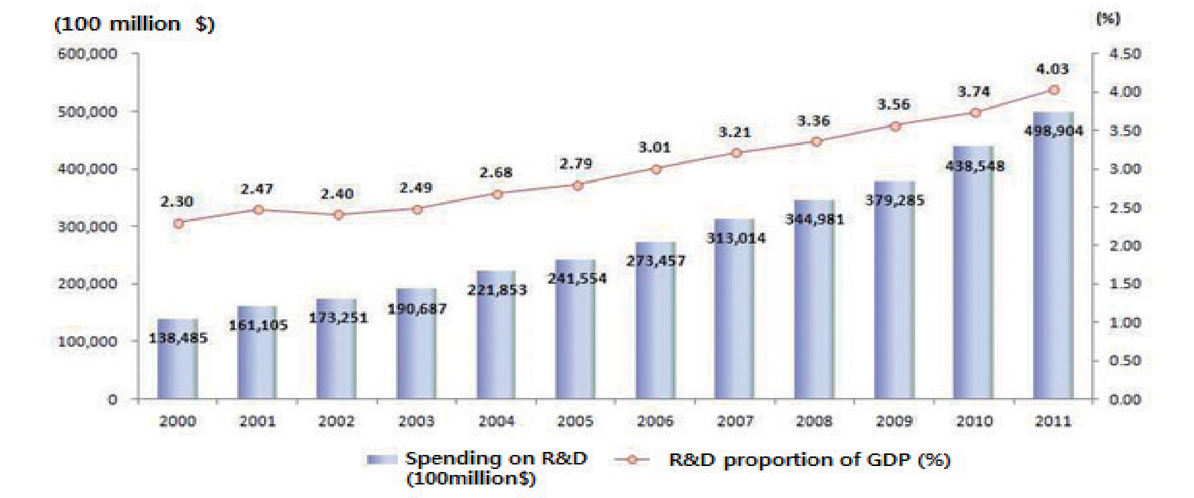
In 2011, Korea ranked second behind Israel in research and development expenditure as a percentage of GDP with 4.03% of GDP invested (see Table 10).

<Table 10> Comparison of R&D Spending among Selected Countries

Index	Unit	Korea (2011)	United States (2009)	Japan (2010)	England (2010)	China (2010)
R&D investment	billion ($)	45.02	401.58	178.82	39.86	104.32
Ratio (Korea=1)	multiple	1.0	8.9	4.0	0.9	2.3
% of GDP	%	4.03	2.90	3.26	1.76	1.77

Source: OECD, Main Science & Technology Indicators 2012

When compared with the year 2000's figures, expenditures have approximately tripled from 13.85 trillion won to 49.89 trillion won, and have also risen evidently in percentage terms from 2.30% to 4.03% of GDP (see Figure 15).

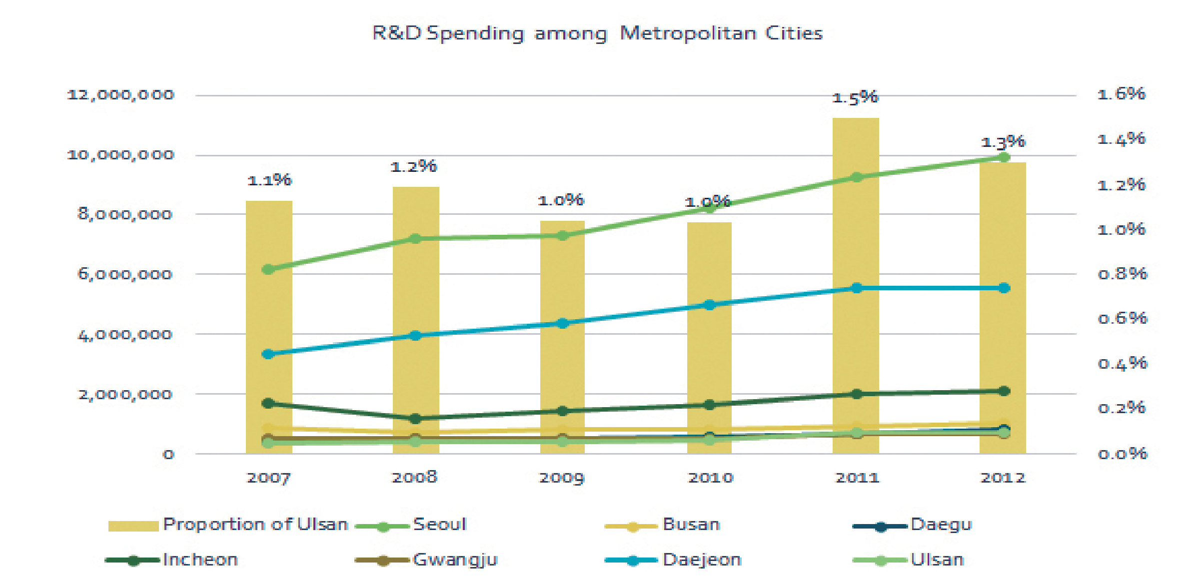


(National science & technology commission · KISTEP, Report on the survey of R&D in Science and Technology)

<Figure 15> Korea's R&D Expenditure

The research and development expenditure for Ulsan in 2011 was 747.5 billion won, or 1.5% of national expenditure, and the human resources employed in R&D numbered 4,919, or 1.3% of the national figure. This represents an increase of 295.3 billion won (0.5% of the national increase) and 937 individuals (0.1% of the nation's increase) over 2010 (see Figure 16).

However, the number of institutions undertaking the important task of increasing R&D expenditure and manpower is low across all three categories of public research institutions, universities, and businesses when considering Ulsan's economic status (see Table 11).



Source: Ministry of Science, ICT and Future Planning, KISTEP, Survey of Research and Development in Korea, various years[7]

<Figure 16> R&D Expenditures in Metropolitan Cities

7) http://kosis.kr/statHtml/statHtml.do?orgId=127&tblId=DT_KBA0019&conn_path=I3

<Table 11> Distribution of R&D Organizations (2011)

Unit: number of organizations

[Chart3] Distribution of R&D Organization by Agent and Region						
By agent	Busan	Daegu	Incheon	Gwangju	Daejeon	Ulsan
Total	913	865	1,217	508	894	272
Public research institute	16	19	12	13	35	5
University	5	9	5	7	9	1
Corporation	876	831	1,194	481	840	263
Government-invested institution	1	1	2	-	9	1
Private enterprise	875	830	1,192	481	831	262

Source: Ulsan Development Institute, 2013, Ulsan Economy & Society Brief Apr 2013 Vol.32

1-5-2. Patents

Korea ranks high in terms of the absolute number of triadic patent families held. In 2010, with 2,182 triadic patent families, Korea ranked fifth behind Japan (15,067), the United States (13,837), Germany (5,685), and France (2,447). Korea has maintained this rank since 2005.

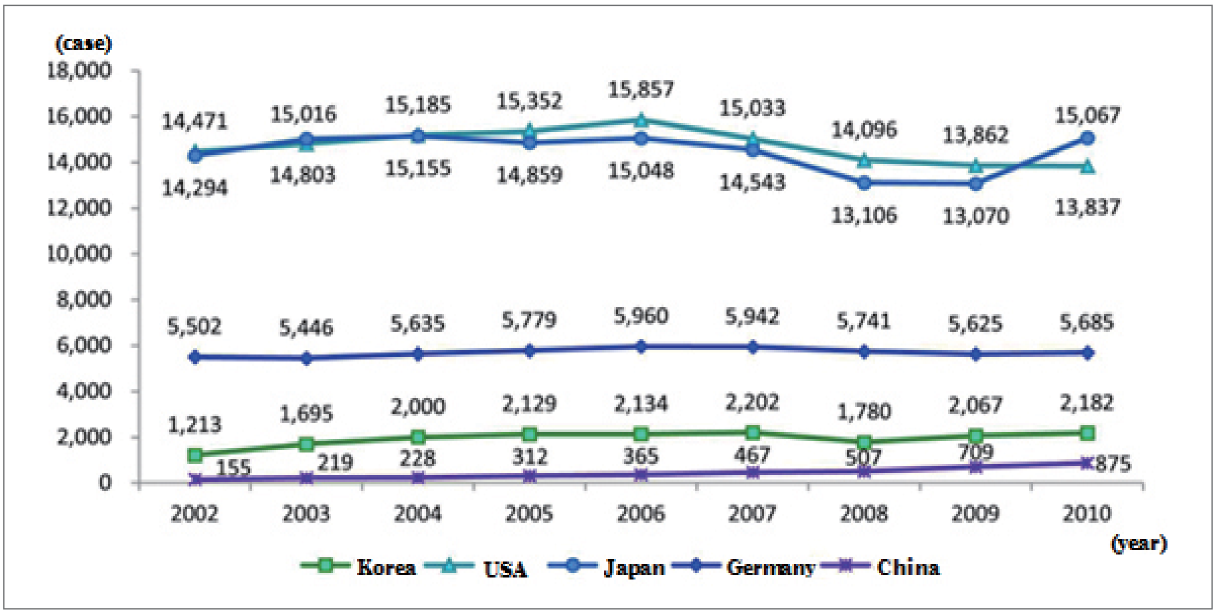
In terms of growth in the number of triadic patent families held, Korea has had an average growth rate of 7.6% since 2002 when it held 1,213 patent families, a growth rate second to China's 24.2% (see Figure 17).

1-5-3. Effect of Technical Factors

Korea's relatively high level of technology made a scientific approach to solving the Taehwa River problem possible. The Taehwa River Master Plan was a plan adopted based on scientific research evidence: analysis of the water quality environment and hydrological environment. The approach was applied to identify the right steps to improve the water quality and to restore the environment. With advanced technology, the deposit accumulated on the Taehwa riverbed could be dredged, and decisions such as where to install water quality improvement project sites could be made. This allowed urban sewage and barn wastewater to be treated prior to release into the river.

1-6. Concluding Remarks

Economic, social, political, environmental, and technological factors influence the formation, evolution, and performance of institutions and also influence the selection of policies as well as the performance of those policies. This logic applies to the case of the Taehwa River Restoration Project.



Source: OECD, Main Science & Technology Indicators 2012

Note: Triadic Patent Families: This is defined as the number of patents applied for at the European Patent Office (EPO) and the Japan Patent Office (JPO) and registered at the US Patents and Trademarks Office (USPTO) in order to protect identical inventions across OECD countries.

<Figure 17> Comparison of Triadic Patents among Leading Countries (2002–2010)

Through its designation in the 1960s as the Ulsan Special Industrial Zone that was a part of the Five-Year Economic Development Plan, Ulsan was able to play the role of the base from which the heavy and chemical industries could be developed. Not only did the government's export-oriented policy of the 1970s contribute to Ulsan's explosive growth as an industrial city, it also turned it into the nation's center for economic growth. The combination of growth-centric policies (e.g. the Five-Year Economic Development Plans, the Land Plans and the Industrial Complex Plan), both at national and regional level, led to the pollution of Taehwa. Beginning in the first half of the 1990s, environmental issues became a main interest of the public due to the phenol leak into the Nakdong River and the pollution of Lake Sihwa. Meanwhile, with the population growing with the industrial zone, Ulsan was promoted to a metropolitan city in 1997. The local government system also came into effect, strengthening the autonomy and influence of the municipal government. This allowed it to take the leading role in local policy making and implementation and in enhancing the performance of the project. In addition, the nation-wide improvement in education and relatively high income level of Ulsan contributed to spurring public interest in the natural environment of the city and their demand on urgently improving the situation. Moreover, Korea's relatively high level of technology made the selection and implementation of measures possible to restore the Taehwa River.

Overall a mid- to long-term plan for the ecological restoration of the Taehwa River was established; measures were taken to prevent the release of gray water and other wastewater into the river; and the Taehwa River Restoration Project began.

2. Water Governance and Institutions

The preceding section outlined broadly the effect that exogenous variables have on institutional factors and performance.This section examines the institutional factors directly or indirectly influencing the Taehwa River Restoration Project. These institutional factors utilize the same structure as in the Lake Sihwa Water Quality Improvement Project case study report. The institutional factors is classified broadly as law, administration, and policy (Saleth and Dinar, 2004). In order to examine the influence of actors such as the state, market, and community on design, implemetation, and performance of the project, institutions such as law, administration, and policy have been recategorized into state-driven, market-oriented, and community-centered institutions.

2-1. State-driven Institutions

In the first half of the 1950s after the Korean War, Korea was in a dire situation largely dependent on foreign aid, with its politics in confusion and its economic base destroyed to the extent that was without necessary basic infrastucture end of the decade. In 1962, Korea had a GNP per capita of $83, and the country's main exports were iron ore, squid, and fishes. At the time when Korea's economic level was comparable to that of Kenya and Ghana. The government, through the procurement of foreign capital and through exports, low wage, and deliberate low grain price policies set a path for modernizing the country and economic growth with the goals of stopping the vicious cycle of poverty and laying the foundation for a self-sutticient economy. To these ends, the government through strong and determined leadership, established and began the first Five-Year Economic Development Plan in 1962. As part of this core plan, Ulsan was designated as a special industrial zone that concentrated on heavy industries such as automobiles, refineries, and shipbuilding. The Ulsan Special Industrial Complex as the first nationally designated industrial zone, contributed greatly to Korea's economic development.

However, the economic growth-focused policy also brought environmental pollution as a side-effect. Ulsan's designation as a special industrial zone led to the introduction of industrial complexes along the Taehwa River and the East Sea coast, resulting in increased inflows of workers from other regions leading to rapid urbanization. Due to the social atmosphere at the time that prioritized industrialization and poverty reduction, the environmental protection was largely disregarded. .

Later, as environmental pollution became a problem and Ulsan gained an unfavorable reputation as a polluted city, the municipality stepped up to improve the situation. The city of Ulsan took charge of drafting and implementing policies and consulted and cooperated with industry, non-governmental organizations, and citizens to make Ulsan a city where the environment, industry, and residents could coexist. The ecological restoration project, undertaken by the municipality was very successful as the city authorities had the capacity to verify and address the cause of the solution most effectively.

2-1-1. Laws and Administration

2-1-1-1. Balance between Government Layers (Structure and Power)

Korea, under the directive of its central government, unfolded its nationwide economic growth policy through the Five-Year Economic Development Plans. The policy of industrializing Ulsan came about as a part of the first of these five-year plans, and therefore took shape under the government's vision. On January 1, 1962, following the discussion of the Economic Planning Board's proposal to establish the Ulsan Special Industrial Zone in a Cabinet Council, the decision to designate Ulsan as a special industrial zone was notified and proclaimed to the relevant angencies (see Pictures 6 and 7).

The course of events from the establishment of the first Five-Year Economic Development Plan to the construction of the Ulsan industrial zone is unfolded as follows.

The development of the Ulsan Industrial Zone took place with the "Land Expropriation Act on Special Cases Concerning the Establishment of Industrial Complex" and the "Urban Planning Act" as its legal basis. The land

Source: National Archives of Korea

<Picture 6> Designation of Ulsan Industrial Complex and Groundbreaking Ceremony (Feb. 3, 1962)

Source: National Archives of Korea

<Picture 7> Ulsan Industrial Complex Construction Scheme Drawing, 1965

Expropriation Act has been instituted for the purpose of developing the Ulsan Industrial Zone. The law stipulated the designation of industrial zones by Cabinet order, and in 1962, the government assigned the name, Ulsan Industrialization Complex, through the "Decision on Special Industrial Zone".

The designated areas included what was at the time Ulsan-eub and Bangeojin-eub of Ulsan County, South Gyeongsang Province. Additionally, in June 1962, the government proclaimed changes to the administrative region, promoting the newly combined area into the city of Ulsan and leaving the remaining area as Ulju County.

At the same time, the government established the "Code of Ulsan District Comprehensive Industrial Zone Construction Promotion Committee." This new committee was made as a part of the Economic Planning Board and was tasked with the selection of land for constructing key industries of the Ulsan District, prioritizing the order by which factories would be built, and reviewing urban development in the industrial zone.

To support the development of the Ulsan Industrial Zone, the government in 1962 set up the Division of Ulsan Special Construction in the Bureau of Land and Construction under the "Act on Establishing Local Construction Public Office" to carry out the urban construction project. This body, beginning with the factory sites, built roads and dams for securing water for industrial use, a harbor, and did urban public works projects. With the repeal of the supporting law, the existing structure was annulled on November 8, 1966. Later, with the "Law on Establishing Ministry of Construction and Local Construction Office," the body continued to exist and carried out the building the Sayeon Dam and some 80 various supportive projects, thereby contributing significantly to the completion of the base of industrial activities before its dissolution on June 18, 1975.

The government established the Law no. 1080 "Act on Establishing Ulsan Development Committee and Ulsan Industrial Development Planning Headquarters" on May 31, 1962, to speed up the formation and development of the Ulsan Special Industrial Zone (see Table 12). This strengthened the institutional structure for the zone's development. In accordance with the law, the Ulsan Development Committee was organized. The Ulsan Development Committee had the Cabinet Head (the Prime Minister of the early Third Republic) as its chairman and the head of the Economic Planning Board as its vice-chairman. In order to draft the comprehensive plans for the formation and development of the Ulsan Industrial Zone and carry out the work involved in the implementation, the Ulsan Development Planning Headquarters was installed under the office of the Cabinet Head. Alongside this, the Ulsan Land Conciliation Committee was established (Cabinet Order No. 789), and the use of land and publicly administered water bodies necessary for the work specified in the Ulsan Industrial Complex Construction Plan was permitted. Moreover, foreign technology service corps were consulted for technical advice.

The Ulsan Development Committee and the Ulsan Development Planning Headquarters, in accordance with the December 14, 1963, "Act on Demolishing Ulsan Development Committee and Ulsan Industrial Development Planning Headquarters" (No. 1520), were dissolved on December 17, 1963. Their responsibilities were carried on by the Ulsan Special Construction Division.

As described above, the decisions and implementation work regarding developing of Ulsan as an industrial zone were undertaken predominantly by the authority and budget-laden central government. As such, it could be carried out with great speed, with the designation and proclamation of the Ulsan Industrial Zone taking place

<Industrial water and road construction>

<Industrial water project>

<Intake tower construction>

<Access road construction>

Source: National Archives of Korea

<Picture 8> Ulsan Industrial Complex Construction Project, 1963

<Table 12> Designation Process of the Ulsan Industrial Zone (1962–63)

Period	Main Events
Jan. 13, 1962	1st Five-Year Economic Development Plan announced
Jan. 20, 1962	Land Expropriation Act on Special Cases concerning Establishment of Industrial Complex introduced
Jan. 20, 1962	Urban Planning Act introduced
Jan. 27, 1962	Ulsan industrial zone designated by Cabinet Order No. 403 under the Land Expropriation Act on Special Cases concerning Establishment of Industrial Complex
Jan. 27, 1962	Code of Ulsan District Comprehensive Industrial Zone Construction Promotion Committee proclaimed by Cabinet Order No. 404
Mar. 7, 1962	Ulsan Special Construction Division established by Cabinet Order No. 504
May 31, 1962	Act on Establishing Ulsan Development Committee and Ulsan Industrial Development Planning Headquarters introduced
Dec. 17, 1963	According to "Act on Demolishing Ulsan Development Committee and Ulsan Industrial Development Planning Headquarters" (No. 1520), the Committee and Headquarters were demolished

in just one week.[8] As the development was driven at the state level by the central government, the role of the local government at the time was weak. However, national interests and the interests of the local government were rarely in conflicts.

The Ulsan area, during the 1960s and 1970s under the first through fourth Five-Year Economic Development Plans, grew into the pivotal city of the nation's industrial development, housing the oil refining, chemical, automobile, and shipbuilding industries—i.e. the nation's most important, heavy, and chemical industries. In the 1980s, under the fifth and sixth Five-Year Economic and Social Development Plans and a focus on the heavy and chemical industries, Ulsan continued to develop, with the main businesses being machinery and equipment centered on automobiles and shipbuilding. In the 1990s, the development of urban facilities was added to the existing Basic Plan for Developing Industrial Base, and the state-led economic development shifted to a development structure based on property rights, with national land development and regional economic development as new priorities.

In a process that began in 1995, the merger of Ulju County and Ulsan's four districts, Ulsan was promoted to a metropolitan city in 1997. With the new status, Ulsan was able to lay the foundation for an independent economy and for pursuing an industrial policy. The municipality began to map out plans for industrial development within its limits, rather than playing the typical role of local governments in supporting state-driven industrial development. Furthermore, as a metropolitan city with over 1 million inhabitants, the need to establish a self-sufficient municipal base with an independent development plan became clear. Therefore, Ulsan's industrial structure was adjusted accordingly. In 1997, the city of Ulsan adopted a long-term development plan for urban and industrial development over the next 20 years. In 2007, reflecting the changing conditions, Ulsan adopted a modified plan designed to ensure the continuous development, which is ongoing.

Ulsan was industrialized under state-driven policies. As it contributed to national economic growth, air pollution and environmental degradation worsened, earning it the epithet, "pollution city of Ulsan." After its designation as an industrial zone, agricultural losses stemming from pollution and other signs of environmental degradation began to appear one by one since the 1970s. In response to this, the central government brought together the Ulsan Environmental Preservation Association to manage environmental risks and to compensate farmers for the damages in cooperation with the Korea Institute of Science and Technology (KIST). However, this situation only continued to worsen in the 1980s. In Ulsan, the environmental problem evolved into a health issue as some residents began to complain about neuralgia, paralysis, and itchiness. As the environmental problem worsened considerably by the end of the 1980s, the state took interest and began the reorganization and expansion of its environmental agencies. What began as the Environment Administration (246 employees) in 1980 became the Ministry of Environment under the Prime Minister's Office (1,216 employees) in 1990 and subsequently the Ministry of Environment (1,364 employees) in 1994.[9] Universities also began to offer courses in environment-related fields. In Ulsan as well, at the end of the 1980s, movements led by local environmental groups to prevent further pollution of the Taehwa River, and to return it to its original clean condition began. However, these movements were insufficient for those two tasks.

8) Ulsan City Tour Guide

9) http://www.me.go.kr/home/web/content/read.do?menuId=307&contentId=189 (Sept. 12, 2014)

The 1990s marks the period when the will to overcome the environmental pollution began to translate into action. The importance of the environment gained recognition, in the case of Ulsan, with the Health and Environment Division being renamed the Environment and Health Division. With Ulsan's promotion to a metropolitan city status in 1997, the city's Health Office and Environment Office were separated and the Environment Office was fully charged with environmental tasks. In addition, the municipal government and environmental organizations tenaciously kept the pollution problem in the public eye, and businesses too increased their investments in environmental improvement, leading to a large reduction in air pollution.

In the 2000s, the overall national awareness of the environment greatly increased. Driven by the Ministry of Environment, passive measures grew into more determined efforts to build an environmental industry. Ulsan ramped up its efforts to transform an industrial city into an eco-city after the third local popular election in 2002. This was possible due to implementation of local self-governing system that was adopted nationwide, which allowed the election of its own members and the head of district and municipal assemblies. In 2004, under the "Ecopolis Ulsan Declaration," Ulsan established the Taehwa River Master Plan for water quality improvement, which focused on the Taehwa River Restoration Project as its first priority, and actively led the project for 10 years.

Prior to the Taehwa River Master Plan, the central government developed the Taehwa River Maintenance Plan, a plan to prevent floods in the state-administered section of the Taehwa River. Since this plan excluded the ecological aspects efforts were made to modify the plan to fit the local situation alongside the establishment of the Taehwa River Master Plan. However, it was beyond the capacity of the local government and residents to modify the maintenance plan. There were limits to the individual activities of administrative bodies, not-for-profit organizations, and the academic community. To overcome the difficulties, the local government formed a governance system with local stakeholders and tried to elicit the cooperation of the central government.

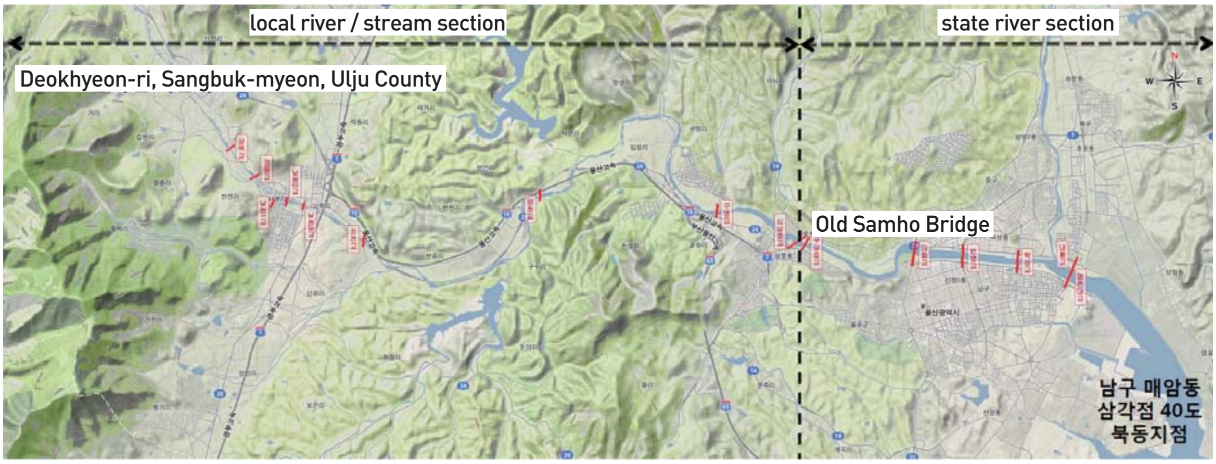
2-1-1-2. Spatial Organization of Water Administration

In Korea's case, the central government plays a leading role in water management. Rather than a single ministry overseeing this role, this role is shared among different ministries: the Ministry of Land, Infrastructure, and Transport is responsible for domestic water, industrial water, and flood prevention; the Ministry of Agriculture, Food, and Rural Affairs manages the agricultural water; and the Ministry of Environment is in charge of managing water quality in rivers. In addition, Korea's rivers can be divided into state river sections and local river sections. The Ministry of Land, Infrastructure, and Transport manages state sections of rivers, while the provincial and metropolitan governments manage local river sections. In accordance with the Small River Act, lower level local governments manage small rivers. The Ministry of Environment manages the four major rivers, which are namely the Han, Nakdong, Geum, and Youngsan Rivers, through the Water System Management Councils it established for each river. Each Water System Management Council, whose membership consists of relevant ministries, local governments, NGOs, and experts, establishes water quality improvement plans and decides how to use its water system budget. However, the council's function is limited to water quality management, and the participation of many stakeholders such as local governments is at the level of tokenism.

The Taehwa River consists of state and local river sections. As a result, the responsible agencies are also separate. The local river section comprises 57 local streams from the Taehwa River's source at Tabsaemgol on Mt. Baegun to the former Samho Bridge and is managed by the Ulsan Metropolitan Government (see Figure 18). The state river section begins at the former Samho Bridge, where the local river section ends, and reaches Ulsan Bay. This section is managed by the Busan Construction and Management Administration under the Ministry of Land, Infrastructure, and Transport (see Picture 9).

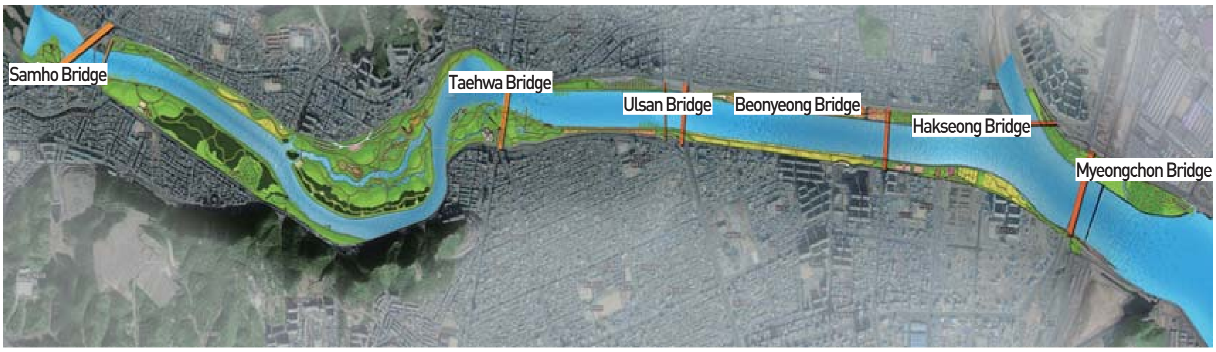
To implement coherent policies in regard to the Taehwa River Restoration Project, which consists environment, sewage, and water control policies, it was necessary to have a single organization vested with full responsibilities for the project. In 2003, the city of Ulsan established the Taehwa River Water Quality Improvement Planning Team and set out on the tasks of water quality policy and natural environment restoration. As the Taehwa River Restoration Project and the related management work took on additional functions and the amount of work grew, the city in 2006 founded the Taehwa River Management Body as a separate entity to carry out the project. The Ulsan government's management structure for the Taehwa River Restoration Project as of 2011 is shown in Table 13.

In August 2014, with the Taehwa River Restoration Project in the final stages, the city of Ulsan downsized the Taehwa River Management Body through restructuring.[10]



Source: Taehwa River Master Plan

<Figure 18> The State River and Local Stream Sections of the Taehwa River



Source: Ulsan Metropolitan City PowerPoint File

<Picture 9> State River Section of the Taehwa River

10) Interview at Ulsan City Hall (Aug. 5, 2014)

<Table 13> Ulsan's Taehwa River Management Structure

Classification	Environment Policy Office, Environmental Management Office, Sewage Management Office, Construction Road Office	Taehwa River Management Body
Ulsan Metropolitan City	Carrying out the water quality project; Operating water quality monitoring stations and monitoring ecology; Preserving and restoring biodiversity in the Taehwa River; Monitoring illegal wastewater discharge; Livestock wastewater management; Pipe maintenance and operating water quality improvement office; Managing non-point pollutant treatment facilities; Putting a stop to household wastewater (storm overflow chamber); Drafting and implementing stream maintenance plans, etc.	(Promotion) Promotion and guiding tours; (Facility management) Taehwa River Grand Park, riverside facilities (e.g., trails, drainways), sports facilities, arboriculture; (Community support) One Company, One Stream campaign, citizen environmental observer; (Environmental management) preventative and remedial measures for water quality degradation, river environment clean-up, securing water for the Taehwa River's flow, etc.
District and county level	Stopping wastewater discharge (individual households), management of drainage facilities; Regulating illegal farming, construction, littering, and fishing; patrolling the stream; Local stream section (Ulju County): riverside arboriculture, issuing permission for river occupation, managing riverside facilities, etc.	

2-1-1-3. Balance in Functional Specialization

To carry out a large scale regional development project in a traditionally centralized country, organic cooperation and coordination among relevant ministries were needed. In this regard, the central government designated the Ulsan Special Industrial Zone in 1962 and established the Ulsan District Comprehensive Industrial Zone Construction Promotion Committee under the Economic Planning Board. The committee was tasked with reviewing the locations of industrial facilities and urban planning and prioritizing the incoming factories. The committee consisted of various members including the president of the Economic Planning Board as the chairman, the Minister of Commerce and Industry as its vice chairman, and the Minister of Home Affairs, the Minister of Transport, the Minister of Communication, the Administrator of Land and Construction Authority, the governor of South Gyeongsang Province, the president of the Korea Electric Power Corporation, the president of the Korea Housing Corporation, the chief of military engineers in the Army Headquarters, the person in charge of Ulsan District Industrial Zone comprehensive construction, the representatives of the beneficiaries (factories that will be constructed), and relevant experts. Thus, a pan-national committee which was composed both the heads of relevant ministries and related organizations was created for a single industrial complex.

Ulsan and the Taehwa River were suffering from pollution, because the polluting facilities were located in the national industrial district, and regulation over the discharge of pollutants lied in the hands of the central government, specifically the Ministry of Environment. Under the Ministry, the Ulsan branch of the Busan Environmental Office oversaw this role. As the Ministry of Environment clearly lacked personnel for the job, the Ulsan government responded to the pollution although the problem was not within its jurisdiction. After its promotion to the status of metropolitan city in 1997, Ulsan enlarged its environmental management function in response to stronger environmental demands from its citizens. About this time, local governments continuously demanded the Ministry of Environment to transfer its supervisory authority over industrial zones. Accordingly, in 2001, the Ministry of Government Administration and Home Affairs held a working-level committee[11] meeting with officials from the Ministry of Environment and provincial and municipal governments to transfer such right to the local governments. They agreed to entrust the local authorities with the environmental oversight of air, wastewater, and harmful chemical pollutant emissions within the national industrial complexes (June 2002). Even though the result was delegation, not transfer, the result empowered local governments to oversee polluters both inside and outside the industrial complexes and enabled more effective policy implementation.

With the state section of the Taehwa River falling under the jurisdiction of the Ministry of Land, Infrastructure, and Transport, the Busan Construction and Management Administration (as the directly responsible government office) managed a part of the Taehwa River Restoration Project. However, most of the project was carried out under the leadership of the Ulsan government, which the Busan Administration approved the role. The municipality carried out the project in cooperation with various stakeholders including environmental NGOs, citizens, and local businesses. As the responsibilities of authorizing work on and engaging in follow-up management of the state river section of Taehwa lay with the central government, the Ulsan city government built a grand park, riverside parks, and other amenities with the permission from the Busan Construction and Management Administration.

Due to the divided management structure of the Taehwa River, Ulsan, where the Taehwa River was located, and the central government at times clashed over the river's management. The Ministry of Land, Infrastructure, and Transport established the Taehwa River Maintenance Plan in 1987 in order to reduce flood damage, disregarding ecological value at the time. The ministry planned to clear the Shimnidae Forest (a bamboo forest) within the basin and build a concrete revetment along the entire state section of the river. Even in the face of opposition by citizen groups, the ministry cleared 20% of the entire bamboo forest area. However, the ministry decided to preserve the remaining bamboo forest thanks to the signature campaign and other efforts of the Taehwa River Conservation Association (founded in 1989) and other environmental groups. In 2003, the Busan Construction and Management Administration proposed a draft plan to create a new waterway for flood prevention while preserving the forest and the residential area. In response, Ulsan's academic community and civil society groups called for a modification of the plan, citing their concern over the possibility of setbacks in the construction of the Taehwa River Ecological Park and destruction of the river's ecosystem due to increased risk of flooding from sedimentation in the existing waterway. That same year, having collected residents' opinion, the city of Ulsan fixed the policy to return the entire residential area to the river section and to build an ecological park. Showing its willingness to shoulder a considerable portion of the land compensation cost, Ulsan forcefully argued for the need to preserve the river's environment in its original condition to the central government. Civil society supported Ulsan in this effort by starting the "Buy a Plot of the Taehwa Field" campaign. Due to the strong political will of the Ulsan government to conserve the environment despite its difficult financial situation, the central government accepted Ulsan's proposal and decided to conserve the Taehwa Field in its original condition, thereby making the building of the Taehwa River Grand Park possible. Moreover, the central government agreed to bear 72.7 billion KRW of the 100 billion KRW required for the land compensation, leaving Ulsan to provide the remaining 27.3 billion KRW.

11) After the launch of the local self-governing system, to facilitate stabilization of the system and transfer of power to the local government institutionally, the "Act on the Transfer of the Administrative Authority from the Central to Local Government" was enacted on Jan. 29, 1999, and to support the efficient authority transfer and coordinate tasks among local governments, the Authority Transfer Facilitation Committee was established under the President's command on Aug. 30, 1999 (History of Metropolitan City, 157).

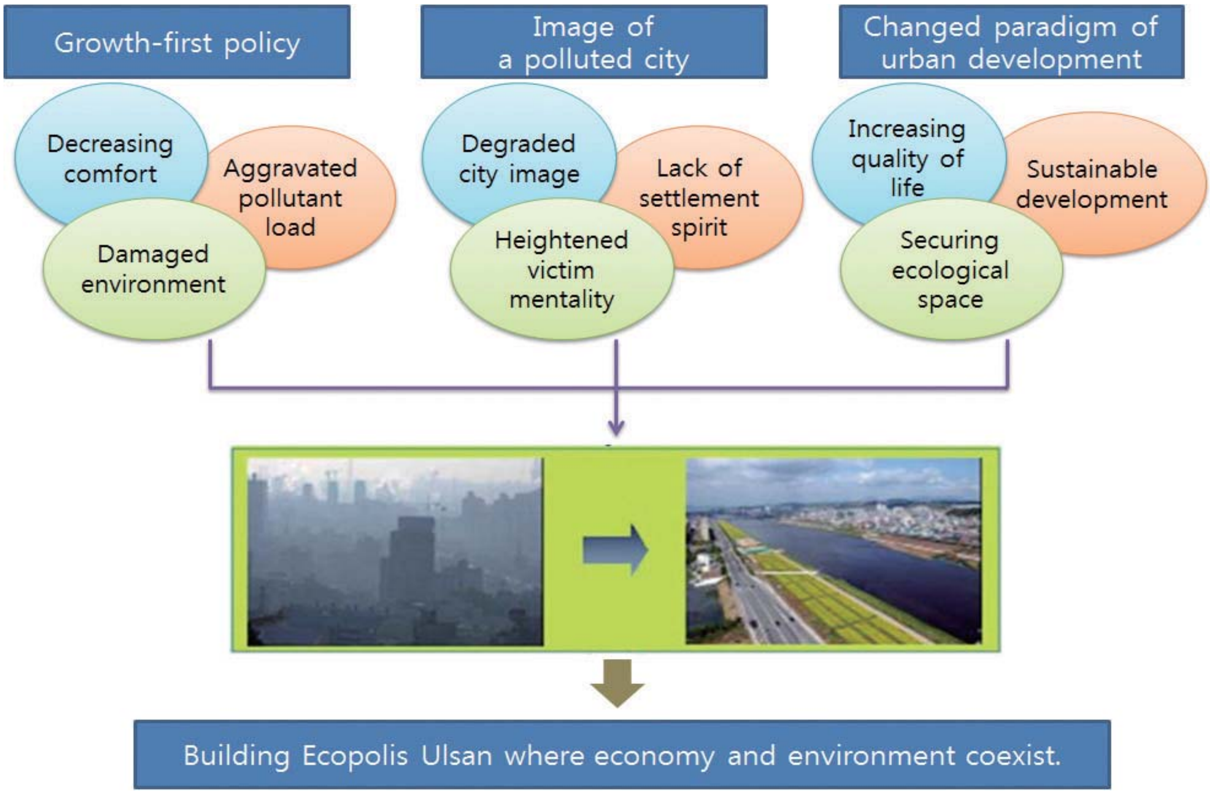
In spite of the divided nature of authority between the central and local governments over the Taehwa River Restoration Project and its possible hindrance to implementation, the project succeeded. This was because of the increased authority and influence of the Ulsan government, which was strengthened by the institution of the local self-governing system, combined with its strong political will. Also, Ulsan was most knowledgeable of the local situation and had its interest at heart.

2-1-2. State-driven Policies

2-1-2-1. Well-organized Hierarchical Plans from National through Regional and to Local Project Plans

The formation of the Ulsan Industrial Complex originated from a Five Year Economic Development Plan. After the plan was announced in 1962, the Land Expropriation Act on Special Cases concerning Establishment of Industrial Complex and the Urban Planning Act were enacted. Ulsan was designated as an industrial district in accordance with the Land Expropriation Act. After the designation, relevant organizations such as the Division of Ulsan Special Construction and Ulsan Industrial Development Planning Headquarters were established and the construction project was carried out. The central government played a leading role in planning and implementing most parts of the policy. After the construction of the Ulsan Industrial Complex, the Ministry of Commerce and Industry took the lead in developing the industrial complex with the support of the municipal and provincial governments. Although the industrial complex was constructed in accordance to the Urban Planning Act, the city took its form quickly as municipal and provincial governments and local companies actively participated in the project due to increase in speculation in the real estate market. In the 1970s, the central government selected heavy and chemical industries as its major industries for economic growth. In 1973, it introduced the Act on Facilitating Industrial Base Development to develop heavy and chemical industries and established the Industrial Sites and Water Resources Development Corporation (present K-water) to develop industrial areas.

In the early 1990s after the industrialization, Ulsan, which had been passive in responding to environmental issues, began to realize the importance of its environment and the necessity to restore the Taehwa River. By then, the river began to reek and fishes recurrently died in large droves. After Ulsan became a metropolitan city in 1997, it began to implement environmental policies, establishing the Environmental Improvement Medium-Term Comprehensive Plan (first plan 1999–2003, second plan 2004–2008). The city of Ulsan made huge efforts for its environment. For example, it provided funds for installing intercepting sewer pipes and waste pipes to prevent the inflow of pollutants into Taehwa. Over the period of 15 years, it installed waste pipes in 47,000 households and connected them to sewage treatment plants. As the overall environmental awareness and the income level of the citizens increased, the tendency to pursue quantitative growth decreased and people began to care about the quality of their lives. Following the changing trends, in Ulsan, it became important to establish more systematic plans not only for the water quality improvement but also for improving the quality of life through the restoration of the Taehwa River. In this respect, Ulsan in 2002 announced a policy to transform itself from a polluted city to an eco-friendly city. In June 2004, it launched the Ecopolis Ulsan Declaration and adopted the Ecopolis Ulsan Plan. Under the Ecopolis Ulsan Plan, the Taehwa River Master Plan was established to give highest priority to river restoration.



The Ecopolis Ulsan Plan, which was designed based on the concept of ecological city, has three objectives.
First, reducing pollution load and protecting the environment by establishing an energy and material-cycling urban system.
Second, sustainably developing Ulsan by developing an efficient spatial structure and transport system.
Third, increasing environmental awareness and responsibility of the citizens by creating an eco-friendly image of the city.

<Figure 19> Background of Establishing the Ecopolis Ulsan Plan

The Ecopolis Ulsan Declaration reflects the strong will of the city to change its environmental paradigm and to enhance the quality of citizens' lives by transforming itself into a whole new eco-friendly city rather than merely focusing on reducing pollution. This declaration, was the springboard for efforts to make Ulsan an eco-friendly city where the environment, industry, and citizens could co-exist..

Although plans based on the River Act such as the Taehwa River Stream Maintenance Plan of 1987 and Re-maintenance Plan of 2003 were established, these plans were criticized as being inadequate for restoring the river to its natural state. This is because they leaned more toward developing the waterfront area around the river. The Taehwa River Master Plan, a comprehensive plan which covers flood prevention, waterfronts, and the environment, includes not only tangible measures, such as constructing basic environmental treatment facilities to address water quality degradation, but also intangible measunes, such as environmental education for the citizens. In addition, the small projects under the Master Plan have been divided into long-term and short-term projects according to their requirements and were carried out. As the target deadline for the short-term projects (2005–2009) approached, Ulsan, reflecting on necessary changes in urban planning and for better water quality systematically drafted and began to implement the second phase of the Master Plan. Ulsan finalized the implementation plan for the Taehwa River Master Plan, specifying 50 main projects to be carried out for a period of 10 years beginning in 2005 across almost the entirety of the river from source to mouth. The main details are shown in Table 14 and Figure 20.

The Taehwa River, which consists of state and local river sections, is subject to the River Act (see Figures 21 and 22). In the implementation of the Taehwa River Master Plan, the projects within the state river section were carried out with the cooperation of and permission from the Busan Construction and Management Administration as required by the Act. The projects in the local river section, being under Ulsan's jurisdiction, were carried out directly by the city government. Offices under the metropolitan government managed the sub-projects each according to a specific plan.

Source: Taehwa River Master Plan

<Figure 20> Basic Concept of the Taehwa River Master Plan

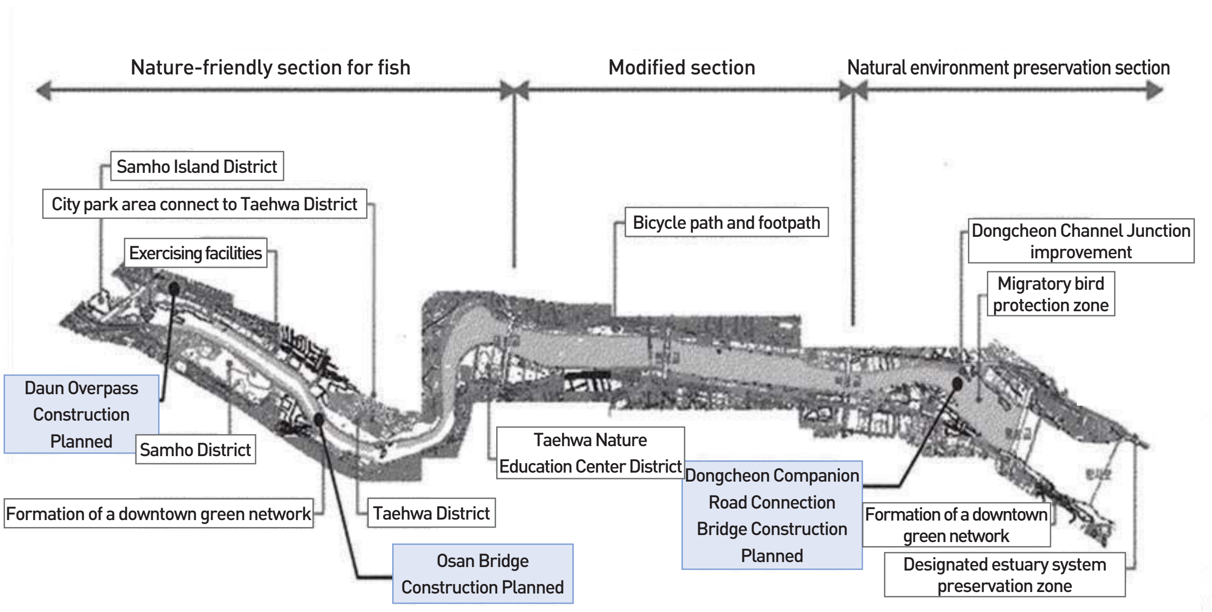
The city of Ulsan carried out both water quality improvement and creation of waterfront space through the Taehwa River Master Plan. 629 billion KRW was invested in water quality improvement between 2002 and 2013, and 336.6 billion was invested in the creation of waterfront space between 2004 and 2013.

The water quality improvement project focused primarily on repairing sewage pipes and constructing new sewage treatment plants, which together took more than 90% of the water quality improvement expenditures. The waterfront space creation project involved removing the concrete revetments which had been installed under the one-size-fits-all river management of the 1980s to restore the natural features of the river and also to create the Taehwa River Grand Park. Other projects were cultural and historical projects that included the restoration of the Taehwaru Pavilion, which was researched and designed according to the Taehwa River Master Plan; the Taehwa Riverside Path restoration project; and cultural festivals such as the Taehwa River Spring Flower Grand Festival.

The details of these projects are shown in Figures 21 and 22 and Table 15.

<Table 14> Main Projects of the Taehwa River Master Plan

Project Name	Main Project	
Safe and clean Taehwa River	Short-Term	Managing non-point pollution and main stream point pollution, preventing algal bloom, improving stream self-purification coefficient, resolving stagnant or obstructed areas in the state river section
	Long-Term	Securing enough water to maintain river flow, eco-friendly stream purification system, rainwater treatment tank, improving riverside environment
Ecologically healthy Taehwa River	Short-Term	Creating riverfront space near Samsan drainage facility, forming an ecological training site at the Eonyang water quality improvement facility, replacing artificial weirs and fishways with more natural ones, creating Seonbawui waterfront space
	Long-Term	Forming the Taehwa River Baekli Fish Forest, making the Taehwa River Baekli Trail, maintaining natural revetments
Familiar and close Taehwa River	Short-Term	Building an ecological parking space, improving walking accessibility, establishing riverside use plan, constructing small-scale amenities, establishing water leisure space
	Long-Term	Remodelling bridges for good scenery, paving a circulating bicycle path, constructing a water environment building
Taehwa River with a history and future	Short-Term	Launching Taehwa River cultural festivals
	Long-Term	Researching and planning Taehwaru Pavilion historical restoration, establishing riverside scenery management plan

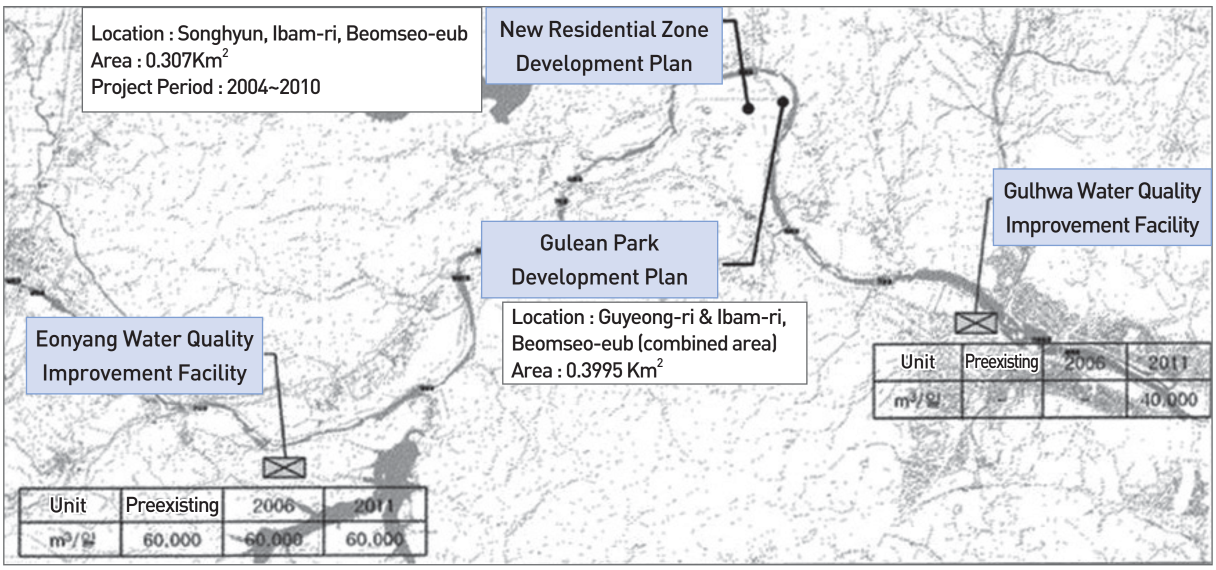


Source: Taehwa River Master Plan

<Figure 21> Projects in the State River Section

2-1-2-2. Financial Support for the Project (Subsidy and ODA)

The central government and the local government provided most of the budget for the Taehwa River Restoration Project. The water quality restoration project was carried out with the investments from the central government, the Ulsan Metropolitan City government, and the private sector. Normally, private participation is active in Korea's sewage business. Thus, the city of Ulsan implemented parts of the sewage treatment plant construction projects in the form of BTL and BTO to lessen the financial burden. The central government and Ulsan provided most of the budget for waterfront space creation projects, and private capital was not involved except for some parts that were funded by local companies as part of their CSR schemes.



Source: Taehwa River Master Plan

<Figure 22> Projects in Local Stream Sections

<Table 15> Taehwa River Master Plan Main Project Details

Project Name		Main Projects
Water quality	Sewage pipe maintenance	Stopping household wastewater, sewage pipe installation
	Establishing wastewater treatment plant	Establishing three water quality improvement offices and small-scale wastewater treatment plants
	Removing sedimentation sludge	Polluted river cleaning activities, dredging riverbed, and maintaining river way
	Improving stream environment	Fostering and cleaning up natural stream, restoring ecological stream
	Resolving hindered river flow	Removing concrete structures
	Securing flow	Installing riverbed filtration facilities, utilizing discharged water from the water quality improvement facilities
	Improving environment near Samsan drainage facility	Installing Incoming wastewater removal facilities, changing retarding basin into parks
	Comprehensive measure for red tide	Improving self-purification ability, removing sedimentation sludge, stopping household wastewater
Water front	Building Taehwa River Park	Building Taehwa River Grand Park and Migratory Bird Park
	Maintaining riverside environment	Managing riverside flowers and plants, making walking paths and bicycle roads, ecological parking space, Taehwa River-Hakseong Bridge, and Eonyang downtown area waterfront, constructing small-scale amenities in state river section
	Forming ecological space	Constructing natural revetments, fishways, migratory bird habitats
	Forming resting space	Constructing or remodelling Shimnidaebat Bridge, Taehwa River Observatory, ecological culture gallery, and bridges

Among the water quality improvement sub-projects, the central government granted subsidies to the sewage treatment plant expansion project, the most expensive sub-project. This subsidy was not specifically for Ulsan but was a general subsidy based on Article 63 of the Sewerage Act. The Act specifies the criteria for granting such subsidies, whose rate is determined by the Ministry of Environment and which varies depending on a project's main agents. The government subsidy rate for sewage treatment plants is in Table 16.

Iu the waterfront development projects, the first stage of the Taehwa River Grand Park construction project was funded by the Ministry of Environment. It was selected in February, 1999, for government funding as part of preparations for hosting the World Cup. The construction of the Taehwa River Migratory Bird Park was funded by the Busan Regional Construction and Management Administration under the Ministry of Land, Infrastructure, and Transport as part of a river environment improvement work.

<Table 16> Government Fund Ratio in Sewage Projects (as of 2014)

Name of Sub-Project	'05–'08	'09~	Note
1) Pipe maintenance			
• Special city	10%	(criterion removed)	
• Metropolitan city	30% (10%)	30% (10%)	Fund for the newly constructed and replaced,( ) is repair
• City (w/ provincial government)	50% (20%)	50% (20%)	
• City, county	70% (30%)	70% (30%)	
2) Construction of wastewater treatment facilities			
• Metropolitan city	10%	10%	
• City (w/ provincial government)	50%	(criterion removed)	
• City, county(Above town/below town)	53% / 70%	50% / 70%	

Source: Ministry of Environment, internal document (Feb. 2014)

2-1-2-3. Taxes and Levies

The Taehwa River Restoration Project has been mostly funded and implemented by tax money and the central and local governments. Consequently, the authority collecting tax on the project and the project undertaker are the same, structurally. Additional taxes cannot be imposed, nor can tax reduction benefits be bestowed.

However, the local government has established a system under provision regarding water pollution, 41 of the Act on Water Quality and Water Ecosystem Preservation that imposes a discharge imposition on polluters based on the polluter pays principle in an effort to reduce the total amount of contaminants released. The discharge imposition amount system has two parts, the excess effluent charge and the basic effluent charge, which are summarized in Table 17.

Aside from these charges, there are a sewage source charge and sewerage use fee. Payment of the sewage source charge is mandatory for the owners of structures that discharge over $10m^3$ of sewage per day. The purpose of this charge is to support the costs for maintenance and construction of public sewerage infrastructure such as sewage pipes, pumps, and terminal sewage disposal plants. The sewerage use fee is imposed according to the amount of sewage discharged.[12)]

2-1-2-4. Regulations

When the Ulsan Industrial Complex was being built, the environmental awareness was very low meaning there were no regulations requiring entering factories to basic environmental treatment facilities. Until the mid-1970s, the city had no office in charge of environmental issues. With crop damages and deteriorating residents' health, conflicts between companies and residents intensified. It became frequent for some companies to even deny the fact that their pollution was the cause. As a result, the administrative bodies responsible for civil petitions and complaints faced many difficulties in resolving the cases submitted by the residents claiming losses from the pollution. In the 1980s, the environmental pollution became far more serious. Relevant ministries and the city of Ulsan realized the severity of the pollution-related losses and the need for environmental preservation and began to implement policies and projects to address the problem. In 1984, the Environment Administration installed a Central Guidance Task Force in Ulsan through

<Table 17> Discharge Imposition Amount

	Excess effluent charge	Basic effluent charge
Objective	Meeting effluent standard; This charge is imposed on those who exceed the standard.	According to the polluter pays principle, this charge is imposed according to discharged amount; Even if the effluent meets the standard, if the effluent exceeds the water quality standard of the terminal disposal plant, this charge is imposed.
Time of Introduction	1983	Jan. 1, 1997
No. of Target pollutants	19 (including basic target pollutants)	2 (Organic material, floating material)
Time of imposition	Irregular (frequently) - The inspection is conducted mainly for the factories which exceed effluent quality standard during check and guide and administrative inspections.	Once in 6 months (2 times a year) - This Inspection is for businesses of types 1–4, excluding the ones whose effluent flows into sewage treatment plants or terminal disposal plants.

12) http://dept.ulsan.go.kr/environment/sense/sense_15.jsp (Sept. 12, 2014)

which it regulated the major polluting factories. In 1986, it designated Ulsan as a special countermeasure area. In the 1990s, the Environment Administration was upgraded to the Ministry of Environment under the Prime Minister's Office (Hwangyeongcheo), and in 1995, it was upgraded to the a proper Ministry of Environment (Hwangyeongbu). This resulted in a leap in the number of environment-related laws and the size of the environment budget. Along with this development, Ulsan established an environmental guidance office to systematically manage and regulate the main polluting factories in the city.

When Ulsan was upgraded to a metropolitan city (1997), it expanded its environment-related office into an independent division and formed the legal foundation for an autonomous environmental management by a local government, establishing the Ulsan Metropolitan City Environmental Basic Ordinance in July 1997. It describes the basic principles of environmental preservation and the rights and duties of the city, local businesses, and local residents. In 1999, Ulsan forged an Agreement of Voluntary Environmental Management. Based on trust and cooperation between businesses and authorities, the municipality allowed businesses to manage their own pollution sources. The decision was made as there were limitations in cracking down polluters and upon the rest of the administrative authority. The city of Ulsan, 128 businesses, and the Nakdong River Environmental Office concluded the agreement in April 2000. In 2003, the Taehwa River Citizen's Environmental Watch Group was established under the Taehwa River Management Body for the purpose of environmental clean-up and environmental surveillance activities, which is still active today. The river monitoring system, of which the citizen's watch group is a part, includes 7,891 members (2,063 public servants and 5,828 civilians) who regularly patrol the river and prevent the dumping of pollutants into the river and discover water pollution incidents early.

As of 2012, Ulsan had established measures for managing pollutants by source and is regulating septic tanks, industrial wastewater, and livestock excreta. Regarding septic tanks and wastewater treatment plants, the city inspects whether the facilities meet the effluent water quality standard and issues an improvement order or a fine when necessary. The effluent standard for industrial wastewater is implemented differently by region, taking into account regional differences.

To preserve water quality, the upstream water source area is administered as a clean area, and stricter effluent standards are applied to facilities that discharge large quantities of wastewater than to small-scale facilities. Regulations regarding both concentration and quantity are being enforced. Guidance and inspection of wastewater discharging facilities focus on the illegal discharge of pollutants, exceeding effluent standards, and such direct polluting acts rather than on neglecting an administrative procedure. Also, they are carried out to prevent pollution accidents and educate offenders. When a violation is discovered, the city responds forcefully, issuing an improvement order, work stoppage order, facility shut down order, or warning or pressing charges of the illegal behavior. Also, the city has been carrying out a discharge fee payment system based on the polluter pays principle to reduce the total amount of pollutants discharged. In addition, Ulsan has legislated that livestock farms discharging in excess of a certain amount must install livestock excreta treatment facilities, and it provides regular education for the livestock farmers. In the case of a violation, Ulsan issues an improvement order, imposes a fine, or presses charges; but the violators are few.

2-2. Market-oriented Institutions

The primary goal of Ulsan's industrialization was economic, to serve as a base city spurring growth nationwide. As a result of this narrowly focused industrialization, the Ulsan area became extremely polluted, and the central and local governments had to invest heavily to restore the environment. Substantial funding has gone into this ecological restoration project comprised of water quality improvement and waterfront development. There is currently no direct cost recovery plan. Aside from the collection of sewage fees to recover the cost of building sewage treatment facilities, In this sub-section, the market-oriented institutions of the Taehwa River Restoration Project are discussed.

Market-oriented Laws and Administration

2-2-1. Property Rights and Surface Water Rights

According to the River Act, state and local river sections may only be used after securing permission. The permission is issued by the basin-wide Flood Control Offices under the Ministry of Land, Infrastructure, and Transport. Because the use of river usually involves construction of or changes in water-intake facilities, the permission system requires coordination with the Regional Construction and Management Administration or the local governments as they administer occupational use of state and local rivers. According to the River Act Enforcement Ordinance, the Flood Control Offices issue permission for both river use and occupation for state river sections. For local river and stream sections, different organizations issue permission for water use and occupation. The Regional Construction and Management Administration, the local government, and the regional Environmental Offices, after deciding whether permission can be granted and conducting an environmental impact assessment, pass on the results to the Flood Control Offices and then collect the stream water use fee, the occupation and use fee, and the water use charge.

Through this process, the use of Taehwa River's water is possible if permission is secured from the Nakdong River Flood Control Office. The stream water use fee and occupation and use fee are charged according to the Ulsan Metropolitan Stream Private Use and Water Use Charge Ordinance, which is based on the River Act and River Act Enforcement Ordinance. In the case of unauthorized use, the user has to pay 120% of the regular fee. The water use and occupation and use fee belong to the local governments. In the case of Ulsan, the fees for each use are described in Table 18. Small rivers and streams in the Ulsan area are governed by separate ordinance based on the Small River Act.

The Taehwa River was used as a source of drinking water until the 1970s, after which a dam was built to meet increasing demand for water for economic activities. With the dam now meeting the demand, direct sourrce from the Taehwa River is hardly used. The fees related to river use collected by Ulsan Metropolitan City totals only 365 million KRW, with occupation and use fees of 293 million KRW and flowing water use fees of 72 million KRW.

2-2-1-2. Scope of Private Participation in the Water Sector

There is no law or regulation that blocks private sector participation in water resources management

<Table 18> Water Tariff System in Ulsan

Purpose	Generation	Agriculture	Household, Industrial (/m^3)		
Rate	When 100m^3 is used a day		Raw water	Supernatant	Purified water
	231 KRW/year	231 KRW/year	223 KRW	313 KRW	413 KRW

Source: Ordinance of Ulsan Metropolitan City on Collecting River Occupation and Use Fee (introduced Nov. 12, 2013) or water and sewage services. Private participation in sewage services is so active that 71.0% of public sewage treatment facilities is operated by private companies (as of 2012, Ministry of Environment 2013). Contracting sewage services to the private sector is on a steady rise because the cost of treating 1 ton of sewage costs 34.0% less with private operation (public-private) than with direct operation by local governments (direct operation – 190.9 KRW, operation by proxy – 126.0 KRW).[13] Furthermore, sewerage BTLs and treatment plant BTOs are becoming more common. In the Taehwa River Restoration Project, part of the sewerage project was carried out in the form of a BTL, and the Gulhwa Water Quality Improvement Project was carried out in the form of a BTO. However, private participation in the water provision sector has not taken off because of opposition by local governments, laborers, and civic groups.

The areas of private participation in the Taehwa River restoration project were limited. Aside from the above-mentioned sewage treatment facility construction and operation, no sub-project involved private participation aimed at earning a return on investment.

2-2-2. Market-oriented Policies

2-2-2-1. Cost Recovery

The Taehwa River Restoration Project was mostly financed by the central government and the city of Ulsan. In the water quality improvement project, 629 billion KRW was invested between 2002 and 2013, and in the waterfront facility construction project, 336.6 billion KRW was invested between 2004 and 2013 for a total of 965.9 billion KRW (see Table 19). Some parts of this cost were financed by local companies.

Within the water quality improvement project, the Eonyang sewerage pipe maintenance project (85.5 billion KRW) was carried out in the form of BTL (sewerage pipe lease). And among the three sites of the water quality improvement project, the Gulhwa Sewage Treatment Plant was constructed in the form of BTO using private funds to alleviate Ulsan's financial burden; among the total cost of 94.6 billion KRW, the central government financed 8 billion KRW, the city of Ulsan financed 10.6 billion KRW, and the private sector financed 76 billion KRW. Aside from the cost of this latter sub-project, the central and local governments covered the rest. The central government currently provides subsidies to the sewage part of the project. These subsidies can be seen as the government's way of paying most of its share of the burden of the water

<Table 19> Annual Investments in the Taehwa River Ecological Restoration Project

(Unit: hundred million KRW)

	Total	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Total	9,656	623	891	1,212	946	917	524	413	464	1,047	1,163	813	642
Water quality	6,290	623	891	1045	770	247	222	162	49	483	776	585	437
Waterfront space	3,366	0	0	167	176	670	302	251	415	564	358	228	205

Source: Ulsan Metropolitan Government, internal document – Saving the Taehwa River

13) http://www.me.go.kr/home/web/policy_data/read.do?pagerOffset=0&maxPageItems=10&maxIndexPages=10&searchKey=&searchValue=&menuId=92&orgCd=&condition.code=A5&seq=5108

quality improvement project. If the metropolitan government is conducting a sewerage project, 30% of the cost of sewer pipe maintenance, 50% after 2009 (60% from 2005–2008) of the cost of excreta treatment facility construction, and 10% of the cost of wastewater treatment plant construction has been paid out of state coffers. Of the 629 billion KRW invested in the water quality improvement project until 2013, the sources of investment for the 622.2 billion KRW cost of the 26 completed sub-projects are shown in Table 20.

Among the waterfront development projects, the first stage of the Taehwa River Grand Park construction project was financed by the Ministry of Environment after it was selected in February, 1999. The government funding was a part of preparations for host cities for the World Cup. The Taehwa River Migratory Bird Park construction project (31.9 billion KRW) was financed by the Busan Regional Construction and Management Administration as a part of river environment maintenance projects. Including 8.4 billion KRW invested by the Busan Regional Construction and Management Administration in creating waterfront space along the state section of the Taehwa River, state funds in the waterfront development work totaled 159.1 billion KRW, of which roughly half, or 72.7 billion KRW, was used to purchase land for the Taehwa River Grand Park. Area businesses also funded the projects as a part of CSR activities. The city of Ulsan and Gyeongnam Bank signed an agreement to fund 1.1 billion KRW and 5.1 billion KRW respectively for the Shimnidaebat Bridge (see Picture 14) in the Taehwa River Grand Park and to transfer the bridge to Ulsan after completion. S-Oil bore the whole 10 billion KRW cost of constructing the Taehwaru Pavilion (in progress until 2013, the construction of the Taehwaru Pavilion was excluded from the list of completed projects) (see Pictures 12 and 13). K-water remodeled the Taehwa River water intake tower into the Taehwa River Observatory as a contribution to Ulsan, paying 1.3 billion KRW of the total 1.5 billion KRW cost (see Pictures 10 and 11).

Source: Taehwa River White Paper, 205

<Picture 10> Former Water Intake Tower

Source: Taehwa River Web site

<Picture 11> Taehwa River Observatory

<Table 20> Type of Investments by Source (Projects Finished as of the End of 2013 Only)

(Unit: hundred million KRW)

	Total	Central government	Local government	Private fund(local business CSR)	Note
Total	8,854	2,889	4,286	1,679	For the projects already finished as of 2014
Water quality	6,222	1,298	3,309	1,615	
Waterfront space	2,632	1,591	977	(64)	

Source: Ulsan Metropolitan City, internal document

Most of the Taehwa River Ecological Restoration Project was funded by the central and local governments. However, among the water quality improvement project costs, apart from the 4.7 billion KRW saved from the 2.3 billion KRW earned from selling the aggregate gained from dredging sedimentation sludge, from the 2.4 billion KRW earned in shipping fees, from the wastewater treatment facility construction and related costs to be recovered through sewage fees, there are no measures to recover project costs. Although the private sector investors have no way to recover their investment, they received tax benefits for their legal donations according to the Corporate Tax Act.

Source: Taehwa River White Paper, 210

<Picture 12> Taehwaru Pavilion (1900s)

Source: Ulsan Metropolitan City Web site PowerPoint file

<Picture 13> Taehwaru Pavilion Bird's Eye View

2-2-2-2. Private Sector Promotion Policy

In the Taehwa River Ecological Restoration Project, a policy to actively promote the private sector's participation was not implemented. However, some parts of the project were carried out with private sector investment to alleviate the financial burden of the local government. In the Eonyang wastewater treatment plant project, the sewage pipe maintenance project was carried out in the form of BTL, and the Gulhwa water quality improvement project was carried out in the form of BTO with an operation period of 20 years from the completion date.

Another example of policy for private participation was taking advantage of companies' social contribution activities. Local companies aiming to build a favorable company image through social contribution projects provided the budgets for building the Shimnidaebat Bridge, the Taehwa River Observatory, and the Taehwaru Pavilion in full or in part.

Source: Taehwa River Web site

<Picture 14> Shimnidaebat Bridge

2-2-2-3. Project Selection Criteria

The Taehwa River Ecological Restoration Project began in earnest with the establishment of the Taehwa River Master Plan to make Ulsan a sustainable ecopolis where the environment and the economy stand together. Until the finalized Taehwa River Master Plan was announced, the city of Ulsan made great efforts to reflect the opinions of citizens and other stakeholders in and to share the contents of the plan. In this regard, the office in charge held a workshop with consultants and the project implementation planning team in October 2004, to discuss their opinions and held a debate in January 2005 that drew 250 participants including the implementation planning team, NGO officials, and regular citizens.

Each sub-project for the Taehwa River's ecological restoration was classified as either a short-term or long-term project. Projects were selected based on their contents and urgency. Those that required the permission of the central government for work on the state section of the river were cleared by the Busan Regional Construction and Management Administration, while those involving work on the local section of the river were cleared by Ulsan's own process prior to their implementation.

2-3. Community Govemance Stuctures

2-3-1. Community-centered Laws and Administration

When Ulsan was designated as a special industrial zone and the industrialization was at its height, the laws and management structures which guaranteed the participation of various stakeholders did not exist. At that time, the Korean government was implementing growth-first policies and power was concentrated in the central government.

However, during the 1990s, as the nation-wide environmental awareness increased and the environmental problems that had accumulated as a side effect of growth-oriented policy grew increasingly visible, environmental NGOs grew rapidly. As the environmental pollution of Ulsan was especially severe, not only the local media but the nationwide media reported the problem as a main issue. With growing concern over the situation, environmental groups, civic groups, and local experts worked to restore Ulsan's environment.

Since the Taehwa River includes the state and local river sections and is therefore managed by the central and local governments respectively, it was difficult for civic groups and other such stakeholders to participate in the decision making process. To make the central government accede to local opinion, the local stakeholders including the local government, NGOs, and the academic community established a governance network for mutual cooperation. In fact, the local NGOs and the academia successfully persuaded the Ministry of Land, Infrastructure, and Transport into preserving the Taehwa River Shimnidae Forest and Taehwa Field by conducting a signature-seeking campaign and the Buy a Plot of the Taehwa Field Campaign. As of 2012, 42 NGOs had participated in the Taehwa River's restoration.

One of the defining characteristics of the Taehwa River Restoration Project distinguishing it from other environmental projects was the participation of local businesses. These companies took part in the river's restoration through the "One Company, One Stream Reviving Campaign" leading in the installation or restoration of the Taehwa River Observatory, Shimnidaebat Bridge, and the Taehwaru Pavilion as a means of corporate social responsibility. As of 2012, 105 companies had participated in the One Company, One Stream campaign.

Since the end of the 1990s, Ulsan has guaranteed the participation of local stakeholders through ordinances.

On April 6, 1998, Ulsan's Office of Environmental Policy established the "Ordinance of Establishment and Operation of Ulsan Metropolitan City Environmental Council" which later became the "Ordinance of Establishment and Management of the Green Ulsan 21 Environmental Committee." The Green Ulsan 21 Environmental Committee (hereafter referred to as the Committee) established through this ordinance involves Ulsan residents in environmental policy formulation, pollution monitoring, implementation of the Green Ulsan 21 agenda, and review and inspection of Green Ulsan 21 activities. The Committee consists of up to 50 members appointed by the mayor of Ulsan. The Committee can review the city's environmental policies and suggest new and alternative policies to the mayor. In addition, the Committee provides environmental education to increase the environmental awareness of the local residents and can participate in various environmental preservation and watch activities. The ordinance allows the Committee to receive its budget from the city. The Committee is a channel through which the local government, residents, and businesses can establish a partnership and have continuing dialogue. This partnership is an important mechanism which reinforces the mutual trust between the private and public spheres and allows the local residents to have a continuing interest in the Taehwa River problem and voluntarily participate in the ecological restoration project. The 7th Committee formed in 2014 is composed as shown in Table 21 and Figure 23.[14)]

As described above, the city of Ulsan conducted the water quality restoration activities with the Green Ulsan 21 Environmental Committee, encouraged the participation of local businesses in the project, and overall shared the problem with the local community so that they could solve the problem together. As a result, the environmental NGOs, which until that time had a negative view of the local government, recognized the state of the environment and endeavored to present responsible alternative policy options; and the local residents, with increased participation, gained a sense of ownership and changed from being mere beneficiaries of environmental preservation to some of its main agents.

2-3-1-1. Effectiveness of Accountability Provisions and Arrangement

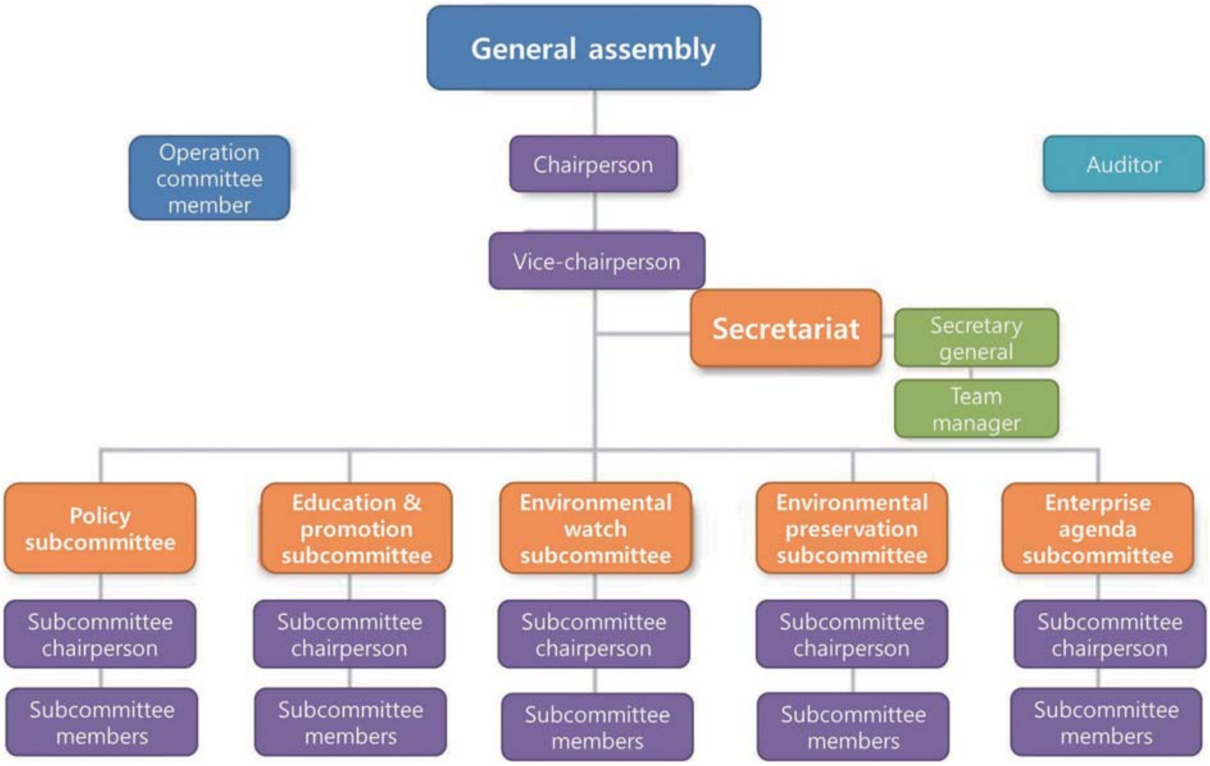
The pollution of the Taehwa River was the result of a narrowly economic development-focused policy—manifested in the building of an industrial zone without environmental considerations—and a lack of environmental awareness in Korean society as a whole from the central and local governments to businesses and ordinary citizens. As late as the 1990s, due to the lack of environmental awareness, local factories and farms discharged wastewater during heavy rains. During the dry season, at times there was a lack of water necessary to maintain the river flow, and in the urban area, households discharged untreated wastewater into the Taehwa River. Given these circumstances, no stakeholder could be held solely responsible for the pollution of the Taehwa River. However, when the city of Ulsan recognized the seriousness of the pollution and the need to improve the situation, it actively took lead in finding a solution instead of playing the blame game.

<Table 21> Organization of the Green Ulsan 21 Environmental Committee (7th Committee, 2014)

Organizations	Public organizations	Education	Press	Environmental NGOs	Civic group	Relevant organizations	Total
People (No.)	3	7	4	17	12	7	50

Source: Ulsan Metropolitan City press release material (Mar. 17, 2014)

14) http://www.ulsan.go.kr/cityboard/Report.do?method=select&func=view&PAGE_NUM=1&mNum=3&sNum=5&GUBUN=&SEARCH=&PGM_GBN=report&RECID=23513



Source: Green Ulsan 21 Environmental Committee Homepage[15)]

<Figure 23> Organizational Chart of the Green Ulsan 21 Environmental Committee

In the Taehwa River water quality restoration project, because effective management was difficult for a general administrative authority due to the connected nature of work in the areas of environment, wastewater, and flood prevention, the city of Ulsan in May 2003, established the "Taehwa River water quality improvement planning team" and the Taehwa River Master Plan and, putting forward significant funds, launched the Taehwa River Ecological Restoration Project (White Paper, 119). As the work of managing the Taehwa River Ecological Restoration Project diversified and the workload increased, the Taehwa River Management Body as mentioned earlier was established in January 2006, as a separate entity to direct the implementation of the project, which it has done to this day. Because the source of most of the pollution was household and industrial wastewater within the city limits, Ulsan was able to reduce most of the pollution significantly by connecting waste pipes to households and establishing wastewater treatment facilities.

The city of Ulsan realized that the effective management of the Taehwa River and its connected streams was not possible through an administrative organization alone. Thus, it formed the Taehwa River Citizen's Environmental Watch Group under the Taehwa River Management Body on December 19, 2003, consisting of 60 people including company employees, environmental and other NGOs, and independent businessmen. The watch group was tasked with monitoring all polluting activities and conducting environmental cleanup activities over 15 sections of five streams. Through these activities, the group instilled the sense of community with the environment among residents and formed a close, cooperative interface between the public and private spheres. In addition, not only did the division

15) http://www.greenulsan21.co.kr/cm05.php

of labor among the managing bodies make the river's management more efficient, the reactive style of administration of crackdowns changed to a proactive style of providing guidance and enlightenment.

2-3-1-2. Adequacy and Relevance of Information

When the Ulsan industrial complex was developed, as the power of the central government was strong and the concept of information disclosure was scarce, information disclosure amounted to government policy decisions being reported in official newspapers. Even until when the Taehwa River became polluted to the point of being called the river of death, due to the inadequacy of information, the public could not get a sense of how serious the pollution in the river was until they saw firsthand the pollution level that was reported in the media. At that time, the Official Information Disclosure Act (enacted in 1998), which guarantees the right to know of the general public, had not yet been implemented.

However, from the time Ulsan established the water quality restoration plan in 2003, it set out to involve local stakeholders in the decision making process and allow the general public to have access to necessary policy information. In the background of this decision, besides the coming into effect of the Official Information Disclosure Act, as decision making power shifted from the central government to the local government with the local government taking charge of the project, the need to share information in order to form social consensus over the project and to answer the demand for information by direct stakeholders in the local government had risen. Ulsan's Environmental Basic Ordinance stipulates that information related to environmental preservation has to be disclosed, and the city does so through its web site like other local governments and thereby complies with the information act. In addition, Ulsan discloses information on pollution by source, water supply and wastewater management measures, environmental organizations and local laws, environmental standards, the environmental community, and overall environmental status, policies, and laws through its annual environmental white paper.

Regarding the Taehwa River Restoration Project, Ulsan disclosed the planning process and adopted the opinions of the general public through the Master Plan workshop (Oct. 8, 2014) and the Taehwa River Master Plan discussion (Oct. 21, 2005). Moreover, during project implementation, Ulsan held a performance reporting event every other month and the main points were continuously reported in the press.[16] In addition, Ulsan made a Web page for the Taehwa River (http://taehwagang.ulsan.go.kr), through which it shares information on the Taehwa River and the Taehwa River Master Plan.

Besides the local Ulsan government, local civic and environmental groups such as the Green Ulsan 21 Environmental Committee and the Taehwa River Conservation Association are also providing information, helping to build consensus in and promote the voluntary participation of local residents and civil society.

2-3-1-3. Integrated Treatment of Water Planning and Development

In regards to urban development planning, water resources planning is necessary. In 1962, when Ulsan was designated to host an industrial complex, Ulsan upgraded the body in charge of the water supply service from the water supply arm of the construction division to the water supply division and undertook to secure more water with the Sayeon, Hoiya, and Daeam Dams. As the heavy industry complex rapidly developed and

17) Interview with Dr. Sang-hyun Lee of the Ulsan Development Institute (22 Aug 2014).

the city grew increasingly populated, the demand for industrial and household water catapulted, threatening to outstrip the water available through wells, streams, and existing filtration plants. In response, the city moved to stabilize the water supply through industrial waterworks expansion of the Nakdong River, the construction of the Daegok Dam in 2000, and the changing of the Sayeon Dam to provide water to households. The Sa-yeon, Dae-gok, and Dae-am Dams are managed by K-water. In the sewage sector, the city set up a basic plan for treatment plants in 1980, and in 1995, the Yongyeon wastewater treatment plant started operation. However, while the expansion of water supply and treatment facilities solved the problem of drinking water, household but industrial wastewater continued to flow into the Taehwa River untreated. This was a time of water supply expansion-focused water quantity management driven by the central government, leaving insufficient consideration toward water quality management.

The Taehwa River water quality improvement case illustrates the process of change from the centralization of authority in water resources management to its decentralization. In addition, the case also shows how the problems that occurred because water quantity control and quality control were divided among the central government and local government were resolved and the efforts of the local government to involve the local community in the policy making and implementation process.

During Ulsan's industrialization, water resources policy focused on water quantity management, and as water quality became an issue, the water resources policy became water quality-oriented. At the time of Ulsan's industrialization, the central government, specifically the present Ministry of Land, Infrastructure, and Transport, took lead in water quantity management through dam construction, and there was not much room for the local government and local residents' participation. When the water quality degradation became an issue and made water quality management the trend, the city of Ulsan, local residents, environmental NGOs, and the local media joined hands and implemented various projects.

When the central government pushed forward plans to carry out a flood prevention project by constructing a concrete revetment along the entire Taehwa River and removing the Shimnidae Forest without considering the environmental aspects, the central government met with opposition from Ulsan and the area community. Likewise, in 1994, when the South Gyeongsang Province Urban Planning Council set about to convert the Taehwa Field into a residential area, the council provoked a conflict with the Ulsan community. In response to these development attempts, Ulsan's environmental groups strove to have their voices heard and their goals realized by conducting a signature-seeking campaign and petitioning the central government, and the city of Ulsan resolved to preserve the environment even at the cost of considerable city finances. As a result of their cooperative efforts and bound by their common goal, the local government, citizens, and the local media were able to resolve the conflicts and change the policy direction to their goal.

Even as the local Ulsan government led the planning and implementation of the Taehwa River Ecological Restoration Project, it guaranteed the participation of civic and environmental groups and encouraged the participation of area businesses. To ensure the participation of local residents in environmental policy making, Ulsan established a relevant ordinance and founded the Green Ulsan 21 Environmental Committee. Moreover, the city also established the Taehwa River Citizen's Environmental Watch Group so that citizens could participate in the environmental watch and environmental cleaning activities. Through these measures, Ulsan citizens could participate not only in the environmental policy making process but in the implementation process as well.

2-3-2. Community-Centered Policies

From an institutional perspective, the main actors in Ulsan's industrialization and the ecological restoration project were the central government (the Ministry of Land, Infrastructure, and Transport), the local government (Ulsan), and environmental NGOs. This subsection examines the following: the policies to facilitate the community's participation in the restoration project, how the level of the community's participation changed, the means of resolving the conflicts that arose between the central and local governments and among area actors, and what efforts each actor put into solving the conflicts.

2-3-2-1. Impact of the Policy for Promoting Stakeholder Participation (Education, Communication, Raising Public Awareness)

The city of Ulsan promoted local stakeholders' participation from the planning stage of the water quality restoration project. During the drafting of the Taehwa River Master Plan, the city held a discussion with citizens, opening the drafting process and gathering citizens' opinion to encourage their participation. During the implementation stage, Ulsan provided environmental education as a means to settle disputes among the local stakeholders and carry out the project smoothly. With the water quality restored and waterfront spaces created, Ulsan now offers city tours to residents and domestic and foreign tourists, publicizing the case of the Taehwa River's ecological restoration from Ulsan's industrialization to its transformation into an ecological city through water quality improvement and making known the importance of environmental preservation.

Also, among the 5 subcommittees of the Green Ulsan 21 Environmental Committee, the city formed the Education and Promotion Subcommittee to provide education on climate change and environmental preservation for the citizens and schools (Ordinance Provision 6 and 15). In addition, Ulsan is training eco-tourism guides who can explain the development of Ulsan as an eco-city to tourists to the Taehwa River and providing ordinary citizens, teachers, and students with hands-on environmental and green growth education. These education efforts raised the local residents' environmental awareness and contributed to their active participation in various environmental preservation activities such as the Buy a Plot of the Taehwa Field campaign.

As an industrial city, Ulsan has more big companies than other cities. Ulsan has engaged the financial assistance and participation of these and other area companies and thereby improved the sustainability of the Taehwa River's restoration. Companies with local operations such as K-water, S-OIL, Hyundai Motors, and Gyeongnam Bank have provided financial assistance to the construction of the Shimnidaebat Bridge, Taehwa River Observatory, and Taehwaru Pavilion restoration project as a form of CSR. The financial support of these companies amounts to 16.8 billion KRW, a substantial financial contribution. Furthermore, the local companies actively participated with civic groups in the One Company, One Stream campaign, which is managed by the Taehwa River Management Body and supports environmental maintenance of the river and its streams at the district and county levels. The One Company, One Stream campaign launched in 1999 and developed as a systematic pan-citizen movement, with 184 organizations (79 civic organizations, 105 private companies) working on 143 sections of 43 streams to voluntarily engage in environmental cleaning activities and remove foreign plant species.

Although Ulsan has led ecological restoration policy in this manner, rather than taking an authoritarian approach, it thoroughly educated its citizens about the environment and raised their awareness level; it institutionalized

Source: Taehwa River White Paper

<Picture 15> One Company, One Stream Reviving Campaign Activity Photographs

stakeholder participation in policy making by forming the stakeholder network Green Ulsan 21 Environmental Committee; and it encouraged the participation of business and carried out the restoration project together with the local community. Thanks to these efforts, the diverse stakeholders of the environmental restoration project participated as engaged actors rather than remaining critics and observers, and the project could be successfully implemented without serious conflicts among the local government, local residents, and civic and environmental groups.

2-3-2-2. Level of Stakeholder Participation

Before the Taehwa River's pollution arose as an issue, the drafting and execution of all plans including development plans had been carried out mainly by the central and local governments. However, after the Ulsan Ecopolis Declaration, besides the government, various stakeholders including local lawmakers, local NGOs, local companies, and local expert groups participated in the policy making process in various forms.

As Ulsan underwent industrialization and water quality improvement, stakeholder participation continually increased. This can be attributed not only to Korea's unique circumstances such as the growth of environmental NGOs and the implementation of the self-governing system, as well as a general trend of increasing stakeholder participation, but also to Ulsan's efforts to involve the stakeholders and the determination of the citizens to restore the environment after gaining awareness through media reports on Ulsan's pollution.

During Ulsan's designation as an industrial zone and its industrialization, the central government played the role of the key stakeholder. In the 1960s, the industrialization took place under the strong leadership of the central government. Because the central government regarded Ulsan's local government as a subordinate institution, the central government did not involve Ulsan in its designation as an industrial city but merely communicated its decision. Even until the harmful side-effects of an industrial city without environmental infrastructure had appeared and Ulsan's environmental pollution starting with the Taehwa River had reached alarming levels by the 1980s, local governments' participation in policy was limited to expressing a supportive or opposing stance on the central government's policy. Economic interests overwhelmed environmental interests, and consequently measures to tackle the pollution were lacking and the environmental movement could not unfold. At this stage, conflicts arose between the central government, which pursued a flood control-oriented water quantity policy, and the local government, which emphasized the Taehwa River's ecology and water quality. In the 1990s, as the environmental degradation worsened with direct economic, social, and environmental consequences, everyone, from the central and local governments to the citizens, realized the seriousness of the pollution and actively tried to address the problem. During this period, many environmental groups formed, but the cohesion among them was yet weak.

After the implementation and stabilization of the self-governing system, in the 2000s, when authority had been transferred from the central government to the local government, the local Ulsan government, having become the key stakeholder, carried out the Taehwa River Ecological Restoration Project. Although Ulsan took lead in implementing the project, it opened the drafting process of the water quality improvement project and the waterfront space creation project, gathered public opinion, and involved the local residents and environmental NGOs in the project's implementation. Furthermore, it built a system of close cooperation among public and private actors through the establishment of the Green Ulsan 21 Environmental Committee, a network of some 50 local organizations that serves as a channel for continuing dialogue and safeguards private participation in policy decision making.

<Table 22> Change in Stakeholder Participation Level

	Ulsan's industrialization (~'70)	Water quality degradation ('80~'90)	Taehwa River restoration period ('03~)
Level of stakeholder participation	Central government-oriented decision making (Nonparticipation)	Central government-oriented decision making but local government and citizens suggest opinions(Tokenism)	Local government-oriented decision making with civil society's participation (Empowerment)
Information release	Announcement of governmental policy	Release finalized policy	Entire procedure of decision making is open

Source: Authors' tabulation based on Min (2011)

2-3-2-3. Effectiveness of Conflict Resolution Mechanism

Conflicts related to the Taehwa River largely divide into those between the state section-administering central government and the local section-administering local government and those among members of the city of Ulsan.

The main conflicts between the local government and the central government (the Ministry of Land, Infrastructure and Transport) were over the preservation of the Shimnidae Forest and the Taehwa Field. Regarding the former, the central government, aiming to mitigate damage from floods, established the Taehwa River Maintenance Basic Plan in 1989. As it set out to remove the Shimnidae Forest and construct a concrete revetment along the entire state-administered section of the Taehwa River in accordance with the plan, the Ulsan municipal assembly submitted a proposal for changing the plan to the central government in 1994, but the Ministry of Construction and Transportation (present Ministry of Land, Infrastructure, and Transport) rejected the proposal saying that the Shimnidae Forest could disrupt the water flow during a flood. However, in the 1990s, when citizens' environmental awareness was increasing, the Taehwa River Conservation Association held a symposium featuring invited experts and revealed that the Shimnidae Forest has almost no effect on Taehwa River floods; and in 1995, it collected the signatures of 70,000 Ulsan citizens and sent a "Proposal for the Preservation of the Taehwa River" to the Minister of Construction and Transportation, the Minister of Environment, the Presidential Secretariat, and the Ombudsman of Korea and thereby elicited the preservation of the Shimnidae Forest.

In the conflict between the city of Ulsan and the central government over the Taehwa Field, the city used the Resident's Audit Demand System as a dispute settlement tool. Nine civic groups in Ulsan including the Ulsan Citizens' Coalition for Economic Justice, Ulsan People's Solidarity for Participatory Democracy, Ulsan Federation for Environmental Movement, and Ulsan Democratic Citizen Group pointed out the problems of residentially developing the Taehwa Field, and after collecting the signatures of 892 people, they petitioned the central government (the Ministry of Land, Infrastructure, and Transport) for a residents audit on July 19, 2001. As a result, the Residents' Audit Committee of the Ministry of Land, Infrastructure, and Transport, to prevent harmful and unbalanced development, limited development activities in general residential areas of Ulsan and ordered the Busan Construction and Management Administration to modify the stream maintenance basic plan. The city of Ulsan also actively worked for the preservation of the Taehwa Field. It declared that it would provide 100 billion KRW in land compensation costs to turn the residential area of the Taehwa Field into a stream area. In response, the central government had Ulsan assume only 27.3 billion KRW of the cost of preserving the Taehwa Field while it footed the remaining 72.7 billion KRW through the national budget. Later, in December 2003, to stop the lingering dispute over the development or preservation of the Taehwa Field, Ulsan's civic groups started the Buy a Plot of the Taehwa Field campaign, a national trust movement, which encouraged citizens to buy plots of the Taehwa Field and preserve the field themselves.

In conflicts with the central government, the local stakeholders utilized the central government's ombudsman system and Residents' Audit Demand System to resolve their conflicts. In conflicts among local stakeholders within Ulsan, the city government played an active intermediary role as described below.

As the number of crows in the Shimnidae Forest increased, so too did civil complaints regarding the damages caused by crow droppings. In response, the Ulsan government started a project to change the residents' attitudes toward migratory birds, alleviating the inconvenience to residents, and carried out a civil communication project regarding ecological preservation. Between 2011 and 2013, the city washed 33,000 affected vehicles and provided their owners with tours of the Suncheon Bay Ecological Park, one of the world's five great coastal wetlands, to educate them on the importance of migratory birds and their value as a resource of eco-tourism. In addition, having chosen migratory birds as a selling point, Ulsan shared its vision of nurturing a vibrant eco-tourism industry with the residents and explained to them that many tourists would benefit the local economy. Furthermore, when the Ulsan Federation for Environmental Movement declared that the floodlights of the Shimnidaebat football ground should be pulled down because of its adverse effects on migratory birds, the nearby businessmen and Ulsan Football Association opposed this. In response, Ulsan gathered opinion in a policy meeting overall leaning toward taking down the floodlights and, on the one hand, took the floodlights down, but on the other hand, it provided the nearby businessmen with a number of measures to revitalize the business area and thereby appeased them. In these ways, the city of Ulsan took the initiative to resolve conflicts as they arose during the Taehwa River Restoration Project and could therefore carry it out smoothly.

Aside from this, the city established the Environmental Dispute Resolution Committee consisting of 9 members including the economic vice mayor of Ulsan as chair, 2 lawyers, 5 professors, and the Director of Environmental Greenbelt Division of Ulsan according to the Ordinance for Ulsan Metropolitan City Environmental Dispute Resolution Committee Operation. The committee was tasked with handling environmental disputes; investigating, analyzing, and counseling with regard to environmental damage-related civil complaints; researching and proposing institutional measures and policies to resolve and prevent environmental disputes; and educating with regard to and promoting environmental damage prevention and recovery. The Environmental Dispute Resolution System can help citizens resolve environmental disputes fairly and swiftly via the expert committee without going through a complicated legal process.

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17) Due to the River Maintenance Basic Plan (established Jan. 6, 1989), which aimed to remove bamboo trees within the river area for flood prevention, the Shimnidae Forest was in danger of disappearing.

18) After 20% of the bamboos in the area, or 53,000m^2, was removed during river maintenance in 1987, in 1994, the Shimnidae Forest faced a second threat of disappearance because 186,000m^2 of green zone of the forest was changed into a residential zone due to the growth-oriented urban policy.

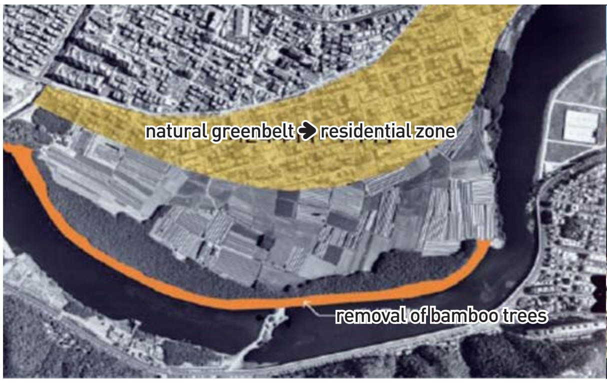
19) In 2003, the Busan Construction and Management Administration suggested a revised version of the Taehwa River Maintenance Basic Plan, which aimed to make a new waterway to prevent floods, leaving the Shimnidae Forest and the residential area unaffected.

20) In 2005, when the Central River Management Committee reviewed the revised version of the Taehwa River Maintenance Basic Plan, the committee changed the residential area into a river area.

21) Since 2006, the local government conducted land compensation for 442,000m^2, collected 3,500 tons of waste, and repaired 391 greenhouses, which led to the foundation of a natural ecological park.

1960s

1987[17]



1994[18]

2003 (Taehwa River Maintenance Basic Plan Revised Version(provisional))[19]

2005[20]

2006

2008

Present[21]

Source: Taehwa River White Paper (1960s), Ulsan Metropolitan City “Taehwa River Grand Park Story” (1987–2008), 2014 Ulsan Municipal Administration White Paper (present)

<Picture 16> History of the Shimnidae Forest

2-4. Concluding Remarks

The Taehwa River Restoration Project shows a successful water and green growth case where the local government became the main agent of the implementation of the local project and the local government established an organic public-private partnership which resulted in effective project drafting and implementation.

During Ulsan's designation as an industrial city and its development, the central government took the lead, leaving only a weak role for the local government, and the local stakeholders including the local government, the mass media, and the citizens supported and seldom clashed with the central government because they held economic development as a common goal. However, when the environment greatly worsened as a consequence of industrialization, the directly affected local government could no longer rely wholly on the central government. With the arrival of the local self-governing system having transferred roles and responsibilities from the central to local governments, the local Ulsan government established the Taehwa River Master Plan and began the ecological restoration of the Taehwa River, carrying out both water quality improvement and waterfront space creation as major parts of the project. As environmental demands from various stakeholders increased as the local community felt the urgency of the problem and citizens grew more environmentally conscious due to media reports of the problem, the city of Ulsan engaged the local community and formed a network of different organizations called the Green Ulsan 21 Environmental Committee to involve the stakeholders in policy and solve the problem together.

In spite of the changes in the structure of decision making, the central government is retaining its influence over Ulsan's industrialization and the entire process of the Taehwa River's ecological restoration. Because the central government has jurisdiction over state sections of rivers, the local Ulsan government had to obtain permission from the central government when carrying out ecological restoration work on state sections of the Taehwa River, and about one third of the project costs of water quality improvement and waterfront space creation was met through the national budget. However, the core stakeholder of the Taehwa River Ecological Restoration Project is the local government. The city of Ulsan, gathering the sentiments of Ulsan citizens, led in the planning and implementation of the Taehwa River Ecological Restoration Project and transformed citizens from policy beneficiaries to direct participants by involving stakeholders from each sphere in the entire policy decision and implementation process. That is, the local government has set the Taehwa River's ecosystem as the highest policy priority and carried out the project with determination by restructuring the project implementing system.

Among the costs of the Taehwa River Ecological Restoration Project, the central and local governments shouldered the lion's share, and private funds were invested in parts of wastewater treatment facilities in the form of BTL and BTO. The costs borne by the central and local governments were met through tax revenue and income from issuing government and local bonds, but aside from income from sewage fees to recover the cost of built sewage treatment facilities, there are practically no cost recovery plans. Although the city collects river water use fees, the collected fee in 2011 amounted to an insignificant 72 million KRW. The sewage fee too, rather than being fixed to the construction cost of the wastewater treatment facilities to recover the cost quickly, will recover that cost over a long period.

In terms of the community aspect, the level of participation of stakeholders has advanced markedly. If the central government merely communicated the policy decisions it had made during the development stage of the 1960s and 1970s, in the 1980s and 1990s, the local government, environmental groups, and citizens were limited to presenting their views in a policy process dominated by the central government. However, since the 2000s, during the ecological restoration of the Taehwa River, the level of stakeholder participation had developed to the point where citizens were guaranteed participation in policy decisions by the local government and the entire decision making process was open. To guarantee stakeholder participation, the city of Ulsan had created the network organization Green Ulsan 21 Environmental Committee, which it continues to manage. In addition, in order to supplement the administrative organization given its limitations and facilitate the participation of the stakeholders as leaders of environmental preservation, Ulsan formed the Taehwa River Citizens' Environmental Watch Group and thereby strengthened the system of public and private cooperation.

IV. Performance of the Project

1. Generic Performance

1-1. Attainment of Project Objectives

Ulsan was designated as the first industrial complex, Ulsan Special Industrial Zone, thanks to the abundant industrial water from the Taehwa River, its proximity to the Busan port, and the low price of land. Since then, through the government-wide policy efforts begun in the 1960s and the efforts of area businesses and workers, Ulsan has consolidated its position as one of Korea's leading industrial cities. The main development indicators of Ulsan are as follows.

For the four consecutive years since 2009, Ulsan has ranked first in per capita annual income among Korea's 15 metropolitan cities and provinces. In 2012, the per capita annual income of Ulsan reached 18.31 million KRW, which is 24% higher than the national average, 14.77 million KRW.[22)]

Thanks to the Taehwa River water quality improvement project, the water quality of the Taehwa River improved to a large extent from 11.3ppm in 1996, a level inhospitable to life, to 3.2ppm in 2004, a normal level. In 2011, the water quality reached grade 1 at 1.9ppm, becoming Korea's cleanest river, a status it maintains. This is appreciably lower than the Han River's level in Seoul (2.8ppm).

In addition, the waterfront space creation project was also a huge success. The construction of the Taehwa River Grand Park, Taehwa River Observatory, and Shimnidaebat Bridge, changed the Taehwa River into a place of rest for citizens, and the new facilities (including the Taehwa River Observatory completed in Sep. 2010) and festivals attracted many outside visitors (0.66

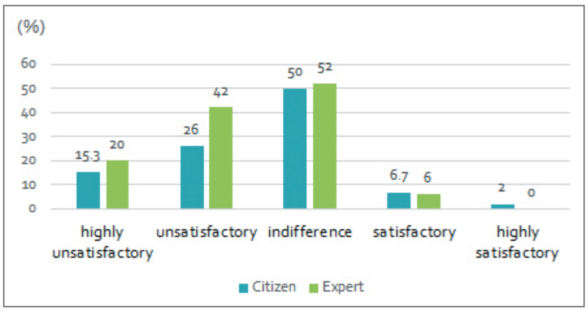
<Table 23> Main Growth Indicators of Ulsan (1962–2013)

		1962	1973	1984	1995	2010	2013
Output	Nation(billion KRW)	187.6	1,395.3	72,297.4	366,561.8		
	Ulsan(billion KRW)	-	273.8	5,219.0	41,633.5		
	Proportion of Ulsan(%)	-	19.6	7.2	11.4		
Exports	Nation(million$)	55	3,225	29,245	125,058	466,562	559,649
	Ulsan(million$)	0.26	8037	4,647	14,905	71,384	91,499
	Proportion of Ulsan (%)	0.47	2.5	15.9	11.9	15.3	16.3

22) *Ulsan's Income per Capita Ranked 1st for Four Consecutive Years...Wealth Concentration in Seoul Alleviated. 2013, 23 Dec. Yonhap News*. (in Korean) (Accessed Sept 2014) http://www.yonhapnews.co.kr/economy/2013/12/23/0302000000AKR20131223093500002.HTML

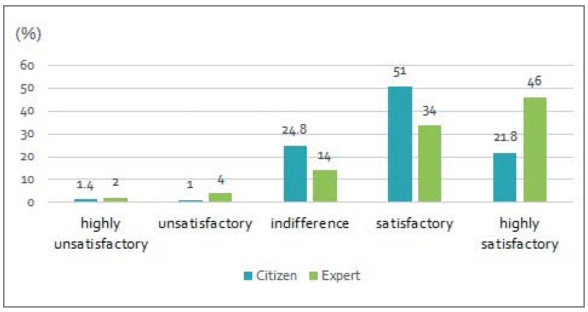
million people in 2006 → 3.04 million people in 2012). Furthermore, construction of bike lanes and walking spaces changed transportation patterns among visitors to Ulsan, decreasing the use of motor vehicles such as buses and private cars from 44.6% in 2004 to 36.4% in 2013 while increasing the use of bicycles and walking from 50% in 2004 to 63% in 2013, transforming Ulsan into an eco-friendly city.

Survey results of Ulsan citizens shows the performance of the Taehwa River Restoration Project in clearer terms (see Figures 24 and 25). The number of respondents satisfied with the overall environment of the Taehwa River has increased from 8.7% in 2004 to 72.8% in 2013, and the number of the dissatisfied decreased from 41.3% to 2.4% during the same period. Survey results of experts reveal more marked differences. The number of respondents satisfied with the overall environment of the Taehwa River has increased from 6.0% to 80.0%, and the number of the dissatisfied decreased from 62% to 6% during the same period.



Source: Taehwa River White Paper

<Figure 24> 2004 Taehwa River Satisfaction Survey



Source: Taehwa River White Paper

<Figure 25> 2013 Taehwa River Satisfaction Survey

1-2. Timeliness of the Project

During the designation and construction of the Ulsan Special Industrial Zone, Korea was in poor economic circumstances, and development of the complex represented a considerable investment cost. At the time, completing the industrial complex to foster the heavy and chemical industries was an urgent national priority, and developing Ulsan, Korea's first industrial area and therefore one without precedent, in an environmentally friendly way in anticipation of environmental problems was an unrealistic expectation.

After the completion of the Ulsan industrial complex, even until the water of the Taehwa River became polluted and could not be used as industrial water, much less domestic water, overall awareness of the pollution's severity was low, and only limited water quality restoration efforts were made. In the latter half of the 1990s, the Taehwa River pollution problem received continuous coverage in the media, and the implementation of the local self-governing system and the expansion of local government tax revenues kindled the will to address the river's water quality and made funding the effort to some degree possible. Thus, it took a while before stakeholders finally began proactive efforts to restore water quality.

However, once stakeholders agreed on the need to restore the Taehwa River and the city of Ulsan decided to take on the task, the city quickly established a comprehensive plan and carried it out actively. It established the Taehwa River Master Plan with the goal of solving the pollution problem and improving the quality of citizens' lives and divided specific projects under the plan into short-term projects and long-term projects. The short-term projects were ones that needed to be undertaken with haste and included the pollution source management and algal bloom prevention project and the waterside park construction project. Ulsan aimed to complete these projects within five years from 2005 to 2009. The long-term projects, which called for thorough prior analysis and evaluation, included projects for securing water to maintain river flow, improving small stream environments, and maintaining natural revetments, and their completion was planned for between 2010 and 2014.

By and large, each project finished within its planned deadline, and this result was made possible by the determination of the central and local governments and the participation and cooperation of civic organizations, businesses, and citizens for the Taehwa River's restoration.

1-3. Appropriateness of Investment

If the initial plan for the Ulsan industrial complex had included basic environmental treatment facilities and an environmental impact assessment had been conducted and the results reflected in the initial plan, a huge amount of the finances spent on the water quality restoration project since the 2000s could have been saved.

The costs of the Taehwa River Water Quality Restoration Project and construction of waterfront facilities between 2002 and 2013 totals 965.6 billion KRW, and the contribution of the central and local governments on the projects which have been completed as of the end of 2013 amount to 717.5 billion KRW out of 885.4 billion KRW. Although huge sums were invested, when taking into consideration the fact that the BOD of the Taehwa River has recovered to the lowest level among Korea's rivers thanks to each water quality project, the large investment was appropriate. Furthermore, since the constructed waterfront facilities provide the citizens with resting places and, having been utilized as a tourism resource, attract many outside visitors, the decision to establish the waterfront facilities was not in vain. Bringing together the Green Ulsan 21 Environmental Committee and thereby involving stakeholders in the decision making process and building social consensus prior to pushing the restoration project forward reduced the possibility of facing opposition from stakeholders and spending additional time and money in the project. However, having spent from the central and local government budgets without ways to recoup the investment except in the case of some treatment facilities can strain the national and local government budgets, so making basic environmental treatment facilities compulsory in future factory installations is required.

2. Economic Performance

2-1. Contribution to Regional Production

2-1-1. Population Growth

With a population of 1.07 million in 2010, Ulsan's proportion of young adults and middle-aged persons

<Table 24> Population Trend, Ulsan and National

(Unit: persons)

	National Population			Population of Ulsan		
	All age	20-49	Ratio between Young and elder	All age	20-49	Ratio between Young and elder
1966	29,159,640	10,518,947	36.1%	233,477	85,050	36.4%
1970	31,435,252	11,521,473	36.7%	275,449	106,442	38.6%
1975	34,678,972	13,242,931	38.2%	368,223	155,663	42.3%
1980	37,406,815	15,791,856	42.2%	534,739	249,871	46.7%
1985	40,419,652	18,288,637	45.2%	668,898	327,049	48.9%
1990	43,390,374	20,854,892	48.1%	804,968	419,735	52.1%
1995	44,553,710	22,341,790	50.1%	966,628	517,260	53.5%
2000	45,985,289	23,173,704	50.4%	1,012,110	538,144	53.2%
2005	47,041,434	23,566,977	50.1%	1,044,934	549,658	52.6%
2010	47,990,761	22,593,645	47.1%	1,071,673	526,810	49.2%

Source: Statistics Korea, Annual Population Census

(20-49 years old), who are part of the working age population, was 49.2% (see Table 24). After its designation as an industrial zone in 1962, Ulsan's proportion of young adults and the middle-aged has exceeded the national average. It seems that the high working age population ratio has contributed greatly to Ulsan's growth as an industrial zone.

2-1-2. Contribution to Regional Economy (GRDP)

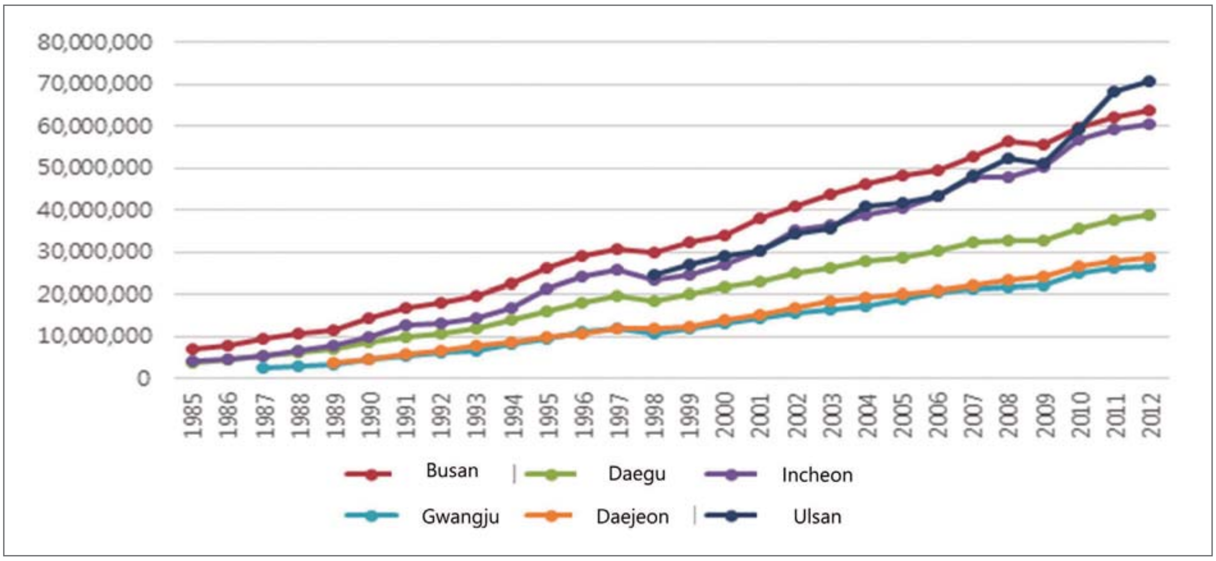
While Ulsan's population of 1.1 million as of 2011 comprises just 2% of the national population, its GRDP of 68.4 trillion KRW represents 5.5% of national GDP, which is 1,241.5 trillion KRW (see Figure 26). Until the mid-2000s, Ulsan's GRDP was second after Busan's among those of the six metropolitan governments not including Seoul. However, in 2010, Ulsan reached level with Busan, and since 2011, Ulsan surpassed Busan in GRDP to rank first among the six metropolitan cities excluding Seoul. It is worth noting the fact that Ulsan recorded a GRDP similar to Incheon's after its promotion to metropolitan city status in the latter 1990s but since the latter 2000s experienced a higher growth rate than other cities.

After the restoration of the Taehwa River, with Ulsan becoming recognized as an eco-culture city, the number of tourists has also significantly increased. The Taehwa River was designated as one of the 12 ecotourism destinations by the Ministry of Environment and the Ministry of Culture, Sports, and Tourism in 2013. Following the designation, it is expected that an increase in the number of tourists will contribute to the growth of Ulsan's GRDP.

2-2. Employment Effect

According to the employment inducement effects of the ecological stream report of the Ministry of Employment and Labor (2011), the employment effects of the ecological stream restoration projects are as follows: the total labor inducement effect per 1 billion KRW is 17.8 people, the employment inducement effect is 10.6 people, and the agriculture, forestry,

Unit: million KRW



Source: Statistics Korea[23]

<Figure 26> Gross Regional Domestic Product (GRDP) of Metropolitan Cities (Excluding Seoul)

23) http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1C51&conn_path=I3

fishery, and construction industries have a relatively higher total labor inducement effect. These results are higher than the average employment effect for all industries in 2008, which was 9.6 people per 10 billion KRW, and the total labor inducement effect, which was 14.0 people per 10 billion KRW. The employment inducement effect of general construction projects (4,175 people) is higher than that of the ecological stream restoration projects (3,887 people) by 7.4% (288 people), and the total labor inducement effect of the ecological stream restoration projects (6,506 people) is higher than that of general construction projects (4,807 people) by 35.3% (1,698 people).

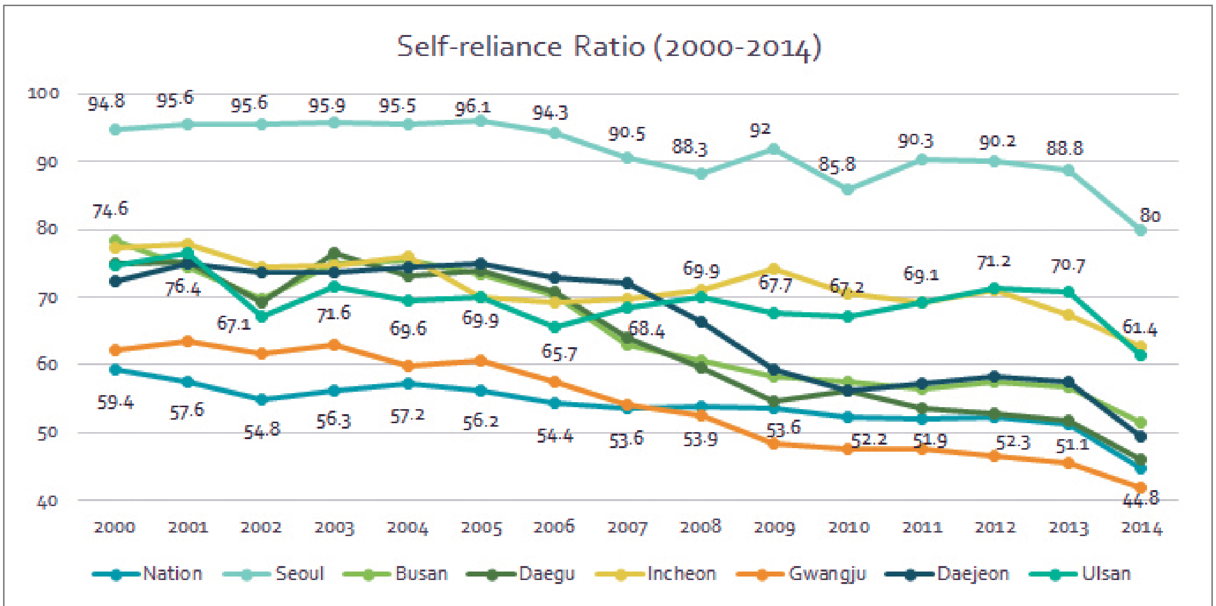
If the budget invested in the Taehwa River Restoration Project of 965.6 billion KRW is converted into employment effects, the project has had total labor employment effects, the project has had total labor inducement effects of 171,876 people (the total annually accumulated people).

Since ecological stream restoration projects such as the Taehwa River project, which are different from typical public engineering works, have higher total labor inducement effects, they can be utilized as a means to more visible economic stability (Ministry of Employment and Labor 2011, Employment Effect Evaluation in Ecological Restoration Project).

2-3. Alleviation of Regional Imbalance

The fiscal self-reliance ratio of Ulsan is much higher than Korea's national average of 54.6% during the period 2000-2013 (see Figure 27). Although the fiscal self-reliance ratio of Ulsan is lower than Seoul's, in 2013 it exceeded Incheon's and was far more favorable compared to the ratios of Gwangju, Daejeon, and Busan.

The reason for Ulsan's relatively high fiscal self-reliance ratio compared to other metropolitan cities excluding the capital can be attributed to its high GRDP and its concentrated industrial complexes, which are a stable source of local taxes. Such a stable fiscal self-reliance ratio has not only served as a pillar in the successful implementation of the Taehwa River Restoration Project, it has also contributed to alleviating the regional imbalance in the national economy, which is heavily concentrated around the Seoul metropolitan area.



Source: Ministry of Security and Public Administration
Note: Fiscal self-reliance ratio = (local tax revenue + non-tax revenue)/local government total budget size*100

<Figure 27> Fiscal Self-Reliance Ratio of Metropolitan Cities

3. Social Performance

3-1. Advancement of Stakeholder Participation

The Taehwa River Ecological Restoration Project, which was started to eliminate pollution in the river, firmly united the citizens, enterprises, environmental groups, and other members of the local community over the environment and brought them to realize that they are the main agents responsible for preserving the environment rather than mere bystanders. The management complications arising from the divided nature of the Taehwa River into national and local sections paradoxically brought the stakeholders to experience the reality that responding to the national policy over the Taehwa River—a task for which the efforts of the local government, local residents, and civic groups separately were too limited—becomes possible when forming a mutually cooperative governance structure.

The city of Ulsan reflected this experience in policy making and stakeholder management. The Taehwa River Ecological Restoration Project from the planning stage made information available and encouraged the active participation of residents, reflecting citizen demands in project policy. Furthermore, it organized the Green Ulsan 21 Environmental Committee that consists of various local public and private organizations and made it directly responsible to the city of Ulsan. As active participants in environmental preservation, Ulsan citizens are directly participating in the Buy a Plot of the Taehwa Field campaign and the activities of the Citizens Environmental Watch Group and are promoting the case of Ulsan's eco-transformation and the Taehwa River's ecological restoration as ecological tour guides. Local companies, as members of the local community, have participated in local contribution work such as providing financial support and conducting the One Company, One Stream campaign. As a consequence, the Taehwa River has become the cleanest river among the seven major urban rivers, and Ulsan has been reborn as an ecopolis.

The local government tried to resolve up front the conflicts that arose during the Taehwa River Ecological

Before(concrete blocks)

Remobing

After

Source: Taehwa River White Paper

<Picture 17> Natural Cleanup Project

Restoration Project rather than avoid them or inflexibly stick to its own position. In conflicts with the central government, in the Taehwa Field problem, the local government expressed its intent to shoulder costs first, and civic organizations through an experts symposium presented evidence for preserving the field. After reaching a general consensus with citizens, the Ulsan government and the local community could establish a governance system and preserve the environment surrounding the Taehwa River. In conflicts among members of the local community, Ulsan proactively set out to reduce its citizens' inconveniences and worked to solve the problem by changing citizens' awareness through ecological education.

The Taehwa River's ecological restoration is a successful case of the local Ulsan government's stakeholder management, and at the same time, it shows how through this most evolved form of stakeholder management, the local government and the local stakeholders could build mutual trust and the stakeholders could become direct participants rather than mere bystanders.

3-2. Improvement in Quality of Life

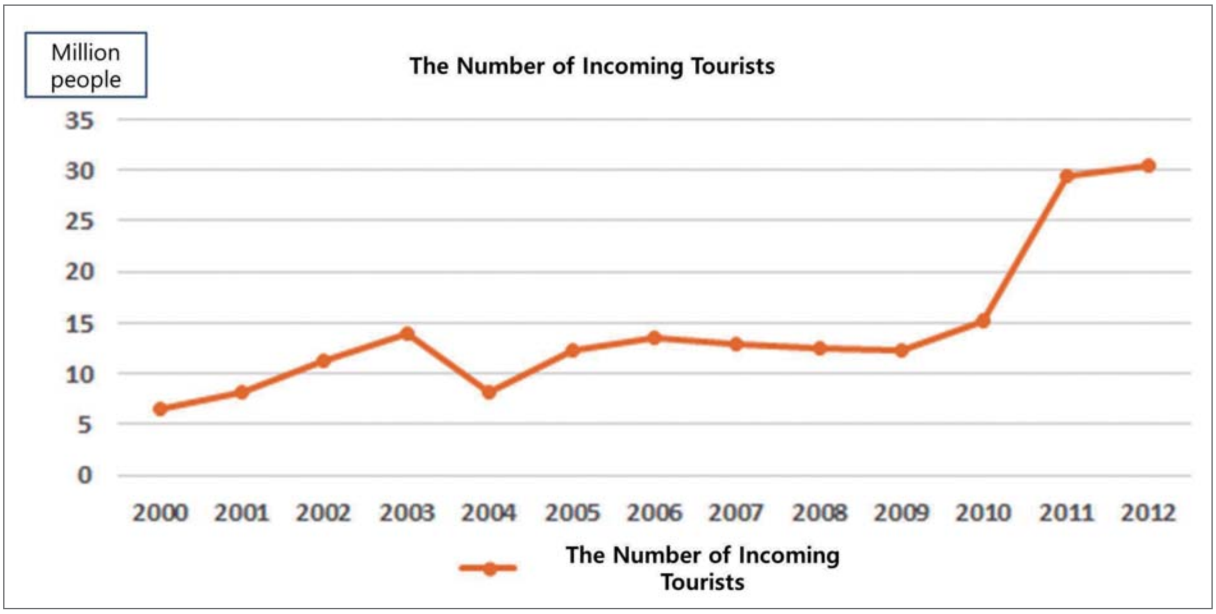
Ulsan conducted the waterfront space creation project alongside the water quality improvement project. In addition to the environmentally successful water quality improvement project, which eliminated the stench of and brought back salmon to the river, the riverfront development project directly improved the life of local residents by providing a riverside park and resting places near the river.

By replacing the concrete structures along the river with natural revetments and maintaining or creating the Shimnidae Forest, a vast field with flowers, and trails and bicycle paths of the Taehwa River Grand Park, the local residents could enjoy education of the natural environment and resting space. Through projects meant to recover the culture and history of the Taehwa River such as the restoration of the Taehwaru Pavilion and the construction of the Taehwa River observation walk, Ulsan provided places where local residents can experience history, culture, and the environment.

As stated earlier, the performance of these projects are well reflected in the survey results regarding the satisfaction with the projects among the local residents and experts in 2004 and 2013. The proportion of residents who answered "satisfied" increased from 8.7% to 72.8% while the proportion of residents who answered "not satisfied" decreased from 41.3% to 2.4%.

The number of visitors to the Taehwa River is increasing every year (see Figure 28). Due to the drastic water quality improvement, national-scale swimming, rowing, and canoeing competitions have been held every year since 2005, and with the myriad cultural festivals such as the Ulsan Whale Festival and the Spring Flower Festival, many tourists nationwide are visiting Ulsan (see Table 25). Among the Taehwa River's major festivals, the Taehwa River Spring Flower Festival that takes place on the flower field of the Taehwa River Grand Park is the most popular. Through its various attractions and hands-on activities, it provides a place to rest for those weary from daily life; during the 11 days of the 2013 festival, 960,000 people visited. The Taehwa River is reborn every season with different festivals, and in 2013 alone 15 different festivals took place. When looking at the visitation data for domestic and foreign visitors between 2006 and 2013, 701 organizations and some 30,000 individuals visited the Taehwa River.[24] The status of Ulsan's major festivals and number of visitors to Ulsan per annum is as follows.

24) Based on data regarding the status of external organizations and groups which requested permission from the city of Ulsan to be in the visiting program (the number between 2012 and 2013 includes ecological tour guides as well).



Source: Statistics Korea

<Figure 28> Number of Incoming Tourists in Ulsan (2000–2012)

<Table 25> Main Festivals of the Taehwa River (as of 2013)

Name	Date	Place	Start year (times held)	Visit and participants (person)
International Marathon Festival	Mar. (1 day)	Riverside of Taehwa River	2004(10)	4,000
Ulsan Whale Festival	Apr. (4 days)	Riverside of Taehwa River	2011(3)	820,000
Spring Flower Festival	May (11 days)	Taehwa River Grand Park	2012(2)	960,000
International Installation Art Festival	Jun. (12 days)	Riverside of Taehwa River	2007(7)	
Bamboo Forest Summer Evening Festival	Aug. (3 days)	Taehwa River Grand Park	2007(7)	100,000
Taehwagang International Walking Festival	Sept. (1 day)	Riverside of Taehwa River	2008(6)	3,000

Source: Taehwa River White Paper

3-3. Equity between Regions and Social Groups

Ulsan's GRDP per capita is much higher than the national average. In 2012, the GRDP per capita of Ulsan was about 63.42 million KRW, 2.3 times higher than the national average (27.54 million KRW) (see Table 26). The GRDP per capita of Ulsan was the highest for four consecutive years among the metropolitan cities and provinces: in 2012, Ulsan's GRDP per capita was 18.31 million KRW, the national average was 14.77 million KRW, and the capital Seoul's was 17.52 million KRW (Statistics Korea, 2012 GRDP). As Ulsan became a good place to live, its economy came alive and the concentration of wealth around the Seoul area lessened to some extent.

<Table 26> GRDP per Capita (2005–2012)

[Unit: ten thousand KRW]

By Region	2005	2006	2007	2008	2009	2010	2011	2012
Nation	1,911	1,995	2,147	2,259	2,341	2,561	2,674	2,754
Seoul	2,200	2,304	2,484	2,609	2704	2,883	3,030	3,142
Ulsan	4,054	4,203	4,652	4,950	4805	5,745	6,220	6,342

Source: Statistics Korea, KOSIS, (Aug. 4, 2014)

<Table 27> Personal Income per Capita (2008–2012)

[Unit: ten thousand KRW]

Region	2008	2009	2010	2011	2012
Seoul	1,537	1,550	1,612	1,696	1,752
Ulsan	1,522	1,562	1,638	1,824	1,831
Nation	1,254	1,292	1,346	1,439	1,477

Source: Statistics Korea, 2012 personal income (temporary)

The city of Ulsan planned to stimulate its economy and its ecological and tourism industries by attracting outside visitors through expansion of its local culture and hands-on tourist activities. To this end, it set up a program linking with nearby tourism resources including the Jangsaengpo Special Whale Culture Zone and tried to attract longer sojourning tourists. It began linking city tours with KTX in July 2001, altogether making eight currently operating regular Ulsan city tour courses including the Ulsan Taehwa River experience course, an industry visiting course, and a whale course. In addition, in January 2013, Ulsan started the full launch of ecological tourism with five tour courses including of the Taehwa River, as a result of which the number of incoming visitors is increasing. Moreover, with the completion of the Taehwa River observation walk, which runs 47km along the length of four river sections to the Taehwa River's source, it created a tourism infrastructure that integrated ecology and cultural tourism. In addition, it contributed to the stimulation of the local economy by prohibiting food inside event areas during festivals, boosting the sales of nearby restaurants.

During that time, the city of Ulsan has invested funds to restore the Taehwa River's ecosystem, but now this project has developed into income generation with more than 800 million KRW expected to be generated every year. Also, the harvesting of short-necked clams which had been suspended since 1987 due to the industrial pollution has begun again providing a new source of income to the residents of what was once Korea's largest harvesting site. Between April 14 and May 31, 2014, 20 fishing households harvested 157 tons of the short-necked clam (on average, 5.8 tons a day) and earned 307.2 million KRW (15.30 million KRW per household).[25)]

4. Environmental Performance

4-1. Water Quality Improvement

In the early 2000s, with the Taehwa River water quality improvement planning team newly formed and drafting and implementing the water quality improvement comprehensive plan, and with the voluntary purification activities of the local residents and companies, the water quality of the Taehwa River, which had deteriorated from the release of domestic and industrial wastewater, significantly improved. The project that contributed the most to the water quality improvement was the expansion of the sewage treatment plants. The sewer system connection rate increased from 48% in 1997, when Ulsan became a metropolitan city, to 72.1%, when it made the Ecopolis Ulsan Declaration, and to 97% by the end of 2012 (see Table 28).

<Table 28> Sewage Service Supply Rate (2003–2013)

Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Supply rate (%)	66.1	72.1	91.6	92.0	92.2	92.3	92.4	94.0	95.1	97.0

Source: Taehwa River White Paper

In addition, the project for securing water to maintain the flow of streams that was launched to prevent Ulsan's streams from drying up also improved the water quality of the river to some extent. The Taehwa River normally requires at least 135,000m3/day of water to maintain its flow. Thus, Ulsan met this need by having the Eonyang Water Quality Improvement Office discharge 33,000m^3/day on average and the Gulhwa Water Quality Improvement Office discharge 70,000m^3/day on average to maintain the Taehwa River's flow.

As a consequence of these efforts, the BOD of the Taehwa River's downstream decreased from 5.5ppm in

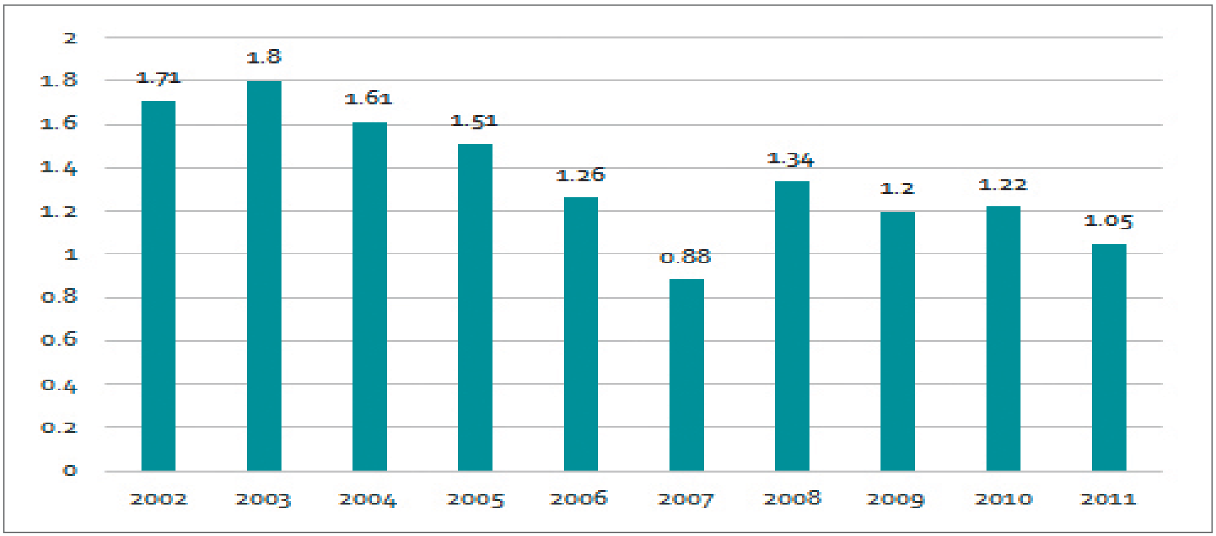
25) Ko, E. 2014, 13 Jun. Ulsan produces 157t of Short-necked Clams for 27 days from the Taehwa River's First Try. Newsis. (in Korean) http://www.newsis.com/ar_detail/view.html?ar_id=NISX20140613_0012979829&cID=10814&pID=10800.

2001 to 4.5ppm in 2002 and to 3.2ppm in 2004, and the water quality greatly improved (see Figure 22). Thus, the Taehwa River became a clean urban river, maintaining a grade 1b water quality rating with a BOD of around 1ppm since 2011. This BOD level is the lowest among Korea's streams.

Thanks to the improved water quality of the Taehwa River, Ulsan's coastal water quality has also improved: the COD of the coastal water in 2012 was 60% of the 2002 level (see Figure 29). Among sources of sea pollution, 80% owes to domestic, industrial, and livestock sewage mostly flowing into the sea through the river, and since these types of wastewater were prevented from release into the Taehwa River, the water quality of the coastal waters improved as well. In this respect, the Taehwa River Restoration Project has created a new paradigm of improving sea water quality through improving stream water quality.

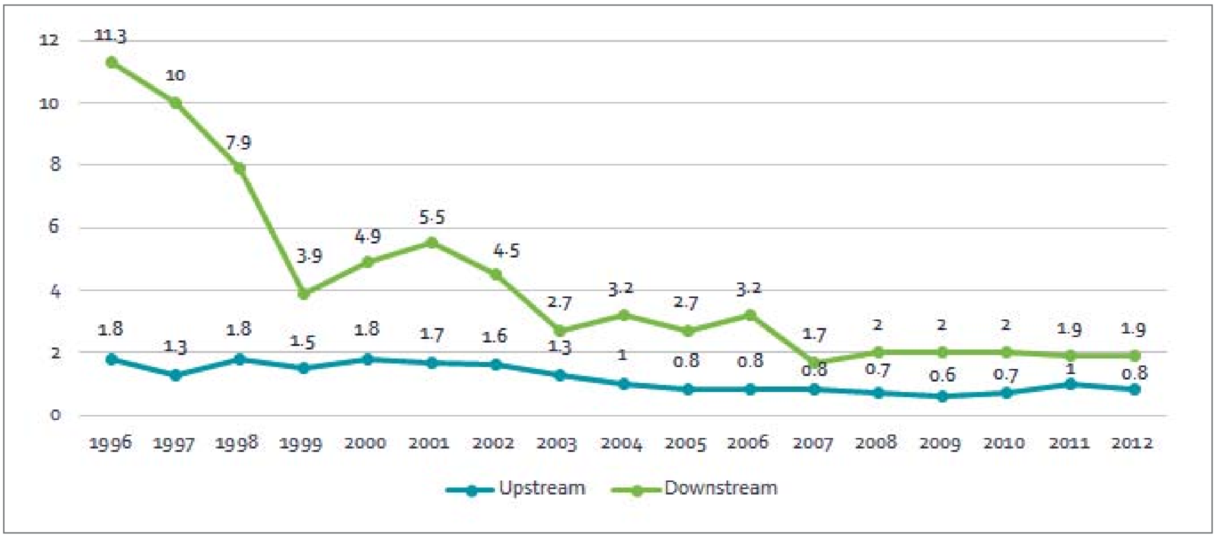
4-2. Increase in Biodiversity

The water quality improvement project improved not only the Taehwa River's water quality but also the



Source: Ulsan Development Institute, Ulsan Urban Environment Brief. 2014 Vol.49

<Figure 29> Change in COD Concentration of Ulsan Coast (ppm)



Source: Ulsan Metropolitan City Environment White Paper 2013

<Figure 30> Change in BOD Concentration of the Taehwa River Upstream and Downstream (ppm)

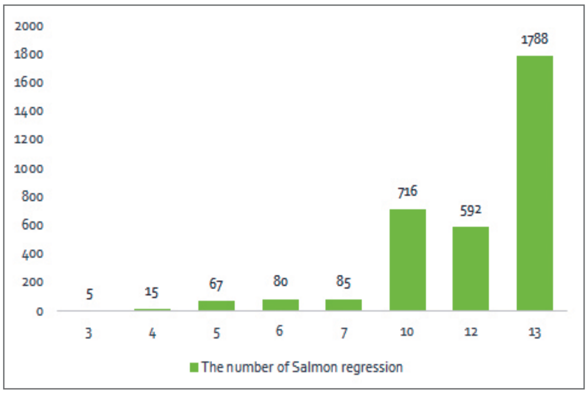
ecological environment. As the number of fish in the Taehwa River began to increase, the number and kinds of birds, mammals, and reptiles have also started to increase. As of 2013, 272 species of animals, including 73 kinds of fish, 146 kinds of birds, 23 kinds of mammals, and 30 kinds of reptiles and amphibians, and 632 kinds of plants inhabit the Taehwa River, making it a biodiversity hotspot and a river characterized by an ecological virtuous cycle (see Table 29).

<Table 29> Change in the Number of Species in the Taehwa River

(Unit: species)

Category	Total	Fish	Birds	Mammal	Herptile
1996	156	32	86	16	22
2013	272	73	146	23	30

Source: Taehwa River White Paper



Source: Taehwa River White Paper

<Figure 31> Number of Salmon Returning to the Taehwa River

A salmon release project in the Taehwa River started in 2000, with the first salmon returning in 2003. By 2013, the number of salmon that returned reached 1,788 (see Table 30). Because a salmon can return to its

Young Salmon

Sweetfish

Source: Taehwa River White Paper

<Picture 18> Taehwa River Fish

pochard

seagull

Source: Taehwa River White Paper

<Picture 19> Taehwa River Migratory Birds

Source: Taehwa River White Paper

<Picture 20> Taehwa River Grand Park Raccoons

birthplace using its sense of smell only when the river's water quality is at least second grade, these returning salmon indicate that the Taehwa River and connected streams have become clean. Moreover, each summer, around 8,000 white herons come to the ecological park for migratory birds that has been created around the Taehwa River area. In addition, after the installation of wastewater treatment plants improved the water quality, the once polluted mud flats downstream became a sand bed, turning the downstream of the river into the biggest harvesting site for short-necked clams in Korea.

Meanwhile, an agency under the Ministry of Environment published the Red List (a list of endangered species) for Korea using the criteria and categories of IUCN, and among the 190 species on the list, 31 species inhabit the Taehwa River ecosystem (see Table 30).

5. Overall Performance

Although the objective of economic growth, established when Ulsan was designated to host an industrial complex, was achieved through Ulsan's industrialization, the economic growth brought about a huge social cost resulting from the severe environmental pollution, an outcome of failing to consider environmental consequences. This was not a problem specific to Korea and to Ulsan; the cause can be attributed to the low environmental awareness of the period. In the end, however, the goal of the Taehwa River Ecological Restoration Project, to attain economic growth and environmental restoration at the same time and make a sustainable city by restoring the damaged environment, was achieved. The local government gave the highest policy priority to the Taehwa River Ecological Restoration Project and implemented the project after dividing it into short-term and long-term sub-projects. Subsequently, the investments required in the project's implementation were made appropriately, and as a result, the water quality significantly improved, and the waterfront space creation also increased the quality of local residents' lives.

Ulsan was able to attract a lot of people from other regions by creating jobs because the large-scale industries, the automobile, shipbuilding, and petrochemistry industries were concentrated there. Additionally, a

<Table 30> Indicators of Endangered Species in the Taehwa River

Category	Total		Bird		Amphibian/ Reptile		Fish	
	Nat'l	TH River	Nat'l	TH river	Nat'l	TH River	Nat'l	TH River
Regionally Extinct (RE)	4	-	3	-	-	-	1	-
Critically endangered (CR)	5	-	1	-	-	-	4	-
Endangered (EN)	36	-	18	-	5	-	13	-
Vulnerable (VU)	50	12	36	12	5	-	9	-
Near threatened (NT)	24	3	8	1	2	1	14	1
Least concern (LC)	71	16	28	4	23	7	20	5

Note 1: This table is based on the National Institute of Biological Resources (2011). Red Data Book, and Ulsan Development Institute, "Study on Taehwa River Water Ecosystem Monitoring and Assessment."

Note 2: The Red List is the list shown in the Red Data Book that the International Union for Conservation of Nature has published to prevent the extinction of animals and plants and to preserve biodiversity. The Red Data Book has information on endangered creatures and their current habitation status.

higher proportion of young adults and the middle-aged than the national average likely drove Ulsan's growth as an industrial zone. Based on this high productivity, Ulsan's GRDP is the highest among the six metropolitan governments excluding Seoul. As of 2011, Ulsan's GRDP (5.5%) as a share of national GDP was much higher than its share of the national population (2.2%). Ulsan's GRDP has occupied second place after Seoul's, after it surpassed Busan's in 2011, and its GRDP per capita has been the highest nationally among all metropolitan cities and provinces, including Seoul, for the past four years. The increased income stabilized the local tax revenue and raised Ulsan's fiscal self-reliance ratio of Ulsan, which in turn has not only provided a fiscal base for the Taehwa River Restoration Project but has also helped reduce the regional economic imbalances characterized by the concentration of wealth in the Seoul area.

Ulsan has benefited the local community in a number of ways through the Taehwa River Ecological Restoration Project. The local Ulsan government chose an actively inclusive policy and legally guaranteed the participation of the local stakeholders in the policy process. This governance structure has strengthened the solidarity among the local residents, companies, and NGOs through the environment. Furthermore, the partial transfer of administrative authority and duty to monitor environmental pollution to the local residents has made the local residents realize that they are agents responsible for protecting and preserving the environment rather than just beneficiaries. Most of the project financing came from the central and local governments, and as a result, the clean environment and waterfront facilities belong to the public. Thus, everybody, regardless of gender, income, and socioeconomic status, can enjoy the positive effects that the Taehwa River Restoration Project has brought about. In addition, thanks to the water quality restoration project, the once extremely polluted Taehwa River has been born again as a river of life boasting the cleanest water quality among Korea's rivers and accommodating annually increasing populations and kinds of birds and fish.

When considering the overall economic, social, and environmental impacts of the Taehwa River Ecological Restoration Project, the project has by and large been successful. If Ulsan's development had proceeded with a consideration of the impact of the industrial complex construction on the surrounding environment, even if that would have had economic costs, tremendous social and environmental costs could have been avoided. However, the local government did not stand and watch the environment deteriorate, but rather, with a goal not only to solve the water quality problem but also to build an ecopolis, it focused its resources and capabilities and established and implemented the Taehwa River Master Plan. Sometimes, when Ulsan faced a challenge which could not be properly addressed with administrative capabilities alone, it solicited help from other stakeholders, and at other times, through its efforts to involve stakeholders in policy decision making and execution, it made the stakeholders close cooperators and leaders of environmental preservation. That it did so speaks not only to the success of the Taehwa River Ecological Restoration Project, it suggests a deeper social and societal development. As for the economic impact, the project has brought positive employment inducement effects and improved Ulsan's fiscal self-reliance ratio by increasing the local tax revenues, and this in turn has enabled the Taehwa River Ecological Project to take place. Finally, the project has produced various positive environmental results such as improved water quality and restored biodiversity, and these essentially equate to returning the site and cradle of life to the residents and creatures and plants that depend on the Taehwa River.

V. Lessons Learned and Conclusion

As discussed above, the Taehwa River case is a representative case of Water and Green Growth that shows how a local government (Ulsan) strongly determined to restore the environment and the local community, in a community spirit, formed an organic cooperation structure and turned Korea's economically symbolic industrial city into an ecological city. In this chapter, the major findings of this case are examined.

The case proves the possibility of turning polluted industrial cities into eco-friendly ecological cities.

The development of industrial districts in Ulsan was the core business of the first Five-Year Economic Development Plan in Korea, which was launched in 1962 in order to raise the country out of poverty and bring about economic development. The Ulsan Special Industrial Zone, as the first national industrial complex designated by the Korean government, grew as a heavy industry complex with a high density of the automobile, oil refining, and shipbuilding industries and played a central role in Korea's economic development, buttressing national economic growth. However, the economic growth-focused urban development policies which were blind to environmental concerns brought with them the negative externality of environmental pollution, and Korea's first industrial city Ulsan became the worst polluted city. This came about due to the lack of understanding about the environment and because the lack of a pollution precedent made it difficult to consider the issue.

However, present-day Ulsan is the result of a complete transformation from a city of pollution to an ecopolis. The Taehwa River, which had showed the worst water quality among Korea's rivers in 1996 with a BOD of 11.3ppm, reached a BOD of 1.9ppm in 2011, claiming—and maintaining—the title of cleanest river as a river of life. With this and related achievements, the city of Ulsan earned the designation as one of Korea's 12 eco-tourism sites in 2013.

What made this change possible does include the mood at the time with rising social awareness about the environment, but more importantly, the local government adamantly pursued policies to solve the environmental problem. With the nationwide entry into force of the local self-governing system, the newly empowered city of Ulsan, seeing that the pollution had become the area's biggest current issue, rather than aiming simply to reduce the environmental problem with half-hearted, defensive policies, engaged in proactive, ambitious policies with the determination to build an ecological city and thereby change the environmental paradigm and improve the environment to the point of raising the quality of life for its citizens. In order to realize the groundbreaking strategy of building an ecological city, after it made the Ecopolis Ulsan Declaration and established the Ecopolis Ulsan Plan, it established the Taehwa River Master Plan as an overall management plan for water quality improvement and pushed ahead with the water quality improvement and waterfront space creation projects over the next 10 years under the master plan. Although the local government directed the overall project, local environmental and citizen groups, enterprises, and residents actively participated.

Ultimately, the plan was successfully realized, and Ulsan was reborn from the polluted industrial city lacking environmental infrastructure into an eco-friendly ecopolis, where industry, nature, and human beings coexist. This achievement is a case of crisis turned into opportunity and an exemplary case of water and green growth that demonstrates how a pollution-stained industrial city transformed into a proud eco-friendly ecological city through proactive environment policies.

Realizing water and green growth is possible when there is determined leadership and more efficient when authority is vested in one such leading party rather than distributed.

Water management in Korea is generally undertaken by the central government, but there are different managing bodies, with both the Ministry of Land, Infrastructure, and Transport and the Ministry of Agriculture, Food, and Rural Affairs managing water quantity and the Ministry of Environment managing water quality. Korea's streams and rivers classify into national and local streams and rivers, or local stream and river sections; the state manages state, or national, rivers, and the local governments manage local rivers. Accordingly, the Taehwa River, which consists of both national and local river sections, has more than one managing authority, and as its management is divided, there is always the potential for conflict when carrying out work on the river. In reality, conflicts did arise between the central government, pushing water use and flood prevention-oriented policies, and the local government, which was interested in a more holistic approach covering flood prevention, waterfront development, and environmental aspects. In addition to this, the local government was in the position of having to get permission from the central government to proceed with water quality improvement and waterfront development activities in state-administered sections of the river. Also, although the Taehwa River Ecological Restoration Project was expected to cost hundreds of billions of won, there were practically no means to recoup expenses aside from the collection of sewage fees to cover part of the treatment facility costs.

In spite of these circumstances, the restoration project was possible due to the presence of a lead stakeholder, the local government, that was determined to see it through. Ulsan's third popularly elected mayor (elected in 2002) placed top priority on the ecological restoration and soon after taking office carried forward the construction of sewage treatment plants and sewerage infrastructure in order to stop wastewater discharge into and restore the polluted river. With the Ecopolis Ulsan Declaration in 2004 and the establishment of the Taehwa River Master Plan in 2005, the mayor began full-scale operation of the restoration project. Restructuring the organization to pursue the project, the mayor in 2003 organized the Taehwa River Water Quality Improvement Planning Team under the environment policy division and had it establish the Taehwa River Water Quality Comprehensive Plan and oversee the environmental, sewage, and flood control projects. In 2006, to more efficiently handle the diversifying task of managing the river-related work, the city of Ulsan founded the Taehwa River Management Body as a separate organization and assigned around 100 personnel to the body. Along with this reorganization, the city of Ulsan shared its Taehwa River ecological restoration plans with the local stakeholders, held a big discussion with citizens in 2005 to collect their opinions, which allowed the Taehwa River Master Plan to be finalized, and invested 428.6 billion KRW (excludes central government's share; only projects completed as of 2013 included) in the projects.

During the ecological restoration project's implementation, most notably there was a conflict between the central government, which intended to clear the Shimnidae Forest for purposes of flood control, and the local government and residents, who argued for preserving the forest to preserve the Taehwa River ecosystem. There were also procedural difficulties in having to obtain permission from the central government to grow trees along the state sections of the river and inefficiencies arising from the divided nature of authority over the river. In light of these aspects, for efficient project implementation, rather than having divided authority over similar areas, it would be desirable to vest the right amount of authority in a responsible policy agent.

However, the local government, having the determination to restore the Taehwa River's ecosystem, overcame such conflicts and difficulties by establishing an effective cooperation system with local environmental NGOs and resident groups; encouraged local enterprises to participate and secured their financial assistance and environmental preservation activities; and in the area of environmental monitoring where its capacities as an administrative body was limited, drew the participation of citizens. The main reasons behind the success of the Taehwa River Ecological Restoration Project were the combination of careful, systematic planning and the determination of the local government to realize these plans and the fact that the local government provided an environment in which enterprises and citizens could unite for a common goal. This is what enabled water and green growth through the restoration project.

The sustainability of water and green growth can be secured through long-term and inclusive approaches based on comprehensive and systematic planning that reflects the demands of citizens for environmental improvement rather than through one-size-fits-all approaches.

After declaring its intent to build an ecological city through the Ecopolis Ulsan Declaration, the city of Ulsan implemented comprehensive measures aimed not only at improving water quality, but also at improving the quality of life by creating waterfront space and restoring culture and history. In 2005, Ulsan established the Taehwa River Master Plan, combining the plans for water quality improvement and river maintenance, which had until that time been carried out in piecemeal efforts, and it systematized each water quality improvement plan. Although the master plan was nonstatutory, it was a comprehensive and systematic plan which satisfied citizens' demands and was therefore also more advanced than a less flexible, legally mandated environmental plan. Under this plan, Ulsan, in an effort to remove the basic cause of the Taehwa River's pollution, expanded environmental treatment facilities, installing sewers and sewage pipes and constructing new treatment facilities. Also under the plan, it implemented water quality improvement projects, securing water to maintain the Taehwa River's flow. In addition, Ulsan formed the Taehwa River Grand Park, providing waterfront space to its citizens, formed the migratory bird habitat and other ecological sites, and built the Taehwa River Observatory and other rest spaces. In order to sustain public interest in the environment, Ulsan hosted various festivals and provided students and ordinary citizens with education on environmental preservation and the ecosystem.

This long-term plan inclusive of both tangible and intangible elements met with a strong leader in the city of Ulsan and therefore proceeded successfully. The river's water quality significantly improved and the quality of life for residents increased, as also did their level of satisfaction by a large degree. In addition, through ecological, environmental, and each kind of education, environmental awareness rose, and citizens voluntarily took to preserving the environment, showing that the Taehwa River Ecological Restoration Project did not end with temporary results but had gained sustainability.

Participation of the local community and other stakeholders can improve project outcomes.

Although the local government led the Taehwa River Ecological Restoration Project, area businesses, civic and environmental groups, ordinary citizens, and stakeholders from each segment of society participated in the project together. As mentioned before, the Taehwa River includes state-administered sections, so in order to realize local interests in the face of possible opposition from the central government, it was necessary for the local government to establish a mutually cooperative networked governance system, and it was through this system that preserving the Shimnidae Forest and the Taehwa Field was possible.

From the late 1990s, Ulsan has guaranteed participation of civic groups and other stakeholders through an ordinance, and with its organizing of the Green Ulsan 21 Environmental Committee, a federation representing Ulsan's various civic and environmental organizations, Ulsan legally guaranteed stakeholders participation in policy, not only allowing them to review and present suggestions and proposals regarding the city's main environmental policies through the committee, but also allowing them to present policy alternatives to the mayor. Even apart from this, Ulsan, by involving local stakeholders in citizen awareness raising, citizen education, and environmental watch activities, activities difficult for the city to manage as an administrative organization, formed a partnership with the citizens and enterprises of the local community and firmly built mutual public-private trust with them, and in doing so it allowed citizens to voluntarily participate in the ecological restoration project with a continuing interest in the Taehwa River problem.

As an industrial city, Ulsan has many businesses compared to other cities. Ulsan proactively drew the participation of local businesses and led them to participate in diverse areas as part of CSR in the local community. K-water remodeled an old water-intake tower into the Taehwa River Observatory and donated it to Ulsan, and other businesses based in Ulsan provided financing to the construction of the Shimnidaebat Bridge and the Taehwa Field, reinvesting their profits in the local community as a form of voluntary service and at the same time improving their image. A way in which Ulsan enterprises made an especially large contribution to the water quality improvement of the Taehwa River was through voluntary management of Ulsan's urban streams and rivers, including the Taehwa River, through the One Company, One Stream campaign. Begun in 1999, this campaign had developed into a pan-citizen movement by 2012 with 79 civic organizations and 105 businesses voluntarily carrying out environmental cleaning and foreign plant species removal in 143 sections of 43 streams and rivers within Ulsan. Through these activities, the enterprises, which were the main perpetrators of the environmental degradation during the course of economic growth in the past could regain the trust of citizens through their active participation in the Taehwa River's water quality improvement.

The local government policy of embracing the local community and actively drawing its participation in the ecological restoration project is full of lessons. The establishment of a river monitoring system through the formation of the Taehwa River Citizens Environmental Watch Group facilitated more efficient river management and served as momentum to transition the style of river administration from punitive to instructive. Environmental groups harboring negative views of the administrative organization, as they shared and worked to resolve problems in the local community, came to pour their efforts into finding responsible alternatives appropriate to the real environmental situation, and citizens changed from being beneficiaries of environmental protection policy to being direct participants. In addition, the participation of businesses not only eased the financial burden of the local government, it allowed them to change their image from past destroyers of the environment to champions of environmental preservation and thus allowed them to regain citizens' trust.

In this way, the participation of stakeholders within the local community not only greatly facilitated the local government's ability to carry out the projects, it complemented the local government in areas where its administrative influence was weak, and the local community became a leading agent of environmental protection, ensuring the sustainability of environmental preservation.

Active public relations are needed to increase public participation.

To build consensus for the need for the ecological restoration project and to gain resident participation, Ulsan engaged in public relations activities, producing promotional videos and a documentary. In these efforts, Ulsan notified the public about the need for water quality improvement, the details of the project it was seeking to implement, and stories of change and success stories throughout the course of the project. Not only did Ulsan raise interest in the project among residents, it used these opportunities to report on the status of the project. These public relations efforts raised awareness in Ulsan about environmental preservation and contributed to local residents' becoming involved in the project.

Improving river water quality can contribute to improving sea water quality.

The Taehwa River water quality improvement project resulted in improved water quality off Ulsan's coast where the river flows. While BOD figures in the river fell from 4.5ppm in 2002 to 1.9ppm in 2012, the water quality off Ulsan's coast also improved in the same period, falling from a COD of 1.71ppm to 1.05ppm, a decrease to 60% of its prior level.

Generally, 80% of all marine pollution sources consists of domestic, industrial, and farm wastewater flowing via rivers into the sea. As discharge of domestic and industrial wastewater into the Taehwa River stopped, the water quality of both the Taehwa River and the Ulsan's coast improved. The Taehwa River Ecological Restoration Project, as the important case in which coastal water quality improved as a result of water quality work in a river, has made a new paradigm.

The Taehwa River Ecological Restoration Project, as a project led by the local Ulsan government, is the project in which the basic environmental treatment facilities neglected to be built during the economically focused industrialization of Ulsan were later built alongside other measures to improve the Taehwa River's water quality and build an ecological city, for the purpose of which waterfront space was developed and the river's historical and cultural value were restored. As a project carried out under the local government's policy objectives and with the budgets of the local and central governments, market-oriented policies did not have a large role, but private enterprises active in Korea's sewage sector participated in the project, and other local enterprises participated to the extent of financing parts of the project as a form of corporate social responsibility. Thus, to the extent permitted by Korea's institutions and the given circumstances, a market-oriented policy was used to supplement a state-driven policy. However, as evident in the Lake Sihwa project and many other cases, market-based policies, like state-driven ones, are playing an important role in water and green growth.

VI. Conclusion

The Taehwa River Restoration Project illustrates how Korea's quintessential industrial city of Ulsan, which became extremely polluted through the processes of industrialization and economic development that began in the 1960s, transformed into an eco-friendly ecological city through the pursuit of water and green growth. The local Ulsan government, mired in an environmental problem too dire to ignore, rather than opting for the modest policy of simply tackling just the pollution problem, set an ambitious goal to turn Ulsan into an ecopolis. Taking the existing sporadic environmental restoration policies and efforts, Ulsan incorporated them into a master plan and launched a set of policies for water and green growth under the plan, combining appropriate state-driven, market-oriented, and community-centered policies. The project unfolded under the strong leadership of the local government, which made organizational adjustments to meet the project's needs and provided much of the budget, but local stakeholders also became interested, active participants in the project, thanks to the media and various other information channels and the legal and institutional structures instituted by the local Ulsan government. Thus, the project was not unilaterally forced by the local government; from the project's inception, the need for and vision of the project were communicated to the stakeholders and consensus in favor of the project built, and throughout the entire course of the project's implementation, cooperative relations were maintained among the stakeholders, with the local government collecting and reflecting stakeholder opinion in the project. As a result of the project, Ulsan realized environmental benefits most notably in its improved water quality, economic benefits including in having the highest per capita income among metropolitan cities and provinces, for successive years no less, and social benefits such as in the raised quality of life through waterfront rest spaces and in having an environmentally aware and active citizenry.

Ulsan's policies and their success does not mean that they can or should be applied the same way in different countries or even in different industrial cities in Korea. However, this case shows that areas with similar circumstances—a lack of basic environmental infrastructure and severe pollution in an industrial city—can develop into ecological cities and offers that rationale and motivation to pursue water and green growth.

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Water and Green Growth Case Study Report 10

Spain

Ebro River Basin : Sound Water Planning Supports Green Growth

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About the Report

This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

Disclaimer

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Abbreviations and Acronyms

Acuamed Aguas de las Cuencas Mediterráneas, S.A.

AcuaEs Aguas de las Cuencas de España SA

AEAS Spanish Association of Water Supply and Treatment

AETIC The Association of Electronic, Information Technology and Telecom Companies

AFRE Asociación de Fabricantes de Agua y Riego Españoles (Spanish Water and Irrigation Manufacturers Association)

ALBERCA a tool to provide systematic and homogeneous registration of water concessions

ATTA The Association for Water Treatment Technology

BOD_5 Biochemical Oxygen Demand over a five-day period

CAD Consejo del Agua de la Demarcación (Water Council)

CAN Consejo Nacional del Agua (National Water Council)

CEE Comunidad Económica Europea (European Economic Community), the predecessor of the European Union

CEMAS Control del Estado de las Masas de Agua (Control of Status of Water Bodies)

CHE Confederación Hidrográfica del Ebro

CITA Agro-Food Research and Technology Center of Aragón

CiU Convergence and Union

CO_2 Carbon Dioxide

IUCN International Union for the Conservation of Nature

EAJ-PNV Basque Nationalist Party

EU European Union

GDP Gross Domestic Product

GIS Geographical Information System

GW Groundwater

GWh Gigawatt hours

HDI Human Development Index

hm^3 Cubic hectometers (million m^3)

ICT Information and Communications Technology

IMF International Monetary Fund

INE Instituto Nacional de Estadistica (National Statistical Office)

LIC Site of Community Importance (Natura 2000 network)

LIFE program EU Financial Instrument for the Environment program

MAGRAMA Ministry of Agriculture, Food and Environment

MIT Massachusetts Institute of Technology

MW Megawatts

NHP The National Hydrological Plan

NO_x Nitrogen Oxides

OECD Organisation for Economic Co-operation and Development

PHC Planes Hidrológicos de Cuenca (River Basin Hydrological Plans)

PNACC National Climate Change Adaptation Plan (Spanish acronym)

PP People's Party

PSOE Spanish Socialist Workers' Party

RBD River Basin District

RBO River Basin Organization

RBMP River Basin Management Plan

RD Royal Decree

SAD Sistema de Ayuda a la Decisión (Decision Support System)

SAICA Sistema Automático de Información de la Calidad de las Aguas (Automatic Water Quality Information System)

SAIH Sistema Automático de Información Hidrológica (Automatic Hydrological Information System)

SEIASA Sociedad Estatal de Infraestructuras Agrarias, S.A

SITE Ebro Sistema de Información Territorial del Ebro (Ebro Territorial Information System)

SO_2 Sulphur Dioxide

SPC Socialist Party of Catalonia

TRAGSA Empresa de Transformación Agraria, S.A., a public company that executes the works entrusted to it via agreement with the State General Administration, the Autonomous Communities and Municipalities.

UNESCO United Nations Educational, Scientific and Cultural Organization

WFD EU Water Framework Directive

WGG Water and Green Growth

ZEPA Zonas de Especial Protección para las Aves (Special Protection Area for birds)

Executive Summary

The Ebro River Basin Confederation in Spain (Confederación Hidrográfica del Ebro or CHE) provides an example of a living, breathing river basin organization (RBO) that has been working continuously for 88 years. Over the last 15 years, the objectives of the RBO have come in line with sustainable development – economic well-being, social equity and protection of the environment.

Located in the northeast of the Iberian Peninsula, the Ebro River Basin covers 85,700 km^2 or 17.3% of Spanish territory. Rainfall is unevenly distributed in time and space. The spatial distribution can vary from 3,800 mm/yr in the Pyrenees Mountains to just 100 mm/yr in the central river valley where the main economic activities are located. To adapt the available water resources to the locations and quantities where they are needed, the Ebro has been gradually transformed into one of the most regulated river basins in the world. It has 108 big dams with water storage facilities that support agriculture, manufacturing, energy production and drinking water supply, and thus serve as an engine of growth in the region. The dams provide a storage capacity of 7,580 million m^3, equivalent to more than half of the average long-term renewable water supply of the river basin (estimated at 14,600 million m^3).

The Ebro River Basin now accounts for one fifth of Spanish agrarian production and about one third of its meat supply. Irrigated agriculture covers 700,000 ha in the valleys of the Ebro and its main tributaries. The Ebro basin's market advantages include availability of land, a relatively cheap labor supply and proximity to markets in Spain and the rest of Europe.

The Ebro Basin region has experienced rapid economic growth over most of the period since the late 1990s, and the availability of reliable water for agriculture, industry, energy, and tourism has been key to that growth. Even during the recession that gripped Spain from 2008 to 2013, the Ebro Valley experienced relative prosperity and growth.

The Ebro River Basin Management Plan case study explores the rapid growth of the region's economy from the late 1990s through 2008, and moderate growth thereafter, based on an analysis of exogenous factors and water institutions at the national, basin, and local levels that have had a major impact on that growth. The present case study explores the exogenous economic, social, political, environmental, and technical factors that drive water resources planning and management processes. It examines how the institutional framework in the water and related sectors contributed to green growth.

The Ebro River Basin Management Plan, which has provided the framework for water management, responds to the European Union's Water Framework Directive (WFD), which establishes more demanding water quality objectives and greater public participation than had originally been required by the CHE. At the same time it responds to the Spanish Water Act, which set the regulations to fulfil the demands for water from agriculture, industry, energy and domestic uses. The Water Act also fulfils the requirement to carry out a Hydrological Plan or River Basin Management Plan (first one in 1998).

In the Ebro basin, the primary importance has now been given to the environmental objectives of water planning, including quality of water. The water policy framework establishes the actions and measures that will achieve environmental objectives and that generate minimum economic losses or maximum welfare gains. The EU requirement for a greater degree of active public participation has resulted in an extensive public participation network that reaches all the sub-basins and serves as a forum for sharing information and fostering a common understanding of water challenges and measures to overcome them.

The Ebro River Basin Management Plan (or Hydrological Plan), 2010–15 has 12 key elements that are summarized later in this case study. They touch on: integrated management, social opportunities, environmental objectives, pollution control, a realistic environmental flow regime, sustainable development, improved irrigation efficiency, balanced allocation of resources, public participation, shared financial burdens, a commitment to cost recovery, and an extensive monitoring network. The Spanish Government approved the Ebro Hydrological Plan on the 28th of February 2014.

Setting the achievement of a good or fair ecological status of the water bodies as the main objective of river basin management plans in the European Union has been an important element in the Ebro River Basin Management Plan, and has helped make economic development compatible with environmental objectives. Because of the key role played by public participation, the Plan is also focused on social equity, including extending water services to remote and marginal areas. Although the Hydrological Plan for 2010-15 had not been approved by the national government until the end of February 2014, the Program of Measures was being implemented, and many of the provisions of the Plan (such as modernization of agriculture and the promotion of water-saving measures) were going forward. The Hydrological Plan provides a Water and Green Growth framework for the Ebro River Basin.

In 2004 after the government shelved the proposal for large-scale water transfers of the Ebro River from the water-rich north to the water-starved south, it became of paramount importance to manage the water of the Ebro basin very carefully. Thus, the people living in the Ebro Basin have adopted water-saving measures – low water-using irrigation systems, reuse of wastewater and managing demand. This became even more important in light of the WFD imperative to achieve good ecological status for all water bodies. The Ebro set a goal of reaching good status in 83% of the water bodies by 2015, and this status had been achieved in over 71% of surface water bodies and 78% of groundwater bodies by 2011. Improvements in water quality and a more reliable supply have resulted in increases in income, better health, and an improved quality of life for people in the Ebro Valley.

Some of the lessons learned and challenges still facing the Ebro River Basin Confederation and its partners as they implement the Hydrological Plan are described below.

Integrated water planning and management have contributed to green growth.

The implementation of the WFD and its incorporation into the Spanish Water Act have expanded the range of actions that support green growth. Actions such as those to protect the environment were already evolving under CHE, which had experience in integrated water resources management. The EU WFD encouraged a paradigm shift that has been incorporated into the current Hydrological Plan. As part of the process, CHE has acquired a multidisciplinary technical staff, and has further opened the planning process to public participation, resulting in a level of ownership by stakeholders.

Furthermore, preparation of the Ebro Hydrological Plan has resulted in strengthening the institutions at the river basin and sub-basin levels and has improved water resources management in general. Transcending administrative boundaries through the lens of the natural region of the river basin is much more effective in supporting green growth than a number of fragmented interventions. However, some interest groups continue to lobby for their projects at the expense of others. Compromise is essential in this type of consultative process, and in the larger picture it has had positive results for the Ebro region. This should be instructive to other basins in Spain and around the world.

Measures for promoting green growth need reinforcement.

Throughout the period since the late 1990s, including the worst years of recession, the Ebro region's experience and expertise with water-saving technology and sound planning helped the region weather the economic downturns.

All measures aimed at improving water use, particularly in irrigation, and at controlling the associated diffuse pollution, are very positive: modernization of irrigation, environmental measures related to agricultural runoff, automation and control of water intakes. These measures are effective both for enhanced productivity (potential new crops, more efficient workforce and stable water supply) and for environmental improvement (less pollution getting to water ecosystems). Thus the potential to generate green growth is very high.

Current water legislation, even though its implementation still needs improvement, is a good instrument for advancing towards cleaner production systems and for generating knowledge and technology to improve water use efficiency. More intensive use of economic incentives and tariff policy may be necessary to obtain the required financial support and cost recovery.

Several reforms are necessary for the proper use of water becoming a key growth factor: administrative simplification and a more rigorous and transparent accounting system; providing signs of water shortages; regulated water markets that allow more efficient uses from the social and economic points of view; an assessment of the environmental services of water and associated ecosystems, and greater public-private participation, properly supervised, and regulated.

Technological improvements in modernizing the irrigation systems in the Ebro Valley played a substantial role in raising agricultural productivity in the Ebro Valley, largely supported by a reliable supply of water for irrigation. In the Ebro Basin, private sector companies have been instrumental in developing and disseminating water-saving technologies. Continued involvement of the private sector in promoting water saving practices should be encouraged.

Finally, better coordination of water planning with other policies, including energy and food is considered desirable.

Adequate financial investment and cost recovery are required.

By building large-scale water facilities to support growth in agriculture, manufacturing, energy and provision of drinking water, water policy has played a role as an engine of growth in the region. Indeed, the availability of reliable water is perceived as the critical factor underlying both the constraints to and the opportunities for economic growth in the region.

However, the economic crisis after 2008 caused budget constraints along with other technical, administrative, and political difficulties which delayed and impeded the approval and implementation of the Hydrological Plan. Many measures require significant public investment, and budgetary constraints arising from the economic crisis—or lack of assistance from the government and competent authorities to cope with water planning objectives—cast shadows on compliance with the Program of Measures.

Economic self-sufficiency is a key element for water managers in driving the green economy. Another key factor would be better analysis of the economic, environmental and social consequences of climate change and uncertainty. When a productive activity depends on water, in a scenario of scarcity, it is necessary to know the risks involved, and to have a mechanism for decreasing investments to reduce high risks.

While incomplete cost recovery for water services may have constrained extension of water services to underserved areas, support to marginalized areas is in the interest of the economic and social well-being of the Ebro Valley as a whole. The Hydrological Plan includes modifications to cost recovery principles for marginal areas. Subsidies for marginal areas and valuation for ecosystem services are still controversial issues among different water experts. Compensation to people living in remote watershed areas for their contributions to ecosystem services might have positive economic, social, and environmental results.

Protection of water bodies is essential for green growth.

In recent decades, environmental problems linked to the use of water have emerged. By addressing these problems, economic activity has become more sustainable and new positive externalities have appeared. This is the case for irrigation modernization and wastewater treatment, actions that have created new jobs and enhanced economic efficiency.

The environmental objectives set out in the river basin management plans (RBMPs) and the principle of no further deterioration of water bodies may be understood as basic conditions for a sound and balanced growth. Development options that are not compatible with the preservation of the status of water bodies cannot fall under the concept of "green growth". Alternatively, initiatives that are capable of generating economic growth and social welfare while contributing to the improvement of water status should be positively encouraged.

For the future, more research and development activities will be needed particularly to fill current gaps in knowledge, especially regarding the relationship between pressures and impacts on ecosystems and the effectiveness of the proposed mitigation or correction measures.

Public participation can contribute to local development in rural areas.

WFD gives public participation a fundamental role in the achievement of its objectives. Three levels of differentiation are stated: dissemination of information to society; public examination of documents and opportunity to discuss and suggest amendments; and active participation of the concerned actors (stakeholders) and users.

The level of active involvement has been particularly promoted in the Ebro Basin at different levels of action: scientific expertise, through the establishment of a specific working group to identify major water management issues and contribute to defining strategies of the Plan; stakeholders, by convening representatives of the main economic activities and of citizen's groups; and community, holding more than 100 meetings across the basins, involving almost 3,000 representative of social and economic groups, irrigators, local authorities, and other public entities and organizations.

User communities are supposed to have a say in the type of water supply and sanitation facilities that will be installed and the way they are managed at the local level. The expansion of sanitation, sewerage and wastewater treatment—particularly to small and marginalized villages—has been important for human well-being and human health, and reinforces the natural and scenic values of the river. Enhanced water quality allows for the restoration of rivers, streams and wetlands, as well as for new recreational activities (sailing, rafting, fishing, and adventure tourism).

Public participation has been particularly important for increasing understanding of the trade-offs between the environmental, economic, and social objectives that need to be considered in water policy. Water has been the key to rural development, for example, by providing alternative development opportunities such as rural tourism. These ambitions sometimes conflict with the limited capacity of rural areas to finance their own water management projects or even to pay for the entire cost of the water services they receive. For this reason, with the support of public participation processes, the development of the river basin plan focused on identifying actions with the highest potential for promoting local development in sensitive rural areas. The planning process also assessed and identified low-income areas where social objectives should be prioritized, and exceptions to full cost recovery of water prices permitted.

Ebro leads in technical and economic management tools, but much work remains to be done.

Technical staff and engineers working with the Ebro CHE, and the engineering and consulting firms working in the water sector, have accumulated a great deal of expertise in water management during the past two decades. With broad expertise concerning water and the environment, the Ebro region has become the center of water resources training and development. The region has established a large number of technical institutes and science and technology parks.

Water administrators are not direct producers of technology, although they need good technology to generate adequate knowledge to make intelligent decisions. In this sense, spatial data infrastructure, monitoring systems in real time, using satellite imagery, numerical simulation models, and decision support systems have led Spain to occupy a privileged place in the world in terms of planning and integrated water resources management systems within the physical framework of the river basin. Moreover, water scarcity has also contributed to improving and modernizing irrigation and food production, improvements in industrial processes and in human supply. However much work remains to be done.

The hydrological plans should generate technological innovation and growth in the green economy. It would be useful to assess the cost-effectiveness of the measures and action plans. This analysis would lead to a selective process of the most effective and economical technologies to reduce pollution, and would generate competition among companies to find solutions to solve the main problems of the basin. This is already happening, but it would be desirable to expand it. The experience of this planning process should accelerate such analysis leading to green growth.

The lack of adequate tools of economic analysis and knowledge gaps relating to the functioning of water ecosystems, and the need for better responses to pressures and impacts may be hampering efficient policy measures and cost recovery strategies.

Coordination and agreement among Autonomous Communities and other stakeholders needs to be strengthened.

Divergence among water objectives from the various Autonomous Communities makes it difficult to apply homogeneous criteria under the river basin unity principle. The Autonomous Communities generally favour getting increased allocations of water for new irrigation projects and other uses. Thus, conflicts among the Autonomous Communities and/or stakeholders, territories and administrations have caused delays in approval of the Hydrological Plan. Looking for agreement among all stakeholders can be time consuming and can delay the necessary decision-making. Eventually the Plan will have to be approved with some level of disagreement or compromise.

In general, most of the stakeholders appreciate the value of planning at the basin level, and it may be the case that the delays that have occurred in reaching agreement will strengthen the Hydrological Plan in the long run.

Recently-approved Hydrological Plan needs to be implemented.

Spain has encountered considerable delays in finalizing its hydrological plans under the EU WFD. Though they should have been completed in December 2009, most of the plans were approved only during 2013. Until late February 2014, the Ebro Plan was still pending, but now it has been approved. In the meantime, the Ebro Plan had been endorsed by the Ebro district Water Council and the National Water Council, and therefore the River Basin District had already been implementing the Program of Measures.

There have also been delays in establishing and constituting the Ebro River Basin Water Council, which is key to the planning process as the top of the whole participatory framework. Therefore its constitution and functioning is essential. Considering that the composition of this new Water Council will be similar to the old one and, pending the constitution of new Water Council. The former Ebro River Basin Water Council still has a role in monitoring, discussing and validating hydrological planning documents and activity proposals emerging from the participatory process. It should be supported until the new Water Council is constituted.

The current second water planning process provides an opportunity to correct the major mistakes and shortcomings of the planning model that was derived from the Water Framework Directive. The need for greater connection of the planning process with management and operation of water resources systems should be emphasized. The approaches need to be better coordinated, and appropriate tools need to be developed to implement the Program of Measures and related legislation.

I. Introduction

1. Purpose of the Case Study

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then the United Nations and the international community have considered water as essential to the attainment of sustainable development. Moreover, the concept of sustainable development was the cornerstone of UNCED. The Brundtland Commission defined that concept in 1987, and ever since, it has been accepted that development must include not only economic growth, but also environmental and social dimensions.[1)]

In addition, innumerable international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991 and the triennial World Water Forums, convened by the World Water Council every three years since 1997. The Seventh World Water Forum will be held in Daegu, Republic of Korea in 2015.

One of the major partners in all these efforts has been the Global Water Partnership (GWP), which includes members from the UN system, governments, civil society organizations, academic institutions and the private sector. The GWP has been at the forefront of promoting and defining the Integrated Water Resources Management (IWRM) since its establishment in 1996 in Stockholm. GWP defines IWRM as "a process that promotes the coordinated development and management of water, land, and related resources in order to maximize economic and social welfare, an equitable manner without compromising the sustainability of vital ecosystems and the environment."[2)] Water must be managed in a watershed context under the principles of good governance and public participation.

With similar objectives, the European Union adopted its Water Framework Directive (WFD) in 2000 as the new European water policy framework. Its main long-term objective is to make the maintenance and expansion of economic uses of water compatible with the improvement and adequate protection of water-providing ecosystems. The Water Framework Directive has allowed for a systematic analysis of the negative impacts on water bodies caused by industry and economic growth. Moreover, the WFD has demanded an even greater degree of active public participation than previously. These objectives have been incorporated into the planning principles for the Ebro River Basin and have become an integral part of water management in the basin.

The case study of the Ebro River Basin is an example of how to implement IWRM within the EU Water Framework Directive. It is considered a good example of Water and Green Growth, and it is thus included as part of the Water and Green Growth (WGG) project, being jointly undertaken by the World Water Council (WWC)

1) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced Our Common Future (1987, Oxford University Press), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

2) Global Water Partnership Website http://www.gwp.org/The-Challenge/What-is-IWRM/

and the Government of the Republic of Korea. The project, initiated in November 2010,[3] began collecting case studies and developed a policy framework. The first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille in March 2012.[4] A case study on water resources planning and management in the Ebro River Basin was included in the first edition; the expanded case study included here is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu. Preparation of the case study has been supported by the World Water Council and the Government of the Republic of Korea, the organizers of the Forum.

2. Case Study Context

The case of the Ebro River Basin reflects Spain's decades-old water management policy based at the river basin level. The Ebro basin has been managed since 1926 by the Confederación Hidrográfica del Ebro (CHE by its Spanish acronym, or Ebro River Basin Confederation in English) as a partnership of private users and public authorities. CHE was the first water authority created to coordinate water policy in a river basin in Spain, and one of the earliest river basin authorities in the world. It is an autonomous organization under the Ministry for Environment (currently named Ministry of Agriculture, Food and Environment) of the Kingdom of Spain.[5] The Ebro River Basin is the biggest river basin in Spain, covering 85,700 km^2.

The main functions of the Ebro River Basin Confederation are:

- To implement and enforce the Basin Hydrological Plan (also called the River Basin Management Plan);
- To administer and control allocation of public waters; this includes water licensing to private users, quality control, and environmental protection; and
- To manage public dams, canals, and hydraulic works of interest to or affecting more than one region within the river basin.

The management of the Ebro River Basin and the construction and operation of hydraulic works, whether self-funded, commissioned by the national government, or agreed upon by CHE have played a central role in transforming the formerly semi-arid Ebro Valley into a prosperous economic hub of the nation.

The main objective of water management in the basin in the early period was to promote and coordinate the building and operation of water infrastructure—first in support of agricultural development and next as an instrument for meeting water demands stemming from economic growth. The primary objective of water management now is reconciling economic growth with the protection and improvement of the water resources critical to sustaining long-term economic welfare. This case study looks at the past two decades and illustrates innovative water planning processes that led to a transition towards green growth through water planning in the Ebro River Basin.

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3) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

4) Government of the Republic of Korea and World Water Council. 2012, March. Water and Green Growth Edition 1. Marseille. www.waterandgreengrowth.org.

5) UN Water. International Decade for Action, Water for Life 2005-15. http://www.un.org/waterforlifedecade/water_cooperation_2013/organizers.shtml. Accessed 11/02/2014.

3. Case Study Methodology

The Ebro River Basin Management Plan case study explores the rapid growth of the region's economy, based on an analysis of exogenous factors and water institutions at the national, basin and local levels that have had a major impact on that growth. The work was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[6] The present research explores the exogenous economic, social, political, environmental, and technical factors that drive water resources planning and management processes. It examines how the institutional framework in the water and related sectors contributed to green growth.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in *The Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[7]

The questionnaires presented to representatives of the main water-related institutions and other stakeholders in the Ebro River Basin were developed to reflect that framework. Saleth and Dinar define a water institution to be an entity defined interactively by three main components: water law, water policy, and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which the Ebro River Basin Management Plan has been implemented. The policies and institutions that have been responsible for the improvements in water management and availability and thus the region's rapid economic growth are still evolving and are adapting to changing circumstances and lessons learned. The broad participation of stakeholders in consultations related to the plan has had a strong influence on this evolution. The case study describes the water management institutions and policies at national, basin, and sub-basin levels. Their performance is analyzed and lessons and conclusions are drawn.

First, the external environment during the evolution of the river basin management plan is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Then water resources governance, policy, law, and institutions in the Ebro Basin are examined, including local water governance structures. Information and statistics from international, national and basin sources, and from independent academic studies, provide an overview of the situation in the country and the region.

Next the water resources developments, institutions and policies that have evolved over the past two decades are summarized and analyzed showing the changes over time. Finally, the impact and performance of the various elements of the river basin management plan are analyzed. Survey results and expert interviews are

6) Research Center for Water Policy and Economy at K-water Institute. 2013, Sept. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report. Daejeon, Republic of Korea.

7) Saleth, R. and Dinar, A. 2004. The Institutional Economics of Water: A Cross-country Analysis of Institutions and Performance. Washington D.C.: The World Bank.

used to examine the current situation, and performance of the river basin management plan in the Ebro River Basin.

It should be stated here that in this report the terms River Basin Management Plan (RBMP), Water Management Plan and Hydrological Plan are used almost interchangeably. The term Hydrological Plan is the one that has been used in Spain since the Water Act was adopted in 1985. The term used under the EU Water Framework Directive (WFD) is River Basin Management Plan, and the Water Management Plan fits within the basin plan. Thus, in response to the WFD, Spain is submitting its RBMPs, but in Spain they are still called Hydrological Plans.

II. An Overview: Water Planning in the Ebro River Basin

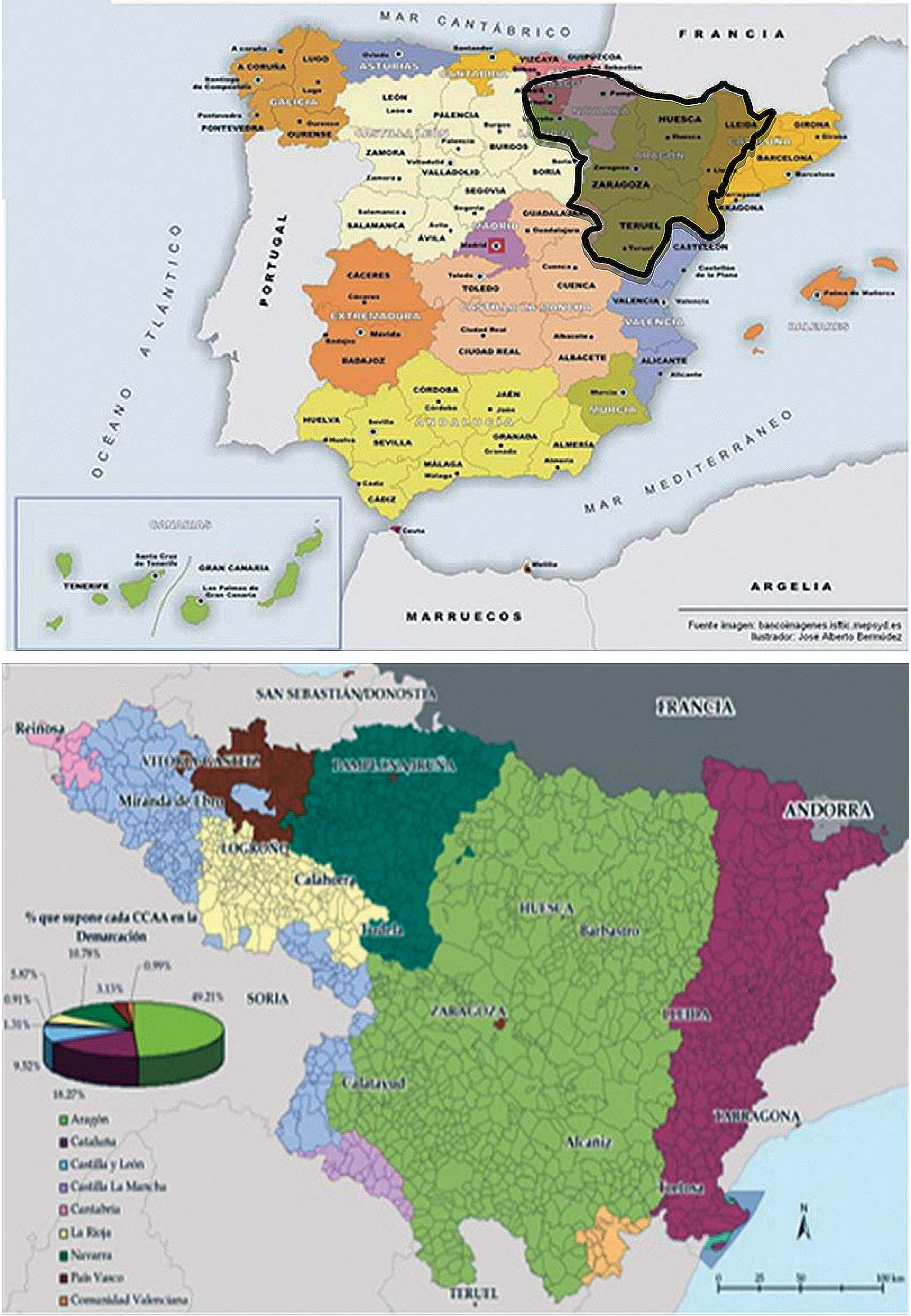
Most developed economies, particularly those in the European Union, are trying to meet international obligations to achieve sustainable development, including economic growth, environmental protection, and social well-being. The threats of climate change multiply the challenges for political leadership in countries such as Spain, as confronting those threats limits the options for development and economic growth. As Spain emerges from a deep recession and high unemployment, it may not be inclined to take national action to minimize carbon emissions and protect the environment if such actions were to reduce the rate of future economic growth. However, as a member of the European Union, the country is pledged to ensure environmental protection of its river ecosystems and to prepare for climate change. In the long run, this will have a positive impact on economic growth and social well-being.

This is the type of balance that the Ebro River Basin Management Plan has been created to achieve. The effort to achieve green growth requires simultaneous action on economic, environmental, and social fronts, while preparing the people and land to be resilient in the face of climate variability and change.

1. About the Ebro River Basin Region

Located in the northeast of the Iberian Peninsula, the Ebro River Basin covers 85,700 km^2 or 17.3% of Spanish territory. Rainfall is unevenly distributed in time and space. The spatial distribution can vary from 3,800 mm/yr in the Pyrenees Mountains to just 100 mm/yr in the central river valley where the main economic activities are located. To adapt the available water resources to the locations and quantities where they are needed, the Ebro has been gradually transformed into one of the most regulated river basins in the world. It has 108 big dams with water storage facilities that support agriculture, manufacturing, energy production and drinking water supply, and thus serve as an engine of growth in the region. The dams provide a storage capacity of 7,580 million m^3, equivalent to more than half of the average long-term renewable water supply of the river basin (estimated at 14,600 million m^3).

The Ebro River Basin now accounts for one fifth of Spanish agrarian production and about one third of its meat supply. Irrigated agriculture covers 700,000 ha in the valleys of the Ebro and its main tributaries. The Ebro basin's market advantages include availability of land, a relatively cheap labor supply and proximity to markets in Spain and the rest of Europe. The map of Spain and the administrative divisions of the Ebro River Basin are shown in Figure 1.



Source: Ebro River Basin Confederation

<Figure 1> Map of Spain Showing Location of Ebro River Basin and Administrative Boundaries of the Ebro River Basin Region

2. Timeline for Water Planning and Management Advances

Water planning and policy in the Ebro River Basin have been gradually transformed from the earlier focus on building water infrastructure to the introduction of IWRM to ensure that water use is compatible with the preservation of the ecosystems in the context of green growth. Many of the changes were in response to the adoption of the EU Water Framework Directive in 2000, although the transition towards IWRM had been going on in the Ebro basin for decades. The case study shows how water planning can make a real contribution to sustainable development and green growth. The participatory nature of the planning process has enabled stakeholders at all levels to take part in the decision-making process. Box 1 below presents some significant milestones in water planning and management in the Ebro River Basin.

III. The Case Study

The Ebro River Basin Management Plan responds to the European Water Framework Directive, which establishes more demanding water quality objectives and greater public participation than had originally been required by the CHE. At the same time it responds to the Spanish Water Act, which set the regulations to fulfil the demands for water from agriculture, industry, energy, and domestic uses. The Water Act also covers water quality, but follows the European Water Framework Directive, which has been incorporated into the Spanish Water Act. The Plan also fulfils the requirement to carry out a River Basin Management Plan (first one in 1998).

In the Ebro basin, the primary importance has now been given to the environmental objectives of water planning, including quality of water. The water

<Box 1> Significant Milestones in Water Laws, Policies, and Administration in the Ebro River Basin

- 1926 : Creation of the Confederación Hidrográfica del Ebro(CHE by its Spanish acronym, or Ebro River Basin Confederation) as a partnership of private users and public authorities to promote and exploit common interest public works. The CHE was the first water authority to coordinate water policy in a river basin in Spain.
- 1985 : Water Act (Act 29/1985 on Water) adopted on August 2, started a revolution in the water regime by introducing the concept of a single hydrological cycle and making water part of the public domain. It also introduces the obligation to draft Hydrological Plans and the process for implementation.
- 1995 : The Automatic Hydrological Information System (SAIH) comes into operation, providing real-time data from gauging stations for flood prevention and resource management, as well as the Automatic Water Quality System (SAICA).
- 1998 : Ebro River Basin Plan was approved by Royal Decree 1664/1998 of 24 July.
- 2000 : EU Water Framework Directive adopted, establishing more stringent requirements on water quality, ecosystems and public participation.
- 2001 : The National Hydrological Plan (NHP) was approved by Law 10/2001 of 5 July. The NHP was amended by Law 53/2002 of 30 December 2002; by Law 62/2003 of 30 December 2003; and by Royal Decree (Law 2/2004), of 18 June 2004
- 2001 : Consolidated Water Act promulgated 20 July. This defined the functions of the basin organizations
- 2005 : National Hydrological Plan - Law 11/2005 of 22 June modified the 2001 Plan and abrogated the Ebro water transfers.
- 2007 : Designation of River Basin Districts by Royal Decree 125/2007 of 2 February.
- 2008 : Committee of Competent Authorities created for the Ebro River Basin on 17 October. It has high-level representation by the autonomous regions in a cooperative and coordinating body for all the public authorities with responsibilities to comply with the WFD objectives.
- 2010 : The Hydrological Plan suspended 36 uninitiated reservoirs from the 1998 Hydrological Plan (RD.1664/1998) for economic, social or environmental reasons. Others were included in the new plan.
- 2013 : After public consultation, the proposal of the Ebro Hydrological was favourably reported by the Water Council of the Basin and received the agreement of the Committee of Competent Authorities (July 2013). The proposal was submitted to the Ministry of Agriculture, Food and Environment.
- 2014 : Ebro Hydrological Plan (2010-2015) adopted by Spanish Government 28 February.

policy framework establishes the actions and measures that will achieve environmental objectives, and that generate minimum economic losses or maximum welfare gains.The EU requirement for a greater degree of active public participation has resulted in an extensive public participation network that reaches all the sub-basins and serves as a forum for sharing information and fostering a common understanding of water challenges and measures to overcome them.

The Ebro River Basin Management Plan (or Hydrological Plan), 2010–15 has 12 key elements that are summarized later in this case study (see Box 2). They touch on: integrated management, social opportunities, environmental objectives, pollution control, a realistic environmental flow regime, sustainable development, improved irrigation efficiency, balanced allocation of resources, public participation, shared financial burdens, a commitment to cost recovery, and an extensive monitoring network. The Plan was finally adopted by the Government on 28th February 2014.

Setting the achievement of a good or fair ecological status of the water bodies as the main objective of river basin management plans in the European Union has been an important element in the Ebro River Basin Management Plan and has helped make economic development compatible with environmental objectives.

1. Exogenous Factors

This section presents the exogenous factors that helped shape the context in which key water resources planning and management decisions were made and implemented in Spain and the Ebro River Basin. It describes some of the economic, social, political, environmental, and technological elements that influenced those decisions and that contributed to the achievement of green growth.

1-1. Economic Factors

Spain's accession to the European Community (now European Union) in January 1986 required the country to open its economy, modernize its industrial base, improve its infrastructure, and revise its economic legislation to conform to EU guidelines. In doing so, Spain increased gross domestic product (GDP) growth, reduced the public debt to GDP ratio, reduced unemployment from 23% to 15% in three years, and reduced inflation to under 3%. Following peak growth years in the late 1980s, the Spanish economy entered into recession in mid-1992. The economy recovered during the first administration of José María Aznar (1996-2000), driven by a return of consumer confidence and increased private consumption. While growth slowed in the early part of the 2000s, it remained strong through 2008, riding on the property boom. Then the economy was hit badly by the world economic recession and did not begin to recover until late 2013.

Since Spain became part of the Euro zone in 1999, trade was facilitated among the Euro nations. Spain is currently the fifth largest economy in the Euro Zone, and it is a leading destination for foreign direct investment. The country has a strong and diverse manufacturing industry, and is one of the biggest tourist destinations in the world.

1-1-1. Effects of the Recession after 2008

However, in the third quarter of 2008, following the collapse of a housing market bubble, the country plunged into recession and has been striving to recover ever since.[8]

8) Trading Economics http://www.tradingeconomics.com/spain/gdp-growth (Accessed 13 Feb 2014)

While Spain's economy grew an average 3.6% per year from 2000 to 2007, it started to slow at the end of 2008 (see Table 1). Spain experienced a decline in economic growth during most of the period from 2009 through 2012. It was one of the countries worst hit by the global economic crisis, with street riots and soaring unemployment.

<Table 1> Spain: GDP, Growth in GDP and GDP per Capita, 2000-2012 (Constant 2005 US $)

	Total GDP (billion US $, 2005 prices)	Growth in GDP	GDP / capita
2000	963	5.05	23,920
2001	998	3.67	24,520
2002	1,026	2.71	24,823
2003	1,057	3.09	25,169
2004	1,092	3.26	25,571
2005	1,131	3.58	26,056
2006	1,177	4.08	26,677
2007	1,218	3.48	27,136
2008	1,229	0.89	26,971
2009	1,182	-3.83	25,738
2010	1,179	-0.20	25,596
2011	1,180	0.05	25,551
2012	1,160	-1.64	25,108

Source: World Bank, World Development Indicators: http://databank.worldbank.org/data/views/reports/tableview.aspx

According to the World Bank, currently more than 70% of the jobs and 70% of the value added (constant 2005 prices) in Spain comes from the service sector,[9] including tourism, finance, and real estate. Spain's service sector grew at the fastest rate in 6½ years in January 2014 and even took on staff, adding to signs that the economy has turned a corner after more than five years in or near recession. In fact, the World Bank data indicates that 74% of employment in Spain is now in the service sector, with 21.8% in industry, and 4% in agriculture.[10]

Agriculture and fisheries accounted for around 3.4% of GDP value added in 2010, with the major outputs including grains, vegetables, citrus and other fruits, wine, olives and olive oil, sunflowers, and livestock. The major natural resources in Spain include coal, lignite, iron ore, uranium, mercury, pyrites, fluorspar, gypsum, zinc, lead, tungsten, copper and kaolin, and hydroelectric power.

Industry (including energy) accounted for 25.7% of value added in 2010. Major industries are processed foods, textiles, footwear, petrochemicals, steel, automobiles, consumer goods, and electronics. In 2011, Spain recorded imports of goods and services at US $457 billion and exports of $ 372 billion. Major exports include: automobiles, fruits, minerals, metals, clothing, footwear and textiles. Spain's major markets are primarily within the EU (over 70%) and the U.S. Spain imports petroleum, oilseeds, aircraft, grains, chemicals, machinery, transportation equipment, and consumer goods. Most of its imports come from EU partners and the U.S.

According to the World Bank, the Gross Domestic Product (GDP) in Spain was US $1,160 billion (constant 2005 prices) in 2012, representing around 2.2 % of the world economy. As shown in table 1, Spain's economy recorded its highest level of GDP in 2008 at US $1,229 billion (constant 2005 prices). Also in constant prices, GDP per capita reached a high of US $27,136 for 2007, with a slight decline in 2008, and a further decline after that. The GDP per capita was recorded at US $25,108 in 2012.[11] Finally in 2013 the country's economy began to improve, but unemployment remained unacceptably high at over 27 % in mid-2013.[12]

9) World Bank. World DataBank. http://databank.worldbank.org/Data/Views/reports/tableview.aspx
10) Ibid.
11) World Bank, World Development Indicators: http://databank.worldbank.org/data/views/reports/tableview.aspx
12) http://www.tradingeconomics.com/spain/gdp

In June 2013, the International Monetary Fund (IMF) stated that Spain had made strong progress towards fixing its economy. However, the IMF warned that the outlook for the country remained tough and has urged more action by the government and EU to boost job creation.[13] In the third quarter of 2013, Spain saw its first quarterly economic growth since 2011, according to data from the country's National Statistical Office (INE)[14]. The country's GDP grew 0.1% in the July-to-September period, after contracting for the previous nine quarters. This confirmed estimates from the Bank of Spain, and meant that Spain is officially out of recession.[15] According to INE, GDP expanded a further 0.3% in the fourth quarter, the strongest expansion in almost six years, confirming two consecutive quarters of economic growth.[16]

The INE attributed the growth to an increasing number of exports, with a boost to the tourist industry from holidaymakers avoiding northern Africa and the Middle East. However, unemployment still remains very high, at about 26%. Currently, spain has the second largest jobless rate in the EU. However, the number of unemployed persons recorded its largest decrease in five years.[17]

After five years of crushing recession and job losses, Spain's downward spiral has stopped and growth has returned. The Madrid stockmarket is climbing, government-bond yields have tumbled below pre-crisis levels, and foreign investors are bargain-hunting.[18]

Yet, analysts estimate that Spain's GDP will grow only by about 1% in 2014 as the economy is held back by heavy private debts. The IMF puts Spain near the bottom of its global growth chart for two years. Also, as wages fall and a quarter of workers remain jobless, most Spaniards have yet to notice the improvement.

Another period of dramatic decline is unlikely growth in manufacturing and services is creating new jobs, and consumer demand is creeping back. But the brakes on growth and job creation remain many. Banks, businesses, and families are still reducing their debts, keeping money out of the economy. As private debt falls, public debt surges. Public debt, which stood at below 40% of GDP when the crisis hit, is expected to rise above 100% in 2014, leaving Spain more vulnerable to future shocks.

Spaniards routinely blame Euro zone leaders for their woes, but in fact they have helped Spain to recover, giving it more time to cut its deficit. The biggest aid has come from the European Central Bank. It has also encouraged the financial markets; Spanish banks are ready to start new lending to small businesses. Also, banks themselves are reviving after their bail-out.

Employment remains the main worry. With salaries frozen, new job creation is needed to boost the consumer demand. It also has the benefit of reducing spending on unemployment subsidies. A bumper tourist season and good harvest helped create temporary jobs in the summer and autumn of 2013; and the public payroll grew in education and health, despite the deficit. Yet unemployment may remain above 20% for several years.[19]

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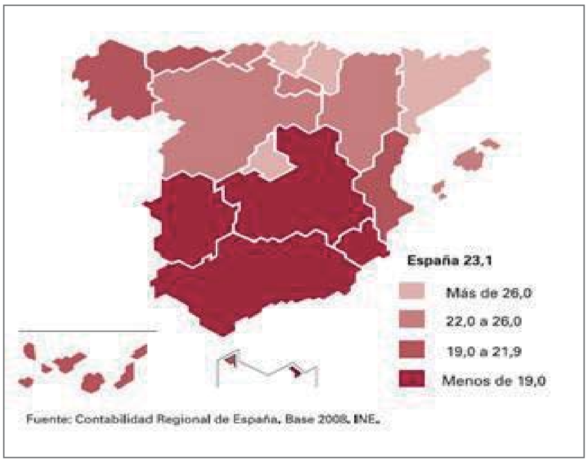
13) IMF Website: http://www.imf.org/external/np/ms/2013/061813.htm
14) Instituto Nacional de Estadistica. (National Statistical Office)
15) http://www.bbc.co.uk/news/business-24740721 30 Oct 2013, accessed_13-02-2014
16) http://www.tradingeconomics.com/spain/gdp-growth, accessed 13-02-2014
17) Ibid.
18) The Spanish Economy: On the Mend, Economist 23 Jan 2014: http://www.economist.com/news/europe/21595057-suddenly-there-new-mood-hope-over-spains-economic-prospects-mend. Accessed 12 Feb 2014.
19) The Spanish Economy: On the Mend, Economist 23 Jan 2014: http://www.economist.com/news/europe/21595057-suddenly-there-new-mood-hope-over-spains-economic-prospects-mend. Accessed 12 Feb 2014.

1-1-2. Economic Situation in the Ebro River Basin

The economic situation in the Ebro River Basin region has generally fared better than that in Spain as a whole. As can be seen from Figure 2, the area of the Ebro Basin (to the north and east) had per capita GDP among the highest in Spain. Having a reliable source of water has encouraged growth in agriculture, industry, and service sectors.



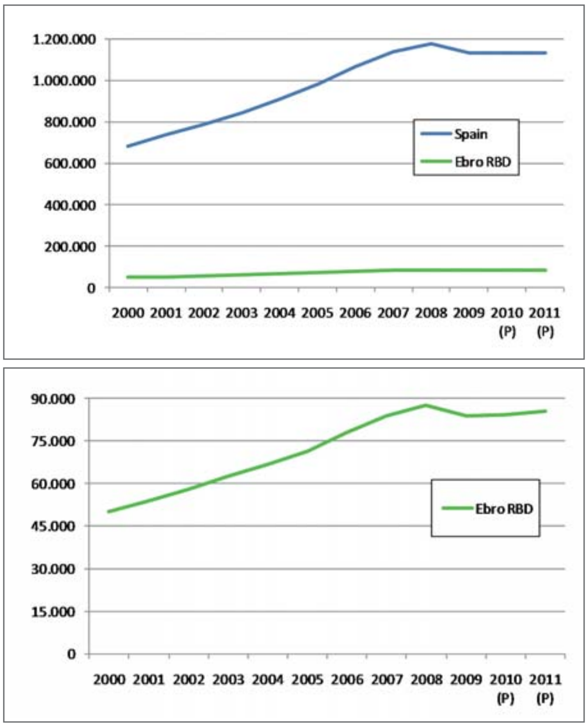
Source: INE, Contabilidad Regional de España – 2011 constant prices (Base 2008)

<Figure 2> Gross Domestic Product Per Capita in Spain by Region, 2011 (Thousand euros)

The GDP generated in the Ebro basin fluctuated in a similar way to Spain as a whole (Figures 3 and 4), but generally performed better than the country as a whole, especially following the downturn in 2009. While GDP registered very strong growth in the region from 2000 to 2008, there was a decline in 2009, but the economy picked up after that.

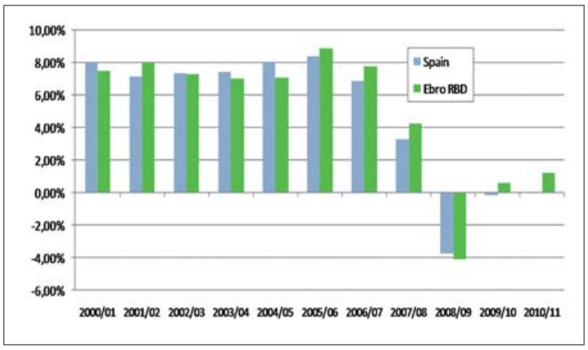
The agri-food complex that gives the economy of the Ebro River Basin its main competitive advantage now accounts for one fifth of the agrarian production and about one third of the meat supply in Spain (Figure 5). The decline in agriculture in the upper ranges of the Pyrenees has been accompanied by the modernization and transformation of agriculture in the lower valleys.

Land use in the Ebro region has traditionally been based on agriculture, including vineyards, orchards and



Note: P = provisional
Source: Author’s elaboration based on World Bank http://data.worldbank.org/country and data from Instituto Nacional de Estadistica (INE or National Statistical Office)

<Figure 3> Gross Domestic Product in Current Prices (million euros): Spain and Ebro RBD



Source: Author’s elaboration based on data from INE - Instituto Nacional de Estadistica. (National Statistical Office)

<Figure 4> GDP Interannual Variation (Current Prices), Spain and Ebro River Basin District

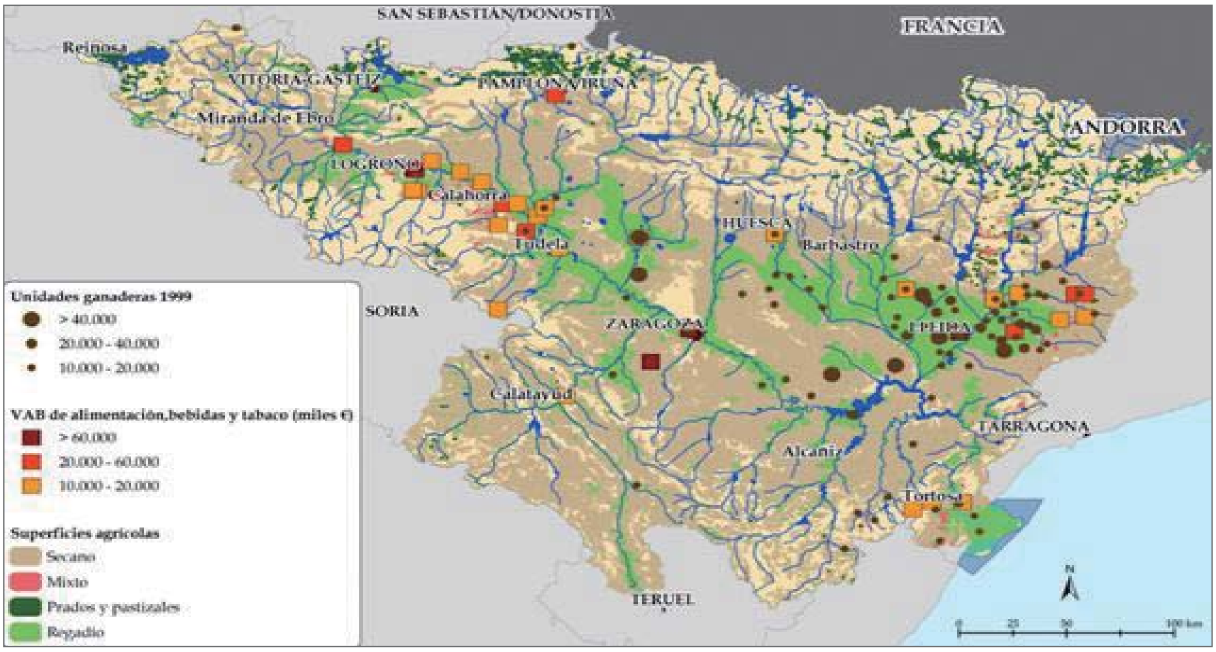
maize. Around 780,000 ha are devoted to agriculture, and most areas in the mid and lower Ebro are irrigated. Industry has become an important activity in some of the main cities (Zaragoza, Pamplona), and hydroelectric energy production at 340 hydroelectric plants uses about 8,300 m^3/sec of water in the basin. Water from the Ebro is also used in cooling nuclear and thermal energy plants.[20]

Legend: Unidades ganaderas: livestock units; VAB de alimentación bebidas y Tabaco: gross value added in the food industry (thousand euros); Superficies agrícolas: agricultural land (irrigated areas in green)

Irrigated agriculture covering an area of 700,000 ha in the valleys of the Ebro (see Figure 5) and its main tributaries is the basis of the agri-food complex. Apart from the financial support provided in the past by the EU's Common Agricultural Policy, the market advantages are based on the availability of land, a relatively cheap labor supply, the proximity to markets in Spain and central Europe, and the use of crops as inputs for livestock production in the upper river basin and low Pyrenees. The viability, profitability, and success of agriculture in the region relied on the development of water-related infrastructure for storage, transport, distribution, and irrigation.

Although the amount of water used in manufacturing represents a minor portion of the total water used in the basin, the industrial sector depends on agricultural raw materials for food processing and the local demand for agricultural inputs, such as agrochemicals and equipment. The Ebro valley is an industrial corridor, and industry provides almost 30% of the value added in the basin economy (compared with less than 20% for Spain as a whole).

Water development has also played an essential role in energy generation; the Ebro basin accounts for about one third of the country's nuclear power, one fifth of hydropower capacity, and one tenth of the country's thermal generation capacity. The hydropower capacity is shared among 360 plants across the basin. Hydropower generation is based on a heavily engineered hydrological system, providing a convenient supply of stored and running water, turbinating 38 billion m^3/yr (four times the average water runoff in the basin). The system uses more than three billion m^3/yr to refrigerate nuclear and thermal power plants.



Source: CHE, 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015: Summary Document version 2.03 (English), 2011: http://www.mma.es/secciones/agua/entrada.htm

<Figure 5> Elements of the Agri-food Complex in the Ebro River Basin

20) *Romani, A.M., Sabater, S., and Muñoz, I. 2011. The Physical Framework and Historic Influences in Barcelo, D. and Petrovie, M (eds.). The Ebro River Basin: The Handbook of Environmental Chemistry*. Springer, 10.

By building large-scale water facilities to support growth in agriculture, manufacturing, energy and provision of drinking water, water policy has played a role as an engine of growth in the region. Indeed the availability of reliable water is perceived as the critical factor underlying both the constraints to and the opportunities for economic growth in the region.

Activities related to water that are expected to expand include golf, skiing, adventure sports, recreational boating, and fishing. These recreational uses of water are different as well as their legal consideration. Activities such as golfing and skiing require concessions and are comparable to other private uses; others, such as sailing, are special common uses and are subject to a statement of responsibility. Others require specific legislation, such as fishing, or common uses such as swimming. There is also a natural aesthetic and scenic value in which aquatic ecosystems are particularly relevant.[21)]

1-1-3. Demographic Trends

The population of the Kingdom of Spain has steadily increased over the last half century, but the rate of growth has varied widely. From about 1960 to around 1985, the growth of the country remained a fairly steady normal increase of population. However, from 1985 to around 1998, the growth slowed down considerably. Then, in 1999, the growth rate increased again until 2009, when the population growth started to fall below replacement levels.

The population of Spain doubled during the 20th century, but the pattern of growth was extremely uneven due to large-scale internal migration from the rural interior to the industrial cities, a phenomenon that occurred later than in other Western European countries. Eleven of Spain's 50 provinces saw an absolute decline in population over the century.[22)]

Spain's 2012 population is estimated to be 46.2 million people (see Table 2), which was only a 0.09% increase over 2011. From 2002 to 2008, the population had been growing at an annual rate of over 1.5%, but growth rates started to fall below 0.8% per year in 2009.[23)] The population of Spain has historically always been less than those in France and Italy. Based on the total land area and the total population of the country, the population density was estimated to be 92.6 people/km^2 in 2011.[24)] Spain's population density is lower than that of most Western European countries. With the exception of the capital, Madrid, the most densely populated areas lie along the coast (see Figure 6). Spain is also less urbanized than many EU countries, with only about one quarter of the population living in cities with more than 1 million

<Table 2> Spain: Population Growth and Urbanization 2000-2012

Year	Total population (million)	Population growth (%/year)	People living in urban areas with more than 1 million population (million)	People in urban areas over 1 million as % of total population
2000	40.3	0.84	9.75	24.2
2001	40.7	1.13	9.93	24.4
2002	41.3	1.45	10.12	24.5
2003	42.0	1.66	10.32	24.6
2004	42.7	1.62	10.51	24.6
2005	43.4	1.64	10.71	24.7
2006	44.1	1.64	10.94	24.8
2007	44.8	1.71	11.17	24.9
2008	45.6	1.50	11.41	25.0
2009	45.9	0.77	11.65	25.4
2010	46.1	0.35	11.89	25.8
2011	46.2	0.22	12.13	26.3
2012	46.2	0.09	12.36	26.8

Source: World Bank, World Development Indicators: http://databank.worldbank.org/data/views/reports/tableview.aspx

21) Confederación Hidrográfica del Ebro. 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015. Summary Document Version 2.03 (English). 2011, Section 12. http://www.mma.es/secciones/agua/entrada.htm

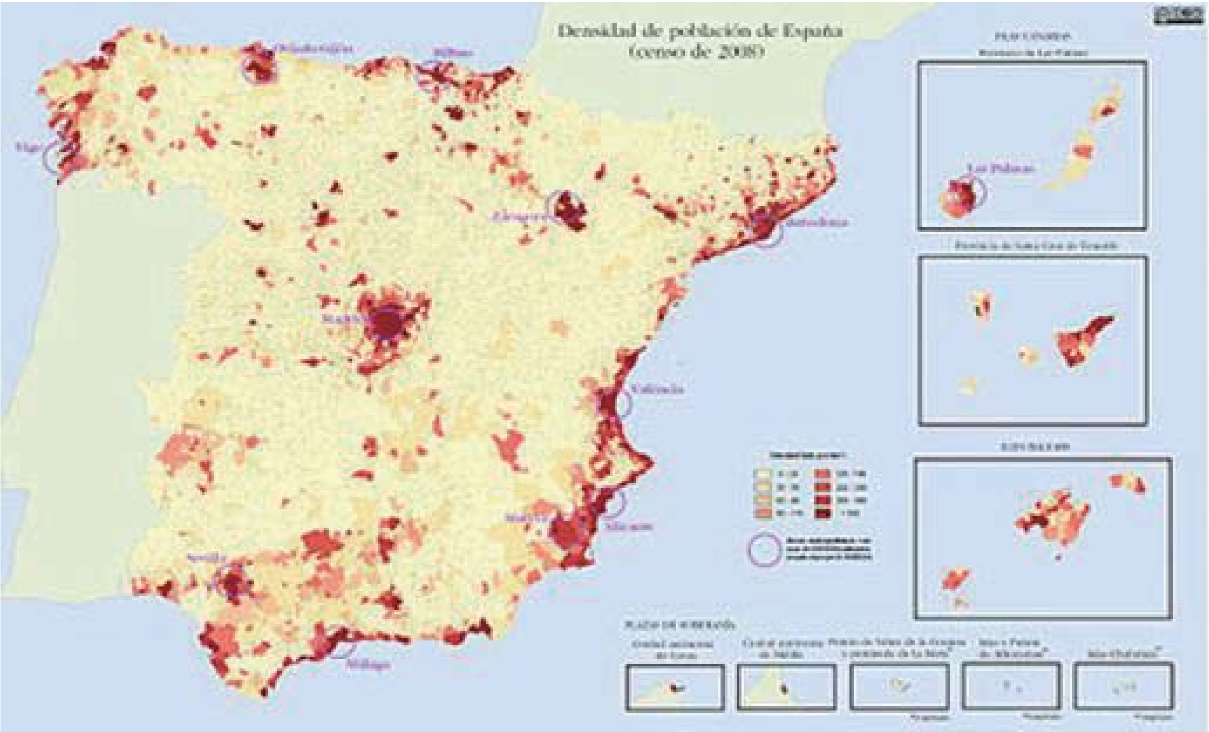
22) Demographics of Spain http://en.wikipedia.org/wiki/File:EspDens2.jpg

23) World Bank. World Development Indicators. http://databank.worldbank.org/data/views/reports/tableview.aspx

24) http://www.tradingeconomics.com/spain/population-density-people-per-sq-km-wb-data.html

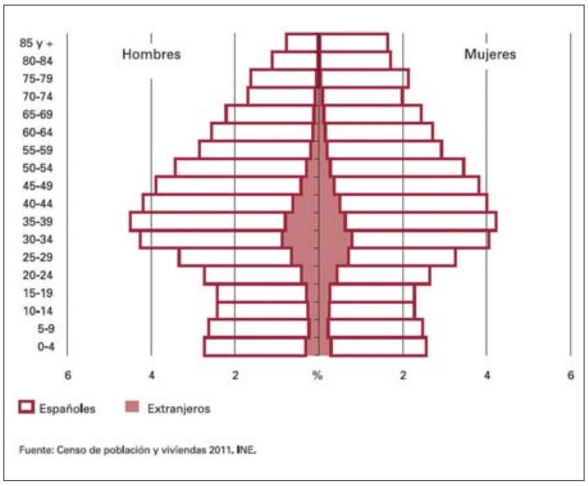
inhabitants. While that percentage rose to 26.8% in 2012 (Table 2), it has remained quite steady.

According to OECD figures, in 2011 youth (under 15) comprised 15% of the population, the elderly (65+) 17 % and the 16-64 age group was 68% of the population (see Figure 7). In emigration/immigration terms, after centuries of net emigration, Spain has recently experienced large-scale immigration for the first time in the modern history.

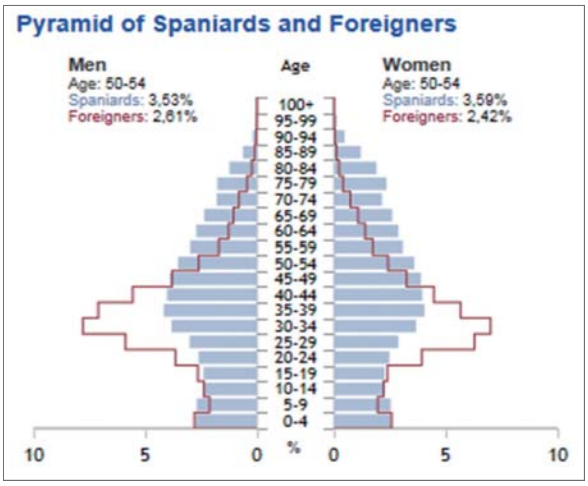


Source: Susana Freixeiro[25] : http://en.wikipedia.org/wiki/File:EspDens2.jpg

<Figure 6> Population Density of Spain, 2009



Source: INE: Census 2011



Source: INE: Census 2011

<Figure 7> Population Pyramid among Spaniards and Foreign Residents by Age Group, 2011

25) Demographics of Spain http://en.wikipedia.org/wiki/Demographics_of_Spain

According to the census data, there were over 5 million foreign residents in Spain in 2011, majority from North Africa, Latin America and other EU countries (see Figure 7). However, many immigrants returned home due to the effects of the European economic and fiscal crisis. About 48% of the population is in urban areas, 38% in intermediate areas, and 13% in rural areas.

1-1-4. Population Trends in the Ebro River Basin region

The Ebro River Basin encompasses the territory of nine autonomous communities (Aragón, Cantabria, Castile-La Mancha, Castile-Leon, Catalonia, La Rioja, Navarre, Basque Country, and Valencian Community).[26]

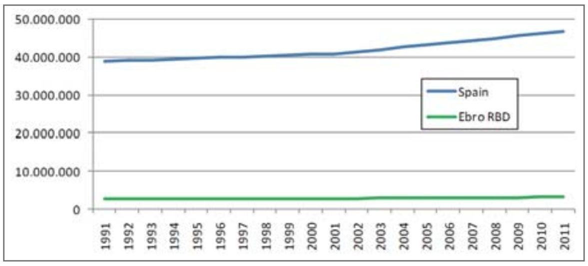
The population in the Ebro River Basin region was estimated at 3.2 million in 2011,[27] around 6.9% of the total population of Spain (see Table 3 and Figure 8). The annual rate of change in the Ebro region was slightly less than in Spain as a whole (1.31% in Ebro as compared to 1.37% in Spain from 2000 to 2011).

<Table 3> Total Population of Spain and Proportion Living in Ebro River Basin District (RBD)

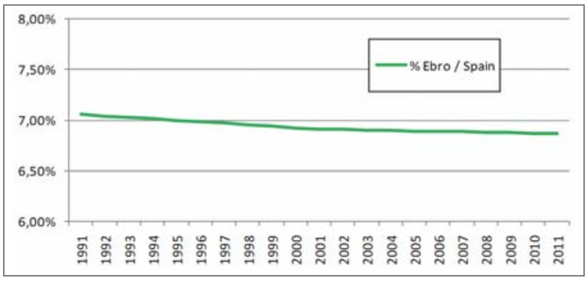
	1991	2001	2011
Ebro RBD (million people)	2.74	2.82	3.22
Spain (million people)	38.87	40.85	46.82
Ebro RBD as percentage of Spain's population	7.06%	6.91%	6.87%

The Ebro River Basin has only 34 inhabitants per square kilometre, less than one fifth of the average in the European Union and only two fifths of the Spanish population density.

The population density is heterogeneously distributed



Source: World Bank: http://data.worldbank.org/country/spain



Source: Author's elaboration based on INE data

<Figure 8> Population Growth Rates: Spain and Ebro River Basin (Census)

in the Basin – half of the population is in the cities of Zaragoza, Vitoria, Logroño, Pamplona, Huesca, and Lleida in the center of the Ebro Valley. However, in the Pyrenees and the Iberian system, the population density is very low. Altogether about 40% of the Ebro Valley is uninhabited (less than 5 inhabitants/km^2).[28]

1-1-5. Effects of Economic Factors

Thanks in part to water development, the Ebro valley has become an important settlement axis linking the rich industrial economies of the north of Spain, from the Basque Country to Catalonia, along an economic corridor. The successful agri-food complex of the Ebro corridor is based largely on irrigated agriculture, supported by the reservoir system that was developed during the 20th century. The production of the irrigated land fuels, a powerful livestock sector, and a remarkable processing industry. Water development is also an important factor

26) Confederación Hidrográfica del Ebro. 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015. Summary Document Version 2.03 (English). 2011, Section 12. http://www.mma.es/secciones/agua/entrada.htm

27) Instituto Nacional de Estadisticaor INE (National Statistical Office)

28) *Barcelo, D. and Petrovic, M. (eds.). 2011. The Ebro River Basin: The Handbook of Environmental Chemistry*. Springer, 10.

in improving livelihoods in the Ebro basin, both directly through the provision of drinking water and sanitation, and indirectly through the development of employment and production opportunities.

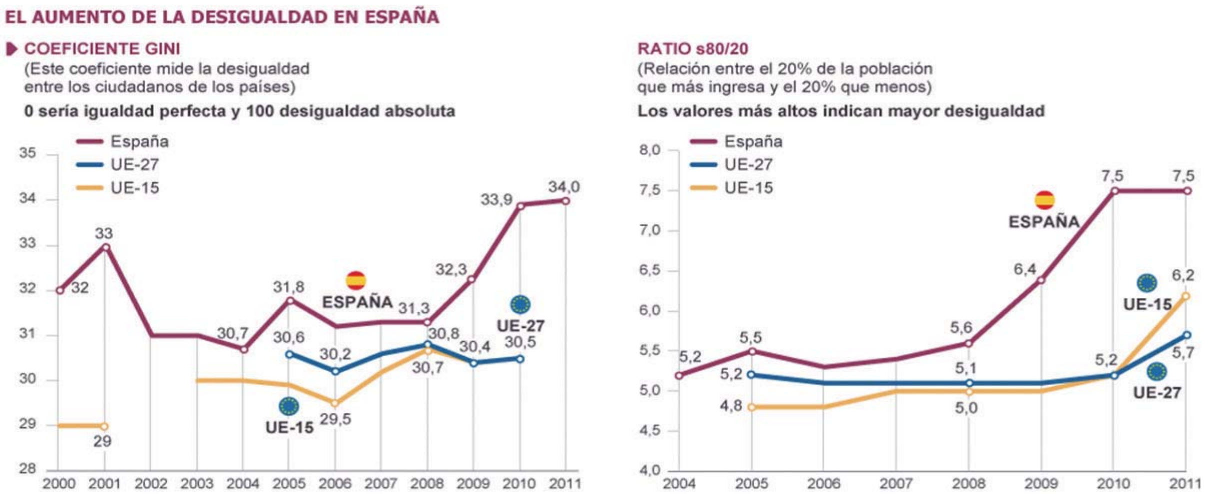
However, the implementation of the Ebro River Management Plan is to a large extent dependent on public sector budgets, and the large national deficit has led to dramatic cuts in public investments. Thus, the implementation of some measures may be subject to considerable delays, and in fact the horizons for achievement of associated objectives under the RBMP the is under review.

Moreover, the sluggish economic recovery has affected the launching of private projects, particularly in the agriculture and energy sectors. At the same time, rising food prices could revitalize agricultural initiatives, irrigation modernization, and commissioning of new irrigation areas.

1-2. Social Factors

1-2-1. Income Inequality: Spain and Ebro Region

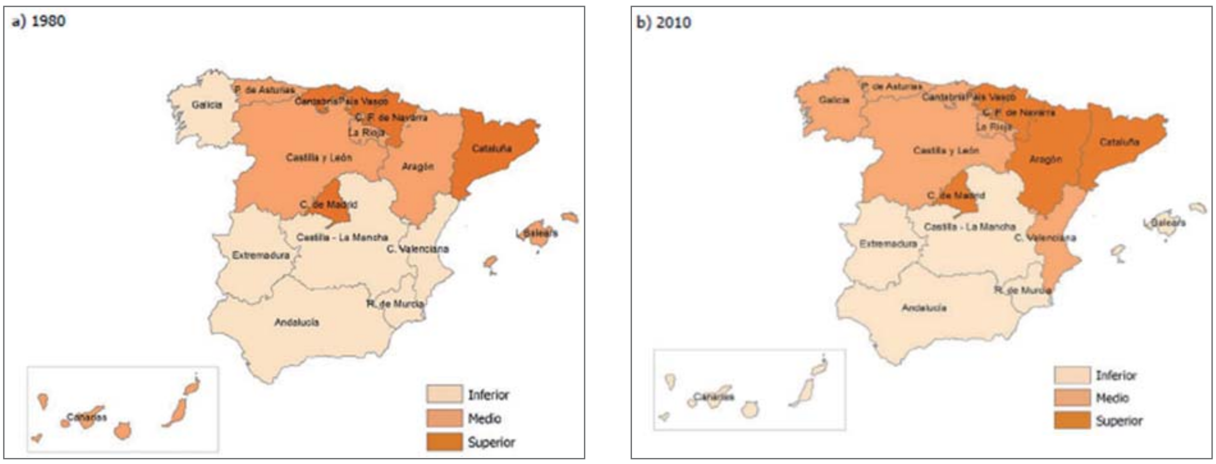
In Spain, economic inequality has always exceeded the average of its EU partners, at least from the start of Eurostat statistical series in 1995. However, the level of inequality was stable until the economic crisis starting in late 2008, when the gap began to grow larger (see Figure 9).



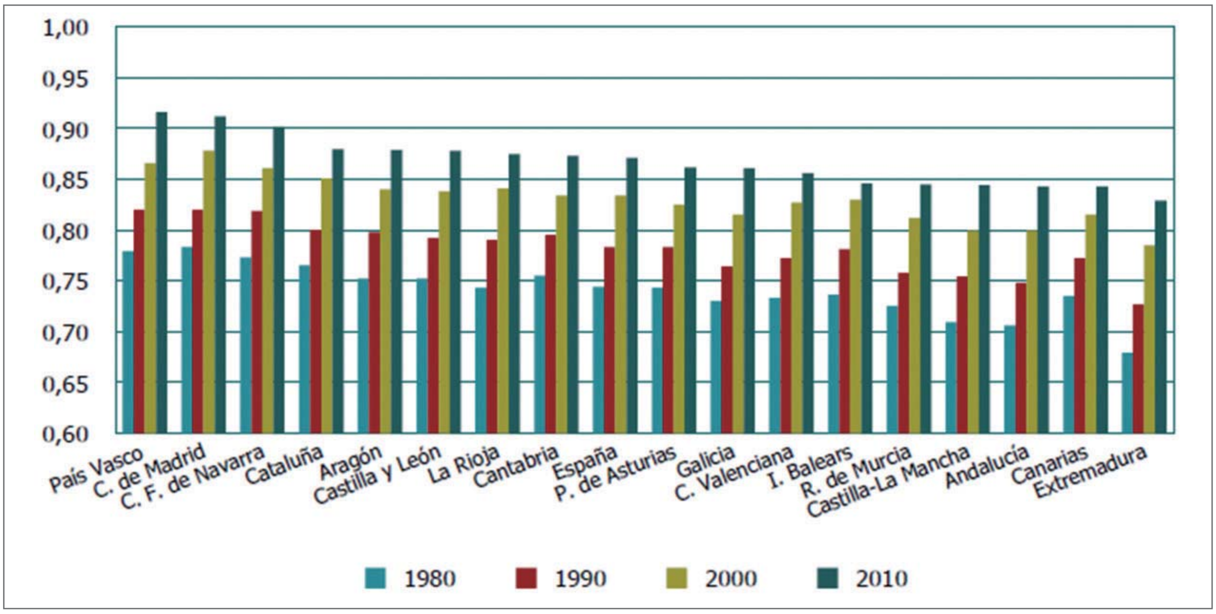
Left: GINI index in Spain and EU, 2000-2011

Right: Income of top 20% to bottom 20% (Spain vs EU)

<Figure 9> Level of Income Inequality in Spain and EU as a Whole



<Figure 10> Human Development Index in Spain, 1980 and 2010 by Thirds (Low, Medium, and High)



Source: Herrero, C., A. Soler & A. Villar.(2013): Desarrollo humano en España: 1980-2011. Valencia: Ivie, 54 pp. : http://dx.doi.org/10.12842/HDI_2012

<Figure 11> Human Development Index by Autonomous Communities

The Gini coefficient[29] is a clear example of that change. Spain has gained 2.7 points from 2008 to 2011, reaching the highest level of inequality since records began.

Figure 10 shows the Human Development Index (HDI) in Spain by thirds (top, medium, and low) in 1980 and 2010. It can be seen from the maps that the Ebro region rates at the top of the HDI for the country and has improved the most in the country over the period.

As shown in Figure 11, in the Spanish context, the Ebro region is in a very good position regarding the HDI both in absolute and relative terms. The Autonomous Communities of the Basque Country (*País Vasco*), Navarra, Catalonia, Aragon, and La Rioja are well above 0.85.

1-2-2. Health indicators

The Ministry of Health and Social Policy provide health indicators to assess health improvements in Spain. At the national level, life expectancy was above 80 years in 2007, placing Spain in the leading group of EU Member States –having gained 4 percentage points since 1990.

According to the OECD *Health at a Glance Report 2013*, Spain is now third highest in Europe and fourth worldwide in terms of life expectancy at birth. Life expectancy among the whole population is 82.4 years, with males at 78.8 and females at 85.2.[30] The report indicates that Spain's life expectancy is high relative to spending on health care.

Again the Ebro region is above average, as shown in Figure 12a. Also the perception of good health among the population is higher in the Ebro region (Figure 12b), but not particularly high in relation to other European countries. Nevertheless, recent cuts in health expenditure have raised concerns about a possible deterioration of the health of the poorest population groups.

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29) The Gini index, or coefficient, is a measure of income inequality from 0 to 1, where a low coefficient indicates even, equitable income distribution while a high coefficient indicates uneven, inequitable distribution.

30) OECD Health at a Glance, 2013: http://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf

12a. Disability-free Life Expectancy (DFLE), by Autonomous Community. Spain, 2007

12b. Percentage of Population Evaluating Their Health as Good/Very Good, by Autonomous Community.

Source: Health indicators 2009. Trends in health status indicators in Spain and their magnitude in the context of the European Union. Ministry of Health and Social Policy, 2009
http://www.msssi.gob.es/estadEstudios/estadisticas/inforRecopilaciones/docs/Indicators2009.pdf

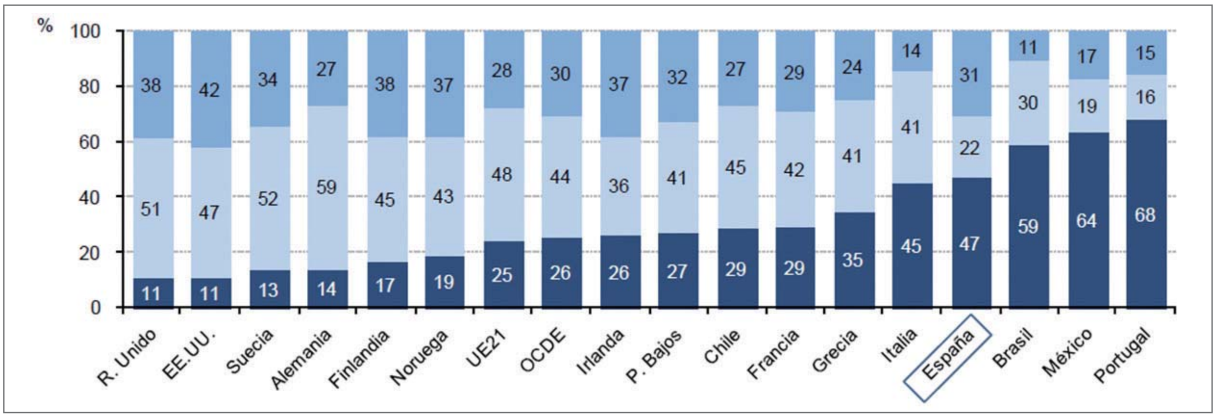
<Figure 12> Health Indicators by Region in Spain, 2007

1-2-3. Education and Religion

Regarding education, 97.7% of the population age 15 and over (2010 estimate) can read and write (male, 98.5%; female 97%). Compulsory education begins with primary school or general basic education for ages 6–16. It is free in public schools and in many private schools, most of which receive government subsidies. Following basic education, students attend either a secondary school offering a general high school diploma or a school of professional study in all fields — law, sciences, humanities, and medicine — and the superior technical schools offer programs in engineering and architecture.

About 70% of Spain's student population attends public schools or universities. The rest attend private schools or universities, some of which are operated by the Catholic Church. The country has an unusual distribution of education levels of its people (see Figure 13). Approximately 31% of the Spanish adult population has higher education qualifications, exceeding 30% of the group of OECD countries and 28% of EU. However, up to 47% has only lower elementary stage education, compared to 26% of the OECD and 25% of the EU.

Regarding religion, although Roman Catholicism used to be a state religion, the Spanish constitution of 1978 made Spain a secular country, with no official religion. However, the majority of people in Spain are still Catholics.



Legend: Medium blue: Tertiary Education; Light blue: Secondary education; Dark blue: Primary and secondary prep stage
Source: Education at a Glance. OECD Indicators 2012. Ministry of Education, Culture and Sports: http://www.mecd.gob.es/dctm/inee/internacional/panorama2012.pdf?documentId=0901e72b81415d28

<Figure 13> Education Levels by Percentage of Population and OECD Country

1-2-4. Effects of Social Factors

In the general context of a developed country such as Spain, the Ebro region is one of the most prosperous in economic terms and is also above average in all the development indicators. The Ebro case study describes a long-lasting process where water management has evolved over the last 88 years to a genuine integrated model. The implementation of a new RBMP, focused to environmental preservation and restoration, improves the livelihoods of the inhabitants in the basin, but it does not have significant effects on the level of education and health standards which were already quite high.

Water quality for human consumption has not been a problem in the Ebro region for many years. Currently, the major efforts being made are directed at improving sanitation and building the pending wastewater treatment plants to improve the quality of ecosystems. Improvements in ecosystems affect the aesthetic quality of the region and attract nature lovers who want to enjoy a clean and protected environment. Outdoor activities linked to the water element, from skiing to navigation and rafting, are a significant part the tourism potential of the region.

1-3. Political Factors

1-3-1. History

Spain is a diverse country that integrates different regions, languages and historical, political, and cultural traditions. While the entire Spanish territory was united under one crown by the 16th century, this was not a process of national homogenization or amalgamation. The constituent territories (i.e., kingdoms, principalities, dominions) retained much of their former institutional structures, and retained a variety of customs, laws, languages and currencies.

From the 18th century onward, the kings and the government tried to establish a more centralized regime. However, in Spain, two important regional languages were spoken in some of the most industrialized and prosperous areas, which also had their own cultures: the Basque Country and Catalonia, giving rise to peripheral nationalisms along with Spanish nationalism. Therefore, Spain did not experience a national cultural unification, and the peripheral nationalism remains strong in Catalonia and the Basque Country, and to some extent in Galicia.[31)]

General Francisco Franco's dictatorial regime (1936-1975) tried to enforce centralization as a way of preserving the "unity of the Spanish nation". His attempts to fight separatism with suppression of regional language and identities backfired: the demands for democracy became intertwined with demands for the recognition of a pluralistic vision of Spain as a nation.

When Franco died in 1975, Spain began its transition to democracy. Juan Carlos I was crowned King of Spain, and he supported a transformation of the political system as soon as he took office. In 1976, the king designated Adolfo Suàrez, as prime minister. The Cortes Generales (Spanish Parliament) was democratically elected, and in 1977 began the transition from a centralized state into a decentralized one. The constitution of 1978, ratified in 1979, found a balance in recognizing the existence of "nationalities and regions", and guaranteed the right to autonomy or self-government for them, through the creation of the "autonomous communities”.

Thus the constitution of 1978 divided Spain into 17 autonomous communities and two autonomous cities.

31) Main sources for this section were http://www.princeton.edu/~achaney/tmve/wiki100k/docs/Politics_of_Spain.html; http://www.lamoncloa.gob.es/IDIOMAS/9/Gobierno/index.htm; and Autonomous Communities of Spain: http://en.wikipedia.org/wiki/Autonomous_communities_of_Spain and citations therein.

There are 50 provinces that fit into these communities, although seven of the autonomous communities comprise only one province ('uniprovincial' communities). The communities are first level political and administrative divisions. Spain is not a federation, but a highly decentralized unitary state. The form of government of each autonomous community and city is based on a parliamentary system, in which the executive power is vested in a "president" and a Council of Ministers elected by and responsible to a unicameral legislative assembly.

Spain has a parliamentary constitutional monarchy in which the monarch is the head of State and the prime minister is the head of the government.Spain's transformation from an authoritarian regime to a successful modern democracy was a remarkable achievement, even creating a model emulated by other countries undergoing similar transitions.

Adolfo Suárez was prime minister of Spain, the leader of the Union of the Democratic Center party from 1977 to 1982. Following his resignation, in October 1982, the Spanish Socialist Workers' Party, led by Felipe Gonzalez, won an absolute majority in both chambers of the Cortes Generales. González served as the Prime Minister of Spain for the next 13 years, during which period Spain joined NATO and the European Community. Prime Minister Gonzalez greatly modernized and economically developed Spain during the period 1982-1996, closing the gap with other European Community members. There was also a significant cultural shift into a tolerant, contemporary, and open society.

The two predominant political parties are the Spanish Socialist Workers' Party (PSOE) and the People's Party (PP). The main regional parties that also play important roles in Spanish politics are: the Basque Nationalist Party (EAJ-PNV); Convergence and Union (CiU); and the Socialists' Party of Catalonia (PSC). Peripheral nationalism continues to play a role in Spanish politics.[32)]

In March 1996, José Marià Aznar, from the People's Party, obtained a relative majority in Congress. Aznar moved to further liberalize the economy, with a program of complete privatization of state-owned enterprises, labor market reform, and other policies designed to increase competitiveness in selected markets. Having obtained an absolute majority in the 2000 elections, Aznar headed the Prime Minister's office until 2004. Aznar supported transatlantic relations with the United States, and participated in the war on terrorism and the invasion of Iraq. In 2004, he decided not to run as a candidate for the Popular Party, and proposed Mariano Rajoy, who had been minister under his government as his successor to lead the party.

In the aftermath of the terrorist bomb attacks in Madrid, which occurred just three days before the elections, the Spanish Socialist Workers' Party won a surprising victory. Its leader, Jose Luis Rodriguez Zapatero, was prime minister from 2004 to 2011, winning a second term in 2008. During Zapatero's first four years as Prime Minister, the economy continued to expand rapidly, and the government ran budget surpluses. The economic crisis of 2008 took a heavy toll on Spain's economy, which had been highly dependent on construction since the boom of the late 1990s and early 2000s. When the international financial crisis hit, the construction industry collapsed, along with property values, and several banks were in need of rescuing or consolidation.

32) Autonomous Communities of Spain http://en.wikipedia.org/wiki/Autonomous_communities_of_Spain and citations therein

In March 2011, Rodríguez Zapatero made his decision not to lead the Socialist Party in the coming elections, which he called ahead of schedule for 20 November 2011. The People's Party, which presented Mariano Rajoy for the third time as candidate, won a decisive victory, obtaining an absolute majority in the Congress of Deputies. Alfredo Perez Rubalcaba, first deputy prime minister during Rodríguez Zapatero's government and candidate for the Socialist Party in 2011, was elected as the secretary general of his party in 2012, and is now the leader of the opposition in Parliament.

1-3-2. Effect of Political Factors in the Ebro River Basin[33)]

In a recent study Font and Subirats (2010)[34)] have proposed an interesting three-stage model that corresponds to the three national single-party governments since the early 1990s to explain the recent transition of water management in Spain:

The first stage [emerging protest] covers the minority government of the Socialist Party between 1993 and 1996. During this period, the so-called Plan Borrell, named informally after the minister, proposed to satisfy the increasing demand for water and correct territorial imbalance through the construction of about 150 dams and a network of multiple water transfers. The weak position of government during the turbulent 1993–1996 legislature stimulated the rise of conflicting interests surrounding water management. Economists and environmentalists invoked the principles of efficiency and conservation to substitute the supply-based engineering approach. The donor regions' actors rejected the idea of enhancing economic activities in some water-short Mediterranean regions, such as Murcia, to the detriment of other water-rich regions, namely Aragón. In fact, all political forces in the region agreed to the so-called "Aragón Water Pact" in 1992 that is still in force. The Autonomous Community would not consent to transfers from the Ebro River while regional needs were not satisfied. Moreover, Portugal opposed to water diversions from Spanish-Portuguese rivers.

The first Hydrological Plans were developed during this period though eventually approved in 1998. It was agreed that they should be in place before drafting the Water National Plan.

The second stage [polarization] includes two Popular Party governments during the periods 1996–2000 (minority government) and 2000–04 (majority government). During the first minority government, the executive reformed the 1985 Water Act in 1999 to define a national strategy to cope with the drought problem, combining market efficiency —creation of water banks and public corporations to establish partnerships with private stakeholders to finance profitable Hydraulic Works ("*Sociedades Estatales*")— and supply-based principles. The new National Water Plan promoted the construction of large-scale hydraulic infrastructure. The key project involved the transfer of 1,050 hm^3 of water from the Ebro River along the Mediterranean coast to the Júcar, Segura, and southern basins and north to the internal basins of Catalonia. It also included the construction of about 120 water dams and river channels. While the more flexible management instruments were generally well accepted, the National Water Plan was widely criticized by a wide range of social organizations, scientists, political parties, and some regional governments, which became

33) Main sources for this section were http://www.feem-project.net/water2adapt/01_project_04.html and http://europeanwater.org/actions/country-city-focus/200-spain-case-ebro-river-delta

34) *Font, N. and Subirats, J. 2010. Water Management in Spain: The Role of Policy Entrepreneurs in Shaping Change: Ecology and Society*. 15(2): 25. http://www.ecologyandsociety.org/vol15/iss2/art25/

engaged in intense informational campaigns and increased pressure on the government.

Also during this period, the Water Framework Directive was approved, introducing a new water management paradigm. With the help of EU Cohesion Funds, the investment in urban wastewater treatment boomed to comply with Directive 91/271 with substantial effects in the improvement of the quality of inland and coastal waters.

Finally, the third stage [symptoms of change], started with the change of government following the national elections of 2004. The Socialist Party, fulfilling an electoral promise, modified the 2001 National Water Plan, cancelled the Ebro River transfer and quickly adopted the AGUA program (2004–08). The AGUA program included more than 100 initiatives, including the construction of water desalination plants and the creation of public water banks (the implementation of centers of exchange of water rights at the Segura, Júcar, and Guadiana river basins was approved). In addition, the program included the regulation of water demand as an option to be assessed. Environmental groups reacted positively to such a policy instrument but rejected the implementation in basins with long-standing problems caused by illegal wells and markets. This new orientation of water management was also partly stimulated by the WFD which advocated for water saving, efficiency, and "user pays" principles.

After the 2008 elections, though the Socialist mandate was renewed, the Ministry of the Environment was integrated into the Ministry of Agriculture, a traditional advocate for a conventional supply-side approach to water management, with emphasis on irrigation. The combined ministry is now the Ministry of Agriculture, Food and Environment. The new Hydrological Plans under the WFD were at the drafting stage but the process stalled. The change of paradigm has been confirmed by the Popular Party Government. In the meantime, some desalination plants have been constructed along the Mediterranean coast over the past few years, but this alternative has lost its momentum for lack of economic feasibility.

A new National Water Plan is being announced after final approval of Basin Plans. Water transfers are still part of the debate, advocated by the east coast regions and rejected by the projected donor regions such as Aragón in the Ebro region. The solutions based on better use of existing water resources, including demand management, more efficient irrigation systems and water re-use are more appropriate under current conditions. It may be the case that the shelving of the water transfer proposals in 2004 was a blessing for the health of the Ebro ecosystem and long-term economic growth in the Ebro region.

1-4. Environmental Factors

Spain's approach to environmental issues has been very much influenced by the general increase in environmental awareness resulting from integration into the European Union. Spain had to assume European environmental standards and the adoption of the WFD has also been a major driver.

The OECD conducted Environmental Performance Reviews of Spain in 1997 and 2004.[35)] The review in 2004 covered the previous 10 years but concentrated mainly on the 1997-2003 period. It pointed out that Spain's economy had been growing rapidly over the previous decade, and that in many cases, economic growth had led to increased pressures on the environment in Spain, in terms of both pollution and use of natural resources (e.g. water, land).

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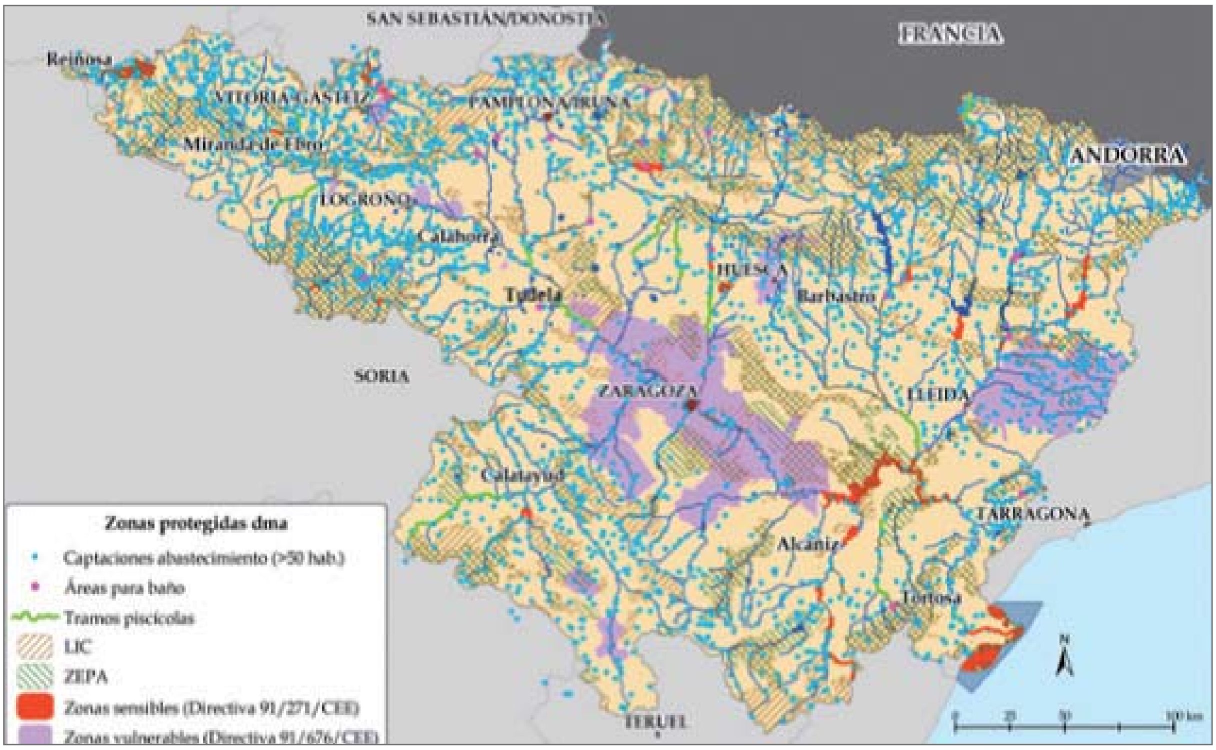
35) *OECD (Organisation for Economic : Cooperation Development). 2004. Environmental Performance Reviews: Spain*. Paris: OECD. http://www.keepeek.com/Digital-Asset-Management/oecd/environment/oecd-environmental-performance-reviews-spain-2004_9789264108639-en#page16; Executive Summary http://www.oecd.org/spain/33843571.pdf

From 1994 to 2003, there had been a 36% growth in GDP, a 52% increase in international tourist arrivals, and an increase in housing construction at a rate of 700,000 new dwellings per year (the tourism and construction sectors accounting for 11% and 9% of GDP, respectively). The population density along coastal regions and the islands (where almost 60% of the population live) was five times higher than in the interior regions. In some tourism areas population density can triple in the summer. Moreover, economic integration into the EU had led to a 77% growth in road freight transport. Despite a significant decline in unemployment during the period, it still remained at over 11% in 2004, among the highest in the OECD area.

Over the review period, Spain made progress in developing environmental infrastructure, particularly related to water supply and wastewater treatment. Environmental legislation evolved significantly during the period, and some regions implemented advanced environmental policies. Under the 1978 constitution, the autonomous regions, which present considerable differences in their physical, social, and economic conditions, have a major role to play in implementing the environmental policy. The number of national parks and protected areas expanded enormously following the transfer of authority to autonomous regions to declare and manage these areas, especially from 1987 to 2001. Protected areas in the Ebro River Basin are shown in Figure 14.

Within the Spanish constitutional framework, environmental legislation evolved positively and significantly over the review period, partly in response to EU Directives. The major national laws and decrees that were enacted related to national park networks (1998), packaging waste (1997), waste (1998), environmental impact assessment (2001), integrated pollution prevention and control (IPPC) (2002), forests (2003) and natural heritage and biodiversity (2007). The autonomous



Legend in figure: Water abstraction for human supply (> 50 inhab.); Bathing areas; Fish reaches; LIC: Site of Community Importance (Natura 2000 network); ZEPAs: Special Protection Area (birds); Sensitive areas (Directive 91/271/CEE)
Vulnerable areas (Directive 91/676)
Source: Ebro Hydrological Plan Proposal 2013

<Figure 14> Protected Areas in the Ebro Basin (Zonas Protegidas)

regions have also adjusted their legal frameworks. The Sectoral Conference on the Environment and Sustainable Development and the network of environmental authorities provide coordination between the central government and the autonomous regions, including for the implementation of EU Directives and distribution of EU funds.

Many of the environmental efforts of national and regional administrations have focused on investment in environmental infrastructure, such as for water supply and wastewater infrastructure. Enforcement activities have increased, and progress has been made with voluntary eco-labelling of products.

Private sector firms in Spain have greatly expanded their participation in environmental management systems. Voluntary approaches have been adopted throughout the country in several industrial sectors. It will be important to monitor their environmental effectiveness and economic efficiency. Authority at regional and local level for collecting environment-related taxes has been expanded. Financial instruments have been used to some extent to protect the environment, but have more often been used as an incentive to reward positive environmental behaviour and investment. These instruments could be used more widely to tax activities that have negative impacts on the environment, as the economy recovers. Energy, transport and water prices might be reviewed from the point of view of conserving the environment and encouraging economic efficiency.[36)]

Spain continued to make progress in decoupling economic growth from enforcement of pollution control measures, in particular control of greenhouse gas emissions, nitrogen fertilizer use, and water abstractions. The country has incorporated environmental concerns into sectoral policies, particularly in the energy sector. Environmental impact procedures, such as for transport projects, have led to stricter conditions or project modifications. Some industries (e.g coal, fishery) have had to start a process of restructuring and phasing-out of subsidies.

Despite the positive environmental improvements in the 1990s and 2000s, Spain still faces major challenges related to high energy and water use intensity, CO_2 emissions, and municipal waste generation. Priority environmental issues include natural and water resources management, biodiversity conservation, climate change and air pollution, sustainable tourism and waste management. Environmental expenditure in Spain increased modestly and remained relatively low compared to that in other comparable OECD countries.

In October 2006, Spain adopted the National Climate Change Adaptation Plan (PNACC in Spanish) as a coherent set of public policies to deal with climate change, after endorsement by the Cabinet of Ministers.[37)] The text had been discussed within the main national coordination and participation bodies dealing with climate change issues: the Commission of Climate Change Policy Coordination, the National Climate Council, and the Environment Sectoral Conference. The Plan was also subject to a wide process of public consultation. The PNACC provides a framework tool for coordinating national and regional efforts to assess impacts, vulnerability, and adaptation to climate change in the nation's most affected sectors (water management, agriculture, forests, biodiversity, coastal zones, health,

36) *OECD (Organisation for Economic : Cooperation Development). 2004. Environmental Performance Reviews: Spain*. Paris: OECD. http://www.keepeek.com/Digital-Asset-Management/oecd/environment/oecd-environmental-performance-reviews-spain-2004_9789264108639-en#page16; Executive Summary http://www.oecd.org/spain/33843571.pdf

37) Ministry of Environment and Rural and Marine Affairs. 2006, Oct. National Climate Change Adaption Plan. http://www.magrama.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc_ing_tcm7-12473.pdf (Accessed 16 Feb 2014)

and tourism, etc.). The Plan outlines a process to guide the activities of the public sector, the private sector, and stakeholders in confronting together climate variability and change.

Moreover, in November 2007 a national sustainable development strategy[38] was issued in consultation with several ministries and autonomous regions. The document addresses environmental sustainability, concentrating on more efficient and rational use of natural resources, particularly those related to energy, water, biodiversity, and land. It also develops policies to mitigate the determinants of climate change in productive sectors, especially energy and transport sectors. The policies were expected to improve air and water and gradually reduce the levels of atmospheric pollution in Spanish cities, so as to have a positive impact on people's health and productive sectors, such as agriculture. The Strategy includes chapters on water resources, biodiversity, land uses and occupation.

While the Climate Adaptation Plan and the sustainable development strategy both outline a vision for protection of ecosystems and the environment, along with social well-being, their implementation has been severely limited by the recession that hit the country in 2008, and many of the policies were unrealistic in the lightof the poor economic and social situation.

Moreover, throughout the period Spain's environmental policy continued to be hampered by reliance on subsidies, government transfers and other forms of financial assistance. Spain makes limited use of environmental taxes and other economic instruments to influence behaviour, as it is widely believed that they could affect competitiveness and employment. This was particularly damaging after the economic crisis hit in late 2008, as accumulated public debt was high, and unemployment became a huge burden.

There is scope to improve efficiency through better recovery of the costs of supplying environmental services such as water and sewerage. Some municipalities do not charge for waste services; less than one third of waste collection and treatment costs are recovered countrywide. Increasing the use of economic instruments (e.g. water services pricing) to finance environmental services is essential, as EU funding for such infrastructure has declined. Penalties for poor implementation of environmental legislation remain limited.

Souce: Javier del Valle Melendo, from "*Los Organismos de Cuenca en el siglo XXI*"

<Picture 1> Congosto de Olvena, Huesca Province, Aragón Autonomous Community, Ebro Valley

In its environment review for Spain, the OECD report made 46 recommendations that could help strengthen Spain's environmental progress in the context of sustainable

38) Ministry of Agriculture, Food and Environment. 2007, Nov. Spanish Spanish Sustainable Development Strategy. http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/files/EEDS_23_NOVIEMBRE_2007_INGLES.PDF

development. Some of the recommendations that were aimed at water management are still relevant today:

- Strengthen demand management with respect to all types of water use (e.g. agriculture, municipal, industry) using existing instruments (such as water pricing, trading, metering) to ensure full payment of charges and cost recovery for service delivery;
- Implement the Water Act's minimum reserve flow requirements to restore and protect river habitats; Complete national plans concerning sewerage, wastewater treatment, and sewage sludge;
- Improve the operation of the pollution licensing system and promote effective and efficient management of urban water services through rigorous monitoring of water quality and strategic planning by utilities;
- Carry out modernization of existing irrigation systems and improve water use efficiency as proposed in the National Irrigation Plan;
- Expand the mix of measures to halt over-exploitation of groundwater resources; and
- Improve recognition and understanding of the relationships between water and economic variables with: i) better data on expenditures, prices and financing; ii) systematic analysis of the microeconomic conditions facing key water users; and iii) a systematic review of subsidies for water supply and treatment infrastructure, aiming at cost-effectiveness and long-term financing of the maintenance and upgrading of facilities.

1-4-1. Ebro Basin: Establishing Environmental Objectives

In the Ebro River Basin, primary importance has been given to setting the environmental objectives for water planning in the RBMP. One of the 12 key elements in the Hydrological Plan (shown in Box 2 in Section IV. 3) is that at least 85.3% of river water bodies will attain good ecological status by 2015.[39] It is against this objective that competing demands of water users and other stakeholders must be accommodated. Once the criteria for good ecological status are set, the water authority assesses the water availability to allow other water uses.

The new water policy framework allows for the actions and measures to achieve environmental objectives and that generate minimum economic losses (i.e. cost effective analysis used to choose the set of measures in the river basin management plan) or maximum welfare gains (e.g. from more efficient water provisioning systems or alternative water supply sources).

Currently the on-going public consultation is addressing the objective of achieving good status in 83% of the water bodies by 2015. By comparing information on the current status of water flows with those under natural conditions, it is expected that an agreement will be reached on the minimum environmental flows needed in the different rivers. This agreement must consider the uses affected by minimum flows and the potential benefits of improving the habitat conditions. The minimum environmental flows decided upon will be verifiable and enforceable through the monitoring network of gauging stations.

The allocation of water resources needs to be balanced in such a way that by 2015, total water consumption will not exceed the current level of 34% of the long-term available resources. This is another 12 key elements in the Hydrological Plan.

Moreover, the water planning process for the Ebro River Basin has contributed to the selection of a combination of projects aimed at restoring the water environment. They include an ambitious program for water quality improvement through a mixture of effluent treatment and water reuse projects combined with a zero tolerance program to control pollution discharges.

39) Confederación Hidrográfica del Ebro. 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015. Summary Document Version 2.03 (English), 2011. http://www.mma.es/secciones/agua/entrada.htm

A set of water-saving measures has also been identified, combining intake, transport, treatment, distribution and efficiency projects throughout the entire river basin. These programs are accompanied by a set of projects focused on the restoration of rivers and river banks, the recovery of wetlands, the restoration of sediment balances and hydrological regimes, the removal of polluted sediments, the control of invasive species and other measures aimed at improving the ecological status of the river basin ecosystem.

Source: Javier del Valle Melendo

<Picture 2> Monte Perdido Glacier, Ordesa y Monte Perdido National Park, Pyrenees, Huesca Province, Aragón Autonomous Community. (It is an IUCN category II national park and a UNESCO World Heritage Site)

1-4-2. Effects of Environmental Factors

As part of its obligations under the EU Water Framework Directive, environmental objectives are prominent in the Ebro River Basin Management Plan. A major part of the effort is to ensure that 83% of the water bodies in the basin achieve good status by 2015, which means a paradigm change to protecting and restoring the water environment, leading to conservation of biodiversity and more sustainable and diverse tourism. Water-saving technologies and campaigns and better wastewater management have contributed to protecting the watershed and improving water quality. The real challenge is making the achievement of environmental objectives compatible with the enhancement of economic opportunities of the region.

The main short-term uncertainties stem from the environmental flows implementation that is a potential source of governance problems, especially during periods of drought. In the longer term, the uncertainties of climate change come into play. According to some predictive models, Spanish Mediterranean basins may be seriously affected.

1-5. Technical Factors

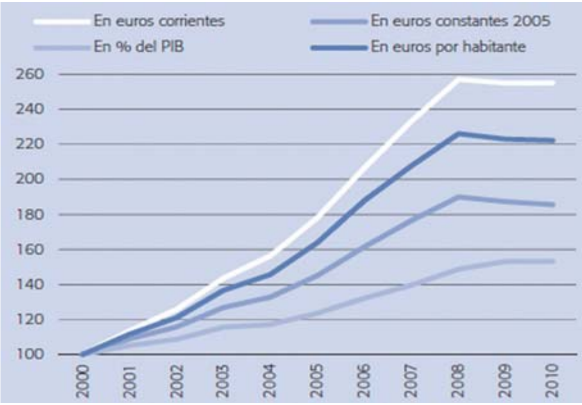
According to the Technology Review of the Massachusetts Institute of Technology (MIT), Spain is known for its leadership in several specific areas of innovation and advanced technologies, especially in the industries of aerospace, renewable energies, water treatment, rail transport, biotechnology, industrial machinery, and civil engineering.[40)]

From 2000 to 2009, the Gross Expenditure on Research and Development (GERD) as a percentage of GDP in Spain was rising at a steady pace (see Figure 15), and then levelled off in 2009-11. As shown in Figure 15, R&D has been severely affected by spending cuts resulting from the economic crisis, abruptly breaking the upward trend of the past decade.

In 2010, Spain spent 1.39% of its GDP on GERD, compared to an average of 1.91% in the 27 EU countries as a whole.[41)] This fell to 1.33% of GDP in 2012, far below other European country standards. Nevertheless, some Autonomous Communities of the Ebro region are

40) *MIT (Massachusetts Institute of Technology). n.d. Explore the Cutting-edge Technologies Emerging from Spain Today. MIT Technology Review*. Multi-part series produced by technology review in partnership with the Trade Commission of Spain. http://icex.technologyreview.com (Accessed 16 Feb 2014)

41) http://www.oecd-ilibrary.org/science-and-technology/gross-domestic-expenditure-on-r-d_2075843x-table1



Legend:White: € in current prices; Light blue: percentage of national GDP spent on R&D: Medium blue: € in constant prices (2005): Dark blue; € per capita

Source: COTEC Report 2013 http://www.cotec.es/index.php/utils/pre_descarga/fichero/f92604f27d6566075166efe728a91bfbfd7ea8c5.pdf/pagina_idioma/2/titulo/Informe+Cotec+2013%3A+Tecnolog%C3%ADa+e+Innovaci%C3%B3n+en+Espa%C3%B1a/categoria_show_id/143/categoria_show_tema/Informes+Anuales

<Figure 15> Gross Expenditure on R & D (GERD) in Spain, 2000-2010 (index 100 = 2000).

leading R&D spending, both in terms of regional GDP and relative to population.

Some of the main areas in which this expenditure has been concentrated are discussed below.

1-5-1. Information and Communications Technology (ICT)

In the information and communications technology (ICT) areas, Spain's two largest ICT companies and world leaders in the field are Indra Sistemas, SA and Telefónica. These companies have provided international solutions for needs such as air and road traffic control, security in public and digital spaces, and mobile telecommunications. Spain was the first country to employ a single broadcasting network for digital television. As a result, Spanish companies became experts in both low- and high-power transmitters and are active around the world in digital processing and transmission.

A number of key factors in Spain have encouraged the flourishing of the ICT sector. Since 2008, Spain has issued all national identity cards in an electronic format and is an international leader in electronic signatures. Spain has also experienced rapid growth in the use of electronic health records. Both have led to advances in information processing and in security systems that protect a user's digital data and all the person's electronic transactions. Both Indra and Telefónica, along with other major ICT companies, are moving into digital services and cloud computing, and are integrating data from different services in order to create the smarter cities of tomorrow. Their solutions might involve integrating traffic control, police notifications, and hospitals and paramedics in order to deal quickly with emergencies.

The number of tourists arriving in Spain (57 million in 2012) made Spain the third highest tourist destination in the world in 2012 (after France and the US). This influx is 15 million more people than the entire population of Spain. The country has built a modern network of internal flights and high-speed rail to accommodate tourist travel, and the private sector has developed sophisticated technology to manage air traffic and rail traffic. Indra Sistemas provides support services to air traffic control, ticketing systems, energy, and health information systems in over 120 countries. Spain's smart electrical grid provides another opportunity for ICT companies to manage huge amounts of data from electric companies together with usage information from consumers, in order to conserve energy and save money.

Connectivity remains crucial across all sectors, and Spain heads European countries in smartphone ownership and use of 3G networks. Spanish companies lead in providing Internet and broadband access.

1-5-2. Renewable Energy Technologies

Spain is also a leader in renewable energy technologies, including solar and wind power. Spain's government, concerned about the country's dependence on oil and its relatively tenuous connection to the greater European power grid, created favourable conditions for renewable energy in Spain, particularly solar (both photovoltaic panels and solar thermal) and wind power. Spain is second in Europe behind Germany in wind-generated electricity, and its installed capacity is fourth highest in the world.[42)]

Spain is one of the most advanced countries in the development of solar energy, and is the fourth largest manufacturer in the world of solar power technology, exporting much of its output to Germany. Spain achieved a record 3.5 GW of solar power capacity in 2008, which increased to 4 GW by the end of 2010. Solar power covered 2.7% of the electricity demand in 2010.[43)]

Through a ministerial ruling in March 2004, the Spanish government removed economic barriers to the connection of renewable energy technologies to the electricity grid, including for large-scale solar thermal and photovoltaic plants. In the wake of the financial crisis in 2008, the Spanish government drastically cut its subsidies for solar power and capped future increases in capacity at 500 MW per year, with effects upon the industry worldwide.[44)]

Wind power has become a relatively mature industry, and is moving into new territories. Iberdrola Renewables, an international leader in wind farm operations, has completed the construction of one of the world's largest wind farms, with 304 MW of installed capacity, in Wert County, Ohio. The Blue Creek wind farm also includes technology from wind-turbine leader Gamesa, which supplied 152 turbines. Spanish companies design critical parts and systems to support these massive renewable energy installations.

1-5-3. Desalination

Spain installed Europe's first desalination plant nearly 50 years ago on the island of Lanzarote in the Canary Islands in 1964. Spain is currently the third largest user of seawater desalination technology in the world, after Saudi Arabia and United Arab Emirates (Spain's installed capacity was 3.8 million m^3/day in October 2013).[45)] The original plant in the Canary Islands used the same distillation/vaporization technology as those in the Middle East, but now most of the plants use reverse-osmosis technology.

Spanish companies operate in regions including South Asia, the Middle East, and North America. One of Europe's largest seawater desalination plants (120,000 m^3/day) is located on the Mediterranean Sea along Spain's southern coast, at Carboneras in Andalusia. It is a reverse-osmosis plant, and represents the efforts of some of the top Spanish firms in the field, both in Spain and around the world. In 2009 the largest seawater desalination plant in Europe was installed at El Plat del Llobregat, close to Barcelona, with a capacity of 200,000 m^3/day, it is operated under an agreement with a French company, Degrémont.[46)] The plant supplies 20% of Barcelona's drinking water.

The Spanish companies that provide a wide variety of parts for desalination plants have improved both cost and efficiency. Research continues in the Canary Islands for ways to couple desalination with renewable energy to provide sustainable, ecological solutions for communities in developing countries.[47)] The government of Spain supports desalination as a method of dealing with water

42) http://www.oecd-ilibrary.org/science-and-technology/gross-domestic-expenditure-on-r-d_2075843x-table1
43) http://en.wikipedia.org/wiki/Solar_power_by_country
44) http://en.wikipedia.org/wiki/Solar_power_by_country
45) http://www.waterworld.com/articles/2013/10/global-desalination-capacity-tops-80-million-cubic-meters-per-day.html
46) http://www.degremont.com/en/news/barcelona/barcelona-the-largest-desalination-plant-in-europe/
47) MIT Technology Review

scarcity, particularly since the plans to divert the Ebro River from the water-rich north to supply the water-short regions along the southern coast were shelved in 2004. Farmers, communities, and environmentalists objected that the diversion would have a serious environmental impact on the Ebro and its delta, on the farmland in the north, and along the hundreds of miles of planned pipeline. Thus, when the new government put the water transfer plan on hold in 2004, it drew up a new plan that would supply water to the south by building 20 new desalination plants along the Mediterranean coast where needs are highest, focusing on the region in the south.

One of the main challenges that remains with the desalination process is the cost of the energy required to produce freshwater, particularly with membrane technology. In the last 30 years, the amount of energy required for desalination has fallen precipitously, along with it the price. Even today, however, the cost of that energy makes up about 40% of the total cost to produce each cubic meter of water.

1-5-4. Technical Institutes and Universities in the Ebro Region

The Ebro River Basin region has some of the top institutions for science and technology in the country, including 23 universities, many technical and engineering centers, and 27 science and technological parks (*parque científico y tecnológico*).[48] Among the institutions for higher technical studies, if Barcelona is included in the Ebro region, the Ebro River Basin hosted 25% of the total students in science and engineering. In 2010-11 almost 120,000 students were enrolled (a decrease from previous years) while 22,930 ended their studies that year.

With broad expertise concerning water and the environment, the Ebro region has become the center of water resources training and development. This has been recognized by the United Nations, which located the UN-Water Decade Program on Advocacy and Communications in Zaragoza. From June to September 2008, Zaragoza was the site of an International Exposition with the theme of "Water and Sustainable Development" in order to bring attention to the International Decade for Action, 'Water For Life', 2005-2015.

Zaragoza, a town of 680,000 (2012) people in the middle of the Ebro Valley, already had a reputation as a center for good practices in water use. In 1997, the city made a first attempt to use new technologies to maintain people's quality of life during the dry months. As Spain joined the European Union, it was given the chance to have a full-scale project financed by the program[49], in which 50 publicly-owned buildings were chosen as models to show how water-saving technologies can be put to work.[50] As water rates started to rise, people began to realize the significance of these new technologies. The program cooperated with local businesses that sold their products and ideas through the NGO Fundación Ecología y Desarollo.[51] The waterworks of Zaragoza had commissioned the Fundación to draft a concept that would meet the requirements set out by the EU WFD and that enabled it to compete for funding under the LIFE program.

The government of the autonomous community of Aragón was also asked to provide additional financial support and expertise. A number of private businesses from the banking and water technology areas also contributed, having recognized the long-term economic

48) Association of Science and Technology parks of Spain (APTE) http://www.apte.org/en/index.cfm
49) The LIFE program is the EU's Financial Instrument for the Environment Program: http://ec.europa.eu/environment/life/about/
50) Zaragoza: the Water Saving City, Spain. Best Practice UN-Habitat 2002: http://bestpractices.at/main.php?page=programme/environment/selected_examples/spain_zaragoza&lang=en
51) Fundación Ecología y Desarollo Website

benefits of the project. During the LIFE program, residents of the city were made aware of the many water-saving options while producers, distributors and users of the technologies established the necessary networks. The program triggered a full-scale discussion process and many measures for further education were put into place. All in all 1.17 billion m³ of water were saved in one year through changes in people's habits and new technologies. The city government established a committee of experts from the local water board to coordinate and monitor additional measures of sustainability. A Website was set up to provide up-to-date information (www.ecodes.org).

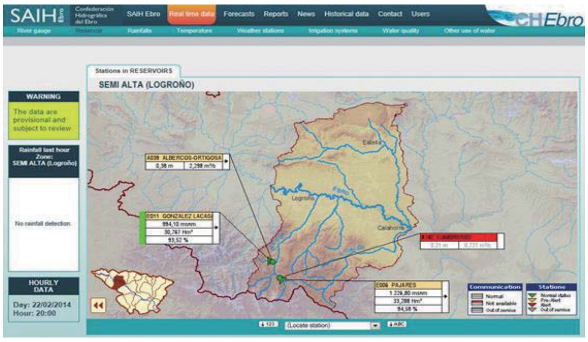
1-5-5. Data Collection and Dissemination

The Ebro Basin Confederation supplies data through the Automatic Hydrological information System (SAIH) of the Ebro River Basin.The application provides real time data about the hydrological situation, gathered from: gauging stations (levels and river flows in the basin); reservoirs (levels, volumes and water filled percentage); irrigation systems (levels and flows in the irrigation channels); weather stations (pressure, temperature, wind speed and direction, solar radiation); precipitation (rainfall intensity and accumulated rainfall data in different times); air temperature; and hydrological forecasts (flow discharge forecasts for the rivers of the basin); other water uses; and interesting news.

Source: Javier del Valle Melendo

<Picture 3> SAIH Ebro Control Center

The information, which is updated in real time (hourly data for the general public and every quarter of an hour for the registered users), is shown through geographical maps (the whole basin or a specific piece of it) and in a numerical form in tables. It provides detailed information for more than 700 stations that complete the network (location, station sensors, images, schemes). The system is illustrated in Figure 16.



Source: SAIHEbro: http://www.saihebro.com/saihebro/index.php?url=/datos/introduccion

<Figure 16> Automatic Hydrological Information System (SAIH) of the Ebro River Basin

It also shows trend lines for the different measurements as well as its numerical values. It contains a search engine in order to get the best access to the information by entering the station code or name.

1-5-6. Effects of Technical Factors

The SAIH information system is considered one of the best accomplishments of the Ebro planning process. It provides high quality information in real time to enable citizens to prepare for floods, droughts or other challenging situations. The location of technical institutes and universities in the Ebro region has enabled it to become a world leader in water resources planning and management.

1-6. Concluding Remarks

Spain is a high-income country with sophisticated systems of agriculture, industry and high technology innovations in water-saving devices, water planning and management. It also has a very decentralized system of government that emerged after the highly centralized system under dictator Francisco Franco was abolished. The 1978 constitution created the autonomous communities, which fit in well with the river basin management model.

Spain suffered considerably from the economic shocks in 2008 that undermined its fast-growing economy and halted the expansion of its construction industry and the housing boom. While it is slowly emerging from the recession, Spain has started to grow again, particularly its service sector, fuelled by tourism and exports. To keep the momentum going, reliable water supply is essential. In fact, throughout the period the Ebro region's experience and expertise with water-saving technology and sound planning helped the region weather the economic downturns during the recession.

The process of focusing on water management and improving river quality had already started around 1990, following the adoption of the 1985 Water Act and a series of Environmental Directives, and the impulse to begin modernizing irrigation started in the late 1990s. In 2004 after the government shelved the proposal for large-scale water transfers of the Ebro River from the water-rich north to the water-starved south, it became of paramount importance to manage the water of the Ebro basin very carefully. Thus, besides promoting desalination for some urban communities along the southern coasts, the people living in the Ebro Basin needed to adopt even more water-saving measures – low water-using irrigation systems, reuse of wastewater and managing demand. This became even more important in light of the WFD imperative to achieve good ecological status for all water bodies. The Ebro set a goal of reaching good status in 83% of the water bodies by 2015. The story of this case study is about how the people of this region are working together to protect their river ecosystems, improve economic growth, and enhance human welfare at the same time. They are involved as stakeholders in this effort to manage water resources supply and demand better and to provide reliable supplies to meet the competing demands of agriculture, industry, human well-being, and the ecosystem.

2. Water Governance and Institutions

2-1. The EU Water Framework Directive[52)]

The EU Water Framework Directive (2000/60/EC of the European Parliament and of the Council) established a framework for Community action in the field of water policy. The Water Framework Directive or WFD was adopted on 23 October 2000. The key aims of the WFD are:

- Expanding the scope of water protection to all waters, surface waters and groundwater: general protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water;
- Achieving "good status" for all waters by a set deadline (2015). Good ecological status is defined in terms of the quality of the biological community, the hydrological characteristics, and the chemical characteristics. Setting the objectives implies a combined approach of emission limit values and quality standards;
- Water management based on river basins, the natural geographical and hydrological unit;
- Getting the prices right: Member States will be required to ensure that the price charged to water consumers - such as for the abstraction and distribution of fresh water and the collection and treatment of wastewater - reflects the true costs;
- Getting the citizen involved more closely through a Public Participation process, so balancing the interests of citizens, interested parties and non-governmental

52) Main Source: The EU Water Framework Directive - integrated river basin management for Europe - Environment - European Commission

organisations (NGOs) and improving enforceability; and

- Streamlining legislation as it rationalizes the Community's water legislation by replacing seven of the "first wave" directives.

The River Basin Management Plan (RBMP) is conceived as a detailed account of how the objectives (ecological status, quantitative status, chemical status, and protected area objectives) are to be reached within the timescale required. The plan will include all the results of the above analysis:

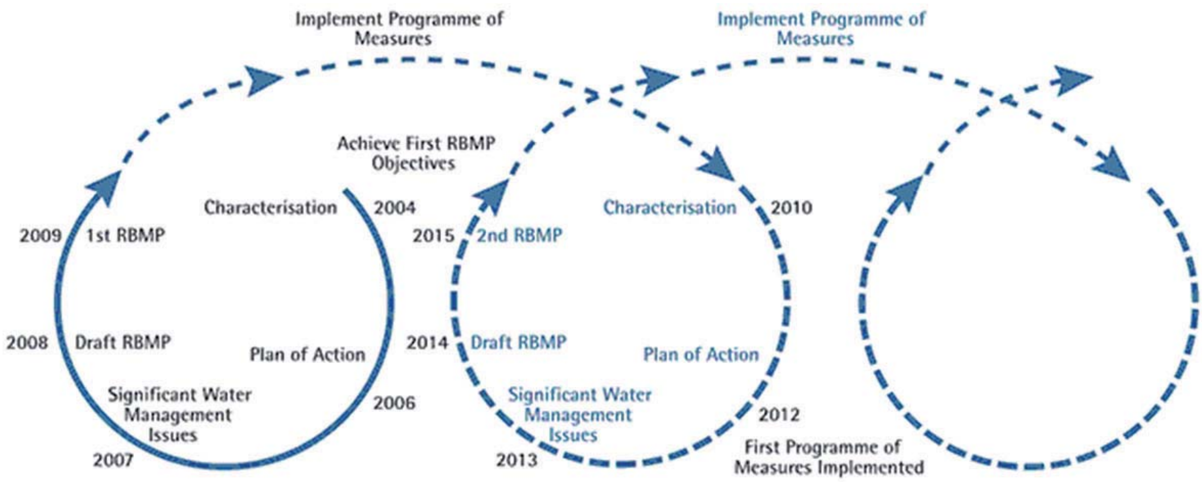
- The river basin's characteristics;
- A review of the impact of human activity on the status of waters in the basin;
- An estimation of the effect of existing legislation and the remaining “gap” to meeting these objectives;
- An economic analysis of water use within the river basin to feed a rational discussion on the cost-effectiveness of the various possible measures; and
- A set of measures designed to fill the gap, the so-called Program of Measures.

The WFD sets out deadlines for each of the requirements with the following key milestones:

Year	Issue
2000	Directive entered into force
2003	Transposition in national legislation. Identification of River Basin Districts and Authorities
2004	Characterisation of river basin: pressures, impacts and economic analysis
2006	Establishment of monitoring network. Start public consultation (at the latest)
2008	Present draft river basin management plan
2009	Finalize river basin management plan including Progamme of Measures
2010	Introduce pricing policies
2012	Make operational programs of measures
2015	Meet environmental objectives. First management cycle ends. Second river basin management plan & first flood risk management plan[53]
2021	Second management cycle ends
2027	Third management cycle ends, final deadline for meeting objectives

This process is a cyclic one, as illustrated in Figure17.

The environmental objectives set out in the RBMPs under the principle of “no further deterioration of water



Source: Implementing the Water Environment (Water Framework Directive) (Solway Tweed River Basin District) Regulations 2004: River Basin Management Planning in the Solway Tweed River Basin District: Guidance

<Figure17> River Basin Management Planning Process

53) According to Directive 2007/60/EC on the assessment and management of flood risks, which entered into force on 26 November 2007.

bodies” may be understood as basic conditions for a sound and balanced growth. Development options that are not compatible with the preservation of the status of water bodies cannot fall under the concept of "green growth". Alternatively, initiatives that are capable of generating economic growth and social welfare while contributing to the improvement of water status would become paradigmatic actions in favour of green growth.

It must be noted that failure to achieve status or to prevent deterioration in the status of a water body caused by new modifications to the physical characteristics of a surface water body or alterations to the level of groundwater bodies may be accepted if theyare the result of new sustainable human development activities if certain conditions are met. In particular, the beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.

2-2. State-driven Institutions[54)]

Water management in Spain was first institutionalized by the enactment of the first and second water acts of 1866 and 1879. At the end of the 19th century the “regenerationist” movement successfully promoted the idea of state investment in hydraulic infrastructure as a national strategy for modernizing the country. Throughout the first two thirds of the 20thcentury, state regulation of water resources, mostly for irrigation, was the main manifestation of water policy. With the advent of democracy in the 1970s and the 1978 constitution, the creation of the Autonomous Communities led to a new distribution of water management powers between national and regional governments that may be summarized as follows.

2-2-1. Administration and Law

In terms of State/national administration, the Ministry of Agriculture, Food and Environment is responsible for the following areas of water administration: the declaration of state control over continental waters, both surface and ground waters in the public domain, as well as state control over access; the legislation, planning, and granting of government concessions and authorization when waters flow through more than one autonomous community (inter-regional river basins); the proposals for hydraulic works that are declared to be of public interest or to affect more than one autonomous community; and environmental protection legislation and planning. Regarding the water planning process, the Ministry of Agriculture, Food and Environment is responsible for the production, supervision, and review of the National Water Plan and the coordination of RBMPs and other relevant sectoral or regional plans affecting hydrological planning.

Most of these State functions are also embodied in the River Basin Organizations (Confederaciones Hidrográficas) for inter-regional basins.

Autonomous Communities are responsible for: the management of intra-regional riverbasins, specifically for the protection and allocation of water resources, the construction of channels and irrigation infrastructure of regional interest; legislation and management of mineral waters, thermal springs; and shell fishing, aquaculture, and fluvial fishing. In some autonomous communities, the responsibilities include the introduction of legislation on environmental protection and the authorization of intra-regional water transfers. However, there are cross-regional variations as not all autonomous communities

54) *Font, N. and Subirats, j. 2010. Water Management in Spain: The Role of Policy Entrepreneurs in Shaping Change. Ecology and Society*. 15(2): 25. http://www.ecologyandsociety.org/vol15/iss2/art25/; Ministerio de Agricultura, Alimentación y Medio Ambiente: http://www.magrama.gob.es/es/; European Commission. 2012, Nov. Spain: Governance Fact Sheets in *Comparative Study of Pressures and Measures in Major River Basin Management Plans*. http://ec.europa.eu/environment/water/water-framework/implrep2007/pdf/Governance-MS%20fact%20sheets.pdf

have the same type and level of institutional development with regards to water management.

River Basin Districts (RBDs). Spain has 25 RBDs, of which six are international, sharing water courses with France to the northeast —this is the case of the Ebro RBD— and Portugal to the west.

Local administrations, including about 8000 municipalities, are responsible for water supply and sanitation.

The Water Act of 1985 started to move towards a more integrated approach in its conceptualization of the water cycle and the role of water as a basic resource both for human activity and the environment, adapting water policy to a new political, socio-economic, and technological context. Under this Act a first generation of hydrological plans was approved in 1998 by Royal Decree 1664/1998. One year later, the 1985 Water Act was amended by Act 46/1999, opening the door to new inter-basin water transfers, with the subsequent adoption of the National Water Plan through Act 10/2001.

The main legal acts that currently determine water management and administration in Spain are listed below with links to details about their provisions:

Basic Legislation

Royal Decree 1/2001 of 20 July, Consolidated Water Act: Real Decreto Legislativo 1/2001, de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas Ley de Aguas (link). Modificada por Ley 53/2002 (link). Modificada por el artículo 129 de la Ley 62/2003 (link). Modificado por Real Decreto-Ley 4/2007(link)

Law 10/2001 of 5 July on the National Hydrological Plan: Ley 10/2001, de 5 julio del Plan Hidrológico Nacional (link). Modificada por Ley 11/2005 (link)

Hydraulic Public Domain

Royal Decree 849/1986 of 11 April on Water in the Public Domain, modified by RD 995/2, RD 606/2003 and RD 9/2008: Reglamento de Dominio Público Hidráulico (RDPH), aprobado por el Real Decreto 849/86, de 11 de abril, que desarrolla los Títulos preliminar, I, IV, V, VI y VIII de la Ley de Aguas (link). Modificado por el RD 995/2000, (link). Modificado por RD 606/2003 (link). Modificado por RD 9/2008 (link)

Planning

RD 927/1988 of 29 July on regulations related to public administration and planning of wáter resources: Reglamento de la Administración Pública del Agua y de la Planificación Hidrológica, aprobado por el Real Decreto 927/88, de 29 de julio, en desarrollo de los títulos II y III de la Ley de Aguas (link)

Law 9/2006 of 28 April on environmental impact assessments of plans and programs: Ley 9/2006, de 28 de abril, sobre evaluación de los efectos de determinados planes y programas en el medio ambiente (link)

RD 907/2007, de 6 de julio, por el que se aprueba el Reglamento de la Planificación

River Basin/Hidrológica(link)

RD 125/2007 of 2 February on designation of river basin districts: RD 125/2007, de 2 de febrero, por el que se fija el ámbito territorial de las demarcaciones hidrográficas (link). Modificado por RD 29/2011 (link)

RD 126/2007 on composition of Committees of Competent Authorities: RD 126/2007, de 2 de febrero, por el que se regulan la composición, funcionamiento y atribuciones de los comités de autoridades competentes de las demarcaciones hidrográficas con cuencas intercomunitarias (link)

Order ARM/2656/2008 of 10 September on Hydrological Planning instruction: Orden ARM/2656/2008, de 10 de septiembre, por la que se aprueba la Instrucción de Planificación Hidrológica (link). Modificada por Orden ARM/1195/2011 (link).

Spain has encountered considerable delays in finalizing its hydrological plans under the EU WFD. Though they should have been completed in December 2009, most of the plans were approved only during 2013. The Government of Spain just recently approved the Ebro Hydrological Plan on 28 February 2014. However, prior to the final Government approval, the RBD was not impeded from implementing the Program of Measures.

The Program of Measures is the genuine core of the RBMP, built from the convergence of a series of diverse strategies, plans and projects that together should fully respond to the pressures exerted on the water environment and all the competing demands. These diverse strategies and projects have their own pace of development and implementation; however, it is likely that the dramatic budgetary constraints that the Spanish Water Administration has suffered in recent years are far more troubling than the delay in the administrative processing of the plans.

One reason for the lateness of the Spanish Hydrological Plans (the national term for RBMP) is that the obligations arising from the implementation of the WFD are superimposed on others that are specific to the national planning tradition, in particular the building of quantitative balances for resource allocation purposes, including the consideration of environmental flow regimes. These complementary requirements have made the technical work considerably more complicated, and have also led to time-consuming (but valuable) efforts to reach consensus among the various regional and sectoral stakeholders.

Additionally, the procedure for approving the RBMP —as established in the Chapter III of RD 927/1988— is also quite complex and prone to causing delays:

1. A Proposal for a RBMP is drafted after integrating, where appropriate, contributions arising from public consultation.
2. The proposal is subject to review by the Water Council of the RBD [Consejo del Agua de la Demarcación-CAD]. Once CAD is in accordance with the Proposal, and with the agreement of the Committee of Competent Authorities, the Plan is submitted to the Ministry of Agriculture, Food and Environment.
3. The Ministry submits the Plan to the National Water Council that issues a mandatory report.
4. If it receives a positive report, the Ministry presents the Plan to the Government for approval.
5. The Government, by royal decree, approves the Plan in the manner deemed in the general interest.

The planning body at the RBD level is the Water Council [CAD], which is in charge of collecting and providing information and fostering public consultation and active participation. In addition, it can give its opinion on issues of public interest for the RBD, on issues related to water protection and on better planning, allocation and preservation of water resources in the public domain.

Its counterpart at the national level is the National Water Council [Consejo Nacional del Agua-CAN] that is the higher advisory and participation body in the field of water in Spain. Its functions include issuing its opinion on the National Hydrological Plan before being approved by the Government to be sent to the Legislative Chambers and on the Planes Hidrológicos de Cuenca or River Basin Hydrological Plans (PHCs) before being adopted by the Government. It includes representatives of the Spanish State, the Autonomous Communities, the municipalities, the main professional and economic organisations involved in water use, the most relevant trade unions and business organizations at the State level, and environmental NGOs. In this membership the public administration has a dominant position.

2-3. Ebro Basin Institutions and Policy

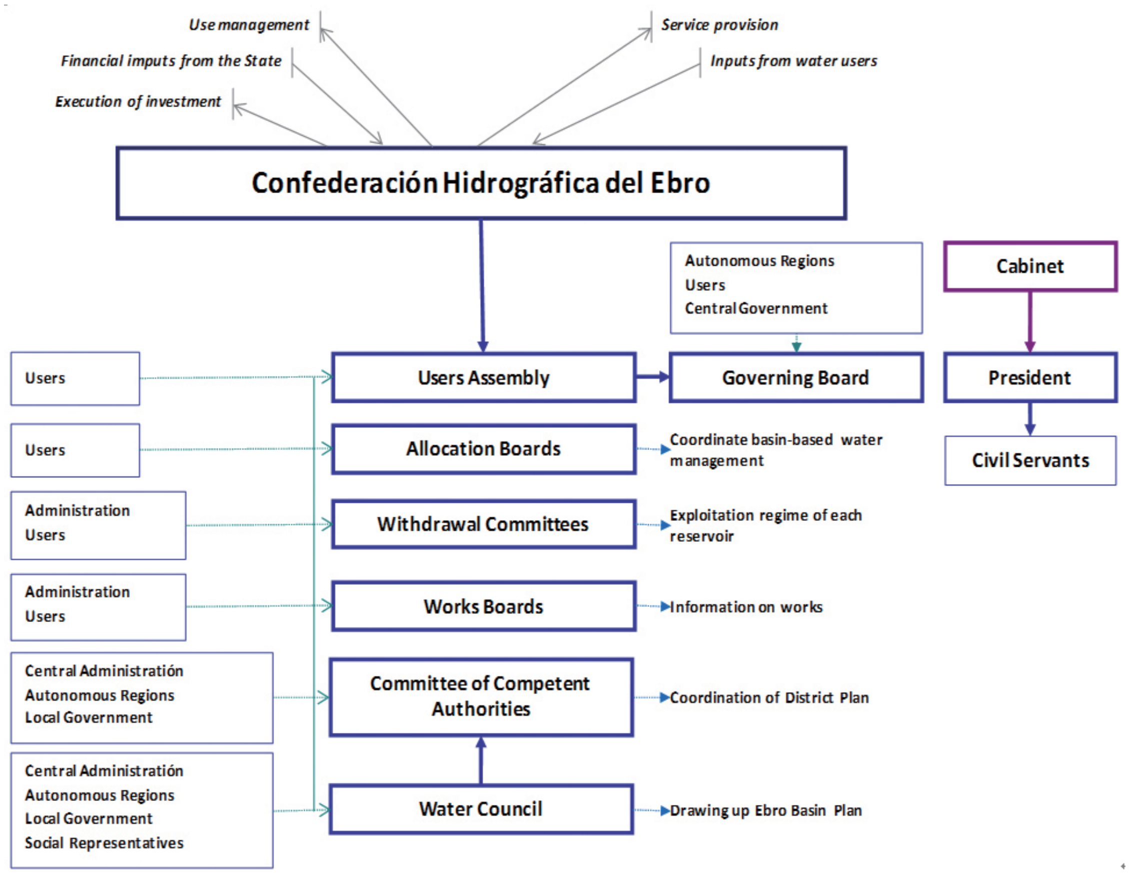
2-3-1. Administration and Institutions[55)]

In Spain, Hydrographic Confederations (or River Basin Confederations) are the main water management bodies that, in the case of inter-regional river basins, are attached to the Ministry of Agriculture, Food and Environment. The legal design of this system as well as the creation of the Confederación Hidrográfica del Ebro (CHE), was made by Royal Decree on 5 March 1926, thus becoming one of the first river basin organizations in the world. In less than two years 1,875 corporations, associations and other bodies were represented in its Assembly.

Plans for hydraulic works and projects followed quickly. Initially focused on the setting up of irrigation systems, industrial development led to the promotion of hydroelectric production, which is still a significant part of the Spanish power mix today. In the 1960s and 1970s, a large number of water supply and sanitation projects were constructed, while recent decades have seen greater complexity in water management and the new challenges arising from compliance with the WFD. The current structure of the CHE is shown in Figure 18.

2-3-2. Policy Framework

The framework for planning and management of the Ebro River Basin is the Program of Measures under the



Source:M. Omedas et al, 2008. River Basin Organizations in the 21st Century

<Figure 18> Organizational Chart of the Confederación Hidrográfica del Ebro (Ebro River Basin Confederation)

55) Omedas, M. et al. 2008. River Basin Organizations in the 21st Century. http://www.chebro.es/contenido.visualizar.do?idContenido=2767&idMenu=2166; and Confederación Hidrográfica del Ebro. http://www.chebro.es/

Hydrological Plan, which has recently been approved by the government. The Program of Measures is formulated in three main groups:

(i) Compliance with environmental objectives, grouping 131 actions intended for the achievement of good status. Of these, 25 actions relate todomestic water supply, 11 to sanitation, five to agro-environmental schemes, seven to point source pollution, 21 to irrigation, 21 to environmental restoration, and 41 to other problems. All these measures are distributed in 22 sub-programs.

(ii) Meeting human water needs includes 104 actions projected for the adequate supply of water to support human activity: two are for domestic water supply, 10 for hydropower, 46 for irrigation, 41 for multipurpose schemes, and five are other. This section includes nine sub-programs.

(iii) Extreme events include 20 measures designed to mitigate the adverse effects of droughts and floods: 6 are related to environmental restoration, three for meeting demands, and 11 other. This group comprises 12 sub-programs.

Management and governance to achieve these objectives will gain strength and social support for the Plan through the exchange of ideas and arguments. A summary of the three areas follows.

Compliance with environmental objectives

One of the main objectives of the Plan is to ensure that up 83% of water bodies achieve good status by 2015. In the current situation, of 926 water bodies in the Ebro basin, the ecological and chemical status in 661 water bodies (71%) is good, while the remaining 265 water bodies (29%) have not achieved good status. Aside from the 83% of river-type water bodies that are expected to achieve good ecological status by 2015, another 12% will need a timeline extension to 2027, and the rest will have less stringent environmental objectives because of their singularities (salt content, thermal component).

There are 11 groundwater bodies (GWBs) with a significant level of extraction where preventative measures and operating rules will be imposed to allow a more rational use of the resources. Currently, 78% of the groundwater bodies are in good status while 22% need an extension to 2027 to achieve good status, as time is needed to control the diffuse pollution. Two GWBs (Urgel and Tarrega) because of specific problems require less stringent objective to be adopted.

Meeting human water needs

The yearly volume of water needed for human supply has been estimated at 480 hm^3 for the whole basin. In recent years, significant investments has been made, most of them associated with improvements in regulation and transport of water, which has benefited about 50% of the population. The main lines of action for the future are:

- The improvement of water quality in areas where the quality of supply is sub-optimal.
- The promotion of joint supply systems, grouping several municipalities and / or population centers.
- The extension of sanitation and wastewater treatment to small population centers, even below 2,000 inhabitants, as well as those in sensitive areas.
- The reduction of phosphorus content in the effluents of some urban areas, draining to sensitive areas.

Regarding irrigation, the Plan includes agricultural plans from the autonomous communities, aiming for consolidation of a competitive agri-food system in the entire Ebro Valley. One of the key challenges is to produce quality raw materials in highly mechanized irrigated areas by promoting new irrigation schemes.

Extreme events

Projections indicate that climate change will exacerbate extreme events and strengthening of water management is necessary to mitigate risks. Regarding flooding, the main activities are aimed at improving SAIH and the flood control decision support (SAD) system, implementing the Directive 2007/60/CE (assessment and management of flood risk) and starting actions for flood protection by establishing flood plains as green infrastructure. Flood management is expected to assume around 15% of the planned investment.

<Box 2> Ebro River Basin Management Plan, 2010-15: 12 Key Elements

1) A socialopportunity to build a system of management that is ethical, efficient and sustainable within the framework of the river basin as a whole, making it the frame of reference for the Ebro.
2) Integrated management, under innovative principles of public participation and a historical cooperative model that includes all stakeholders within the shared authority of the watershed organization.
3) Several ambitious environmental objectives, i.e., at least 83 % of river water bodies will attain good ecological status by 2015.
4) A firm commitment to reducing pollution, both from diffuse agricultural sources and other sources, such as urban centers and industry.
5) A proposal for realistic environmental flow regimes, with targets set for minimum flows, allowing for improvements in habitat conditions. These should be enforceable and verifiable through the monitoring network and main gauging stations.
6) Sustainable development that contributes to strengthening the agro-food processing complex in the Ebro valley, strengthens the role of water as an energy source in a future that relies on renewable sources, and encourages the inclusion of new uses for water, such as recreation.
7) The modernization of irrigation as a necessary action for efficient water management and a reduction in diffuse pollution.
8) Balanced allocation of resources, maintaining the current water consumption of around 34% of the long-term available natural water resources through 2015 and beyond.
9) Participation is seen as the cornerstone -- from start to finish, and from bottom to top. The Ebro River Basin Water Council leads the project, but with a participatory network that reaches all the sub-basins of the main basin.
10) A financial effort shared by all administrative bodies.
11) A commitment to cost recovery through the perspective of socio-economic and territorial balance and targeted rural development programs.
12) Vigilant and adaptive monitoring implemented through extensive networks and procedures to verify the adoption of measures and achievement of objectives.

Souce: Confederación Hidrográfica del Ebro, 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015: http://www.mma.es/secciones/agua/entrada.htm.: Summary Document version 2.03 (English), 2011.

Regarding drought, the Plan includes the "Drought Management Plan of the Ebro Basin" with indicators and thresholds establishing onset, ending, and severity levels for drought events. The Allocation Boards will assess these circumstances, as well as the measures to be taken in each drought phase in order to prevent deterioration of water status and to mitigate negative drought effects. Some structural measures may help to ensure urban water supply and other uses, and to avoid environmental risks posed by drought.

The Ebro River Basin Management Plan 2010–2015 that CHE, the ministry, and the stakeholders have been negotiating for the last four years has 12 key elements that are summarized in Box 2. These describe the essence of a policy for water management in the Ebro Basin. More details can be found in the recently-adopted Hydrological Plan.[56)]

2-3-3. Balance among Government Layers

To implement this Hydrological Plan, CHE has to engage all the stakeholders, including government organizations, autonomous communities, local authorities, private sector, including energy producers and agri-business and representatives of the civil society. The institutions on which representation and participation are based are regulated under Royal Decrees RDs 927/1988 (mentioned above) and 931/1989.[57)]

56) Confederación Hidrográfica del Ebro. 2013. Hydrological Project Plan for the Ebro Basin, 2010-2015. Summary Document Version 2.03 (English), 2011. http://www.mma.es/secciones/agua/entrada.htm

57) Real Decreto 931/1989, de 21 de julio, por el que se constituye el organismo de cuenca Confederación Hidrográfica del Ebro. Modificado por el RD 312/2001

The balance of power within the CHE may be roughly divided as follows: one third for the users' representatives; one third for the autonomous regions representatives; and one third participation is conducted through a series of bodies:

1. Governing bodies: President and Governing Board;
2. Management bodies: Users Assembly, Allocation Boards, Withdrawal Committees and Works Boards;
3. Participation and Planning: Water Council; and
4. Cooperation and collaboration: Committee of Competent Authorities.

The President is the legal representative of the CHE, providing leadership and coordination and exercising executive and management functions. His appointment and dismissal depends on the Council of Ministers, after proposal of the Minister of Agriculture, food and Environment.

The Governing Board, whose chairman is President, consists of representatives from Central Government, Autonomous Communities and users. It is responsible, among other things, for discussing and approval of the Action Plan and its annual budget.

The decision-making bodies responsible for management, planning,, and government of the Ebro Hydrographical Confederation, together with their composition and members are outlined below:

The Users' Assembly is comprised of 397 members and represents those users participating at the Allocation Boards. The autonomous regions have 14 members and central government two. Its main functions are:

- To report on the budgets of the Allocation Boards;
- To propose representatives for the Withdrawal Committee;
- To elect a Vice President of the Confederation; and
- To elect one third of the members of the Governing Board.

The Allocation Boards coordinate the allocation of all water works and water resources from interrelated group of rivers, a river, a sub-basin or a hydrogeological unit, and for the river basin as a whole, respecting the existing concessions and users' rights. This is where users of each part of the river basin area are represented; the members of these boards are taken from the users' assembly. The 17 Allocation Boards meet regularly to discuss how to manage the water volume assigned by the Withdrawal Committees. Its primary mission is to coordinate the hydraulic operation with the resources management.

The Withdrawal Committee formulates proposals for filling and releasing water from the reservoirs. The President of the organization has the casting vote when there is no agreement among its members. It is comprised of 66 members, including three members from central government. It also includes representatives of CHE (non-voting), the Ministry of Agriculture, Food and Environment, and the Ministry of Industry, the company "Red Eléctrica Española, SA" (energy distribution) and other users..

The Works Boards are forums that are established at the request of users of a future infrastructure already approved. Expectant users may present suggestions through their representatives while CHE staff informs about the development of the work, fostering a close and transparent management for citizens. The goal is fostering transparent management and sharing decisions of economic importance.

As mentioned above, the Water Council (CAD) is the participation and planning body. It is the forum in which the central government, autonomous communities, organizations, and associations advocate for environmental, economic, and social interests related to water, and users, discuss and coordinate their respective sectoral visions on water planning. The CAD has 90 members: 15 representatives of the central administration; 34 from the Autonomous Communities; three from local entities (municipalities); 32 representatives of users (domestic water supply, irrigation, energy, and others); and six representatives from other organizations (two from agriculture, two environmental, one business, and one union representative). Apart from the President, some members of the CHE technical staff are present, who can speak but do not have a vote. The River Basin Water Council has been created to promote the dissemination of information, and to provide for public consultations and active participation in water planning. The Council is to present the Hydrological Plan project to the government through the Ministry and to report on its status. The membership in the Council is to be established by the Royal Decree and is then to be approved by the Ministry Council.

Souce: Confederación Hidrográfica del Ebro

<Picture 4> Public Participation Meeting, Ebro River Basin

However, there were delays in establishing the Council, and thus it has not been constituted. This is relevant because the Council is key to the planning process as the top of the whole participatory framework. Therefore its constitution and function is essential. Considering that the composition of this new Ebro River Basin Water Council will be similar to the old Ebro River Basin Water Council, and pending the constitution of new Water Council, the former Ebro River Basin Water Council still has a role in monitoring, discussing and validating hydrological planning documents, and activity proposals emerging from the participatory process.

Finally, the Committee of Competent Authorities has been created as a coordinating body for shared responsibility among the State, the autonomous communities and local entities to achieve the objectives of the Water Framework Directive, water protection and the different aspects of water planning. The Hydrological Plan project must have the consent of the Committee of Competent Authorities prior to its submission to the Government. It has 20 members: eight representatives of the Central Government onerepresentative from each of the nine Autonomous Communities of the basin; and three representatives of local entities. In the Ebro River Basin, the Committee was established on 17 October 2008. Thereafter, on October 25, 2010, it was convened to give approval to the Overview of Significant Water Management Issues in accordance with the provisions of Royal Decree 1161/2010.

The Ebro River passes through nine Autonomous Communities: Aragón, Cantabria, Castilla-La Mancha, Castilla y Leon, Catalonia, La Rioja, Navarre, Comunitat Valenciana, and the Basque Country. The main responsibilities conferred to them are:

- Planning, construction and operation of water facilities, irrigation channels, and infrastructure of overriding public interest for the Autonomous Community;
- Mineral and thermal waters; and
- Inland fishing, shell-fishing, and aquaculture.

The autonomous communities have a tendency to request ever-increasing amounts of water for new irrigation projects and often do not take sufficiently into account the ecosystem needs of the river system. Environmentally relevant amendments to the River Basin Management Plan (RBMP) draft are important for the future of the basin; decisions should reflect the interests of the basin as a whole. Thus, the Confederation needs to take all the competing uses into account and ensure that the ecosystem needs of the basin are met.

2-3-4. Regulatory Framework

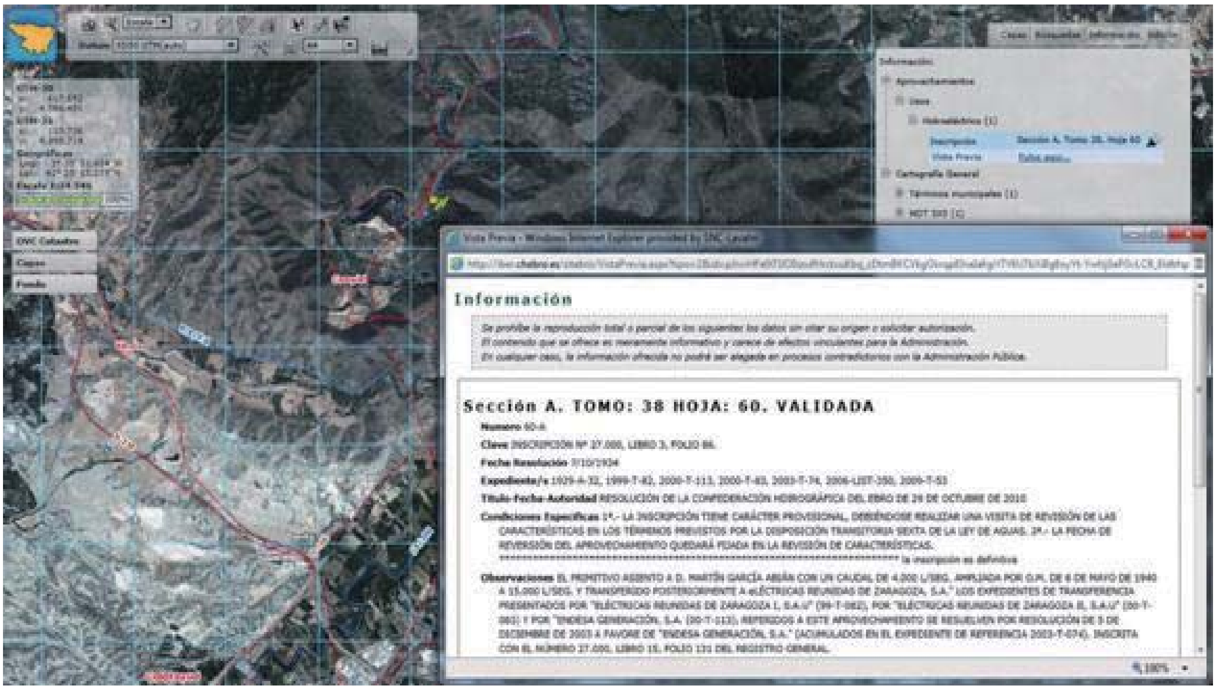
According to Spanish Law, any action or use of public waters—i.e., the use of surface water as it flows through its natural channels for drinking, bathing and other domestic purposes and for watering livestock—is subject to administrative concession, authorization or responsible declaration governed by specific rules. The processing corresponds to the River Basin Authority, such as the CHE.

Spain has launched an ambitious program (ALBERCA) to provide modern, comprehensive and homogeneous, supported by a software tool designed for effective management. It includes updating, homogenization of administrative procedures, modernization of processing tools and a complete characterization of all current uses. This data collection includes the geographical features and spatial references. All collected data have been introduced on a powerful computer system that allows querying and statistical exploitation. This kind of detailed knowledge of water rights is a precondition for effective water allocation and enables better management of resources. In the Ebro webpage, registered data can be accessed through on-line forms or directly into the GIS viewer SITE Ebro (see Figure 19).

2-4. Market-oriented Institutions

2-4-1. Water Rights

Surface water and groundwater have been in the public domain since 1985. In order to be able to use water, users need a license (concesión) from the River Basin Authority. To establish a licensee, there must be a previous water use allocation that is included in the RBMP. A public consultation ensures adverse effects on pre−existing users. Licenses are time-bound and are shorter than 75 years. They are discretionary, and they must be justified as compatible with the RBMP (i.e., no adverse effects on existing users or environmental flows). The granted water must remain ascribed to the uses specified in the license and in the case of irrigation, to the land. If necessary, RBO may modify the water source.



Source:http://iber.chebro.es/geoportal/

<Figure 19> Spatial Query on SITE Ebro

The current licensing system has some difficulty in reallocating water resources to new uses. This is a problem particularly in water-scarce regions where available water resources are almost fully allocated. New instruments were introduced with the 1999 Water Act reform: water rights transfer contracts (private temporary agreements) and water rights exchange centers can be used by the RBA for managing drought periods and overexploitation. Information on quantity allocated by type of use or total amount of water is not clearly summarized in planning documents. However, Ebro water licenses may be consulted at: http://iber.chebro.es/sitebro/sitebro.aspx

2-4-2. Companies Operating in the Ebro Basin

Private sector participation has mainly occurred through State Water Corporations that were created from 1997 as a policy instrument to promote hydraulic works, to involve users in the development and operation of water infrastructure, and enhance access to private funding. A series of companies (whose scope was defined on a RBD or regional basis) were created, but after successive mergers in the framework of the restructuring of the public sector, currently there are only three companies dependent on the Ministry of Agriculture, Food, and Environment that may operate in the Ebro Basin.

Acuamed (Aguas de las Cuencas Mediterráneas, S.A.) is the main instrument of the Ministry for the development of the AGUA Program across the river basins draining into the Mediterranean Sea. The purpose of the corporation includes contracting, construction, acquisition and operation of all manner of hydrological public works, in particular works of general public interest that have substituted those previously established in anticipation of water resources transfers. The corporate objectives may be pursued either directly or through shares in the capital stock of companies established or to be established with any of the purposes indicated above.

The most representative work of Acuamed in the Ebro Basin is the “Chemical pollution elimination in the Flix Reservoir” project. The state-owned company is leading this decontamination project - the only one of its kind in the world - with a view to extracting, treating and removing this sludge and reclaiming the Ebro river and its ecosystem for the 800,000 people living in Tarragona province.[58)]

Souce: Acuamed, http://www.decontaminationflix.com/

<Picture 5> Flix Reservoir Decontamination (Treatment Plants and Enclosure Area's Aerial View)

AcuaEs (Aguas de las Cuencas de España SA) is a large player in the construction and management of major water infrastructure. The corporation can operate in collaboration with users and with other public entities such as local government, regional governments or other institutions. In the first case, the execution of hydraulic works requires the prior conclusion of an agreement between AcuaEs and users. The agreement will be determined, inter alia, by the financial arrangements for the project, specifying the financial investment and transaction; and tariffs chargeable to the users for the amortization, operation, maintenance and financing of the

58) Acuamed http://www.decontaminationflix.com/index.php?chlan=eng

Legend: blue: municipal companies; red: main private companies (Grupo AGBAR, FCC and Acciona); grey: other minor private or mixed capital companies
Source: iugua: Las paradojas de la privatización del agua (original source: elmundo)

<Figure 20> Suppliers of Water to the Provincial Capitals

work. The formulae must guarantee payment by users. AcuaEs is currently working on a variety of measures included in the Ebro Hydrological Plan, including irrigation projects, regulation infrastructure, major irrigation channels and domestic water supply schemes.

SEIASA (Sociedad Estatal De Infraestructuras Agrarias, S.A) is the main instrument for the execution of works of irrigation modernization and consolidation that are declared of public interest and included in the National Irrigation Plan. In addition, some Autonomous Communities (Cataluña, Navarra) also have public corporations to promote the development of water infrastructure, mainly for irrigation.

At the municipal level, the management of the water cycle (supply, sewerage, and sanitation) is a municipal responsibility that may be granted to public, private or mixed capital companies. In most of the main cities of the Ebro RBD (Zaragoza, Huesca, Pamplona, Logroño, and Vitoria), water management is in the hands of public companies, although nationally that is not the majority choice, given that only 19 of 50 provincial capitals have a public management model. This is shown in Figure 20.

2-4-3. Private Sector in Energy Production

Water is now widely recognized as a key driver of energy policy, not only by the importance of hydroelectricity in domestic production, but also because of the need for a secure water supply for cooling thermal power plants. Current energy planning (2008-16) is mostly indicative, as much of the energy production is in private hands. There is no restriction on new facilities as a consequence of energy policy planning. However, the installation of power plants remains subject to prior administrative approval that in turn depends on objective and regulated criteria such as those related to the security of facilities, environmental protection or land planning. On the other hand, transportation networks are still regulated under binding state planning.

2-4-4. Private Sector Contributions to Irrigation Efficiency

The private sector has also been at the forefront in producing water-saving irrigation technologies. The Spanish Water and Irrigation Manufacturers Association (Asociación de Fabricantes de Agua y Riego Españoles or AFRE) was created in 1998 as a non-profit national association which represents, promotes, and develops Spanish irrigation technologies.[59] An Irrigation Congress was held as part of the 2008 Expo in Zaragoza in June 2008 and an International Forum on Spanish Water Technology was held in Zaragoza in March 2012. AFRE was one of the organizers of both events.

Source: Javier del Valle Melendo

<Picture 6> Drip Irrigation in the Ebro Valley

AFRE currently includes 43 manufacturing members and 38 other organizations in the water technology sector (installation and engineering companies, technology centers, media, institutions, public administrations and associations) members. All AFRE members have factories located in Spain, and some have production centers in other EU countries and in other regions. The Association is based in Valencia.

AFRE coordinates the Spanish Water and Irrigation Technology Platform, a forum for public-private partnerships to cooperate in research and development of improved water and irrigation technology and to promote the leading role of Spanish and European technology throughout the world. The Platform was created as a co-operative project by AFRE with the participation of the Spanish Association of Water Supply and Treatment (AEAS), the Association for Water Treatment Technology (ATTA), the Association of Electronic, IT and Telecom Companies (AETIC), The Spanish Association of Water Treatment and Control Companies, the Spanish Association of Engineering, Consulting and Technology Services Companies and the public company TRAGSA together with numerous research centers and universities. The Platform is supported by the Ministry of Science and Innovation, the Ministry of Agriculture, Food and Environment and the Ministry of Industry, Tourism and Commerce.

2-5. Community-centered Institutions

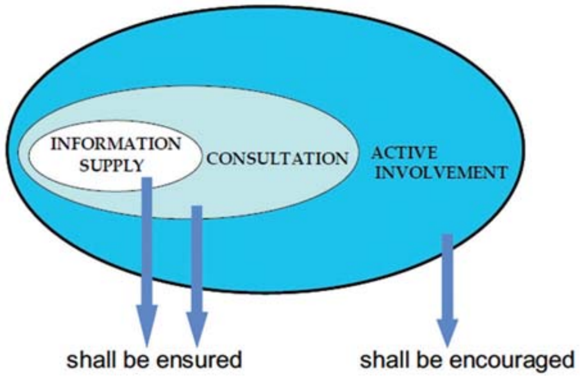
The Water Act regulates the internal organization of local water supply through statutes that once approved by the users, should be submitted for administrative approval to the river basin confederation. Statutes must include the purpose and the location where the public water supply can be used, the representation and participation of users in decision-making bodies, such as a general committee or assembly, a governing committee or irrigators' juries. All the users have to contribute to pay a tariff in adequate proportion to the common expenses of the distribution, operation and maintenance and repair and improvement. The payment of debts or fines is enforced, and non-payment can result in interruption of water supply until the debts are paid.

The local authoritiesare responsible for water supply and sanitation as determined by Law 7/1985 [Ley 7/1985, de 2 de abril, Reguladora de las Bases del Régimen Local

59) http://www.agriculturasostenible.org/v_portal/informacion/informacionver.asp?cod=1389&te=388&idage=1741

(link)]. To fulfil their functions, they rely on technical and financial support from the agencies of the central government and/or various entities or public companies from the Autonomous Communities. The Central Government will only intervene in case of actions of national Interest and after agreement with the local entity.

By legal force, water users sharing the same intake or concession shall organize themselves into “Users Communities”. When the water is used only for irrigation, these communities are named “Irrigators Communities”; there are more than 3,000 in the Ebro basin. The major challenges in this regard are to ensure that groundwater users set up a community to achieve a rational and sustainable use of the aquifer, both in terms of quality and quantity.



Source: Guidance document n.o 8. Public Participation in relation to the Water Framework Directive

<Figure 21> Levels of Public Participation

WFD gives public participation a fundamental role in the achievement of its objectives. Three levels of participation are differentiated: access to information useful to society; public consultation of documents and opportunity to make comments and suggestion for amendments; and active participation of the concerned actors (stakeholders) and users. The three levels are illustrated in Figure 21.

The level of active involvement has been particularly promoted in the Ebro Basin at different levels of action, as follows:

A working group of 13 experts from academia was created, covering various technical and scientific specialties and geographical knowledge. These experts prepared reports on specific topics that were used during the stage of identification of specific water management issues, and also contributed to defining strategies under the Plan. In addition, several meetings were held between the working group and technical staff from the CHE to encourage discussion and exchange of ideas.

Stakeholders’ participation at the basin level was achieved through convening meetings of representatives of the main economic activities and citizens’ groups, ensuring the presence of various competing sectors. At this overall level of participation, 16 meetings and/or sectoral forums have been conducted with a total of 245 attendees.

Souce: Confederación Hidrográfica del Ebro

<Picture 7 and 8> Meetings with Representatives of Recreational Activities Sector (Left, 2006) and Energy Sector (Right, 2007)

The major effort was made at the local level, holding up to 107 meetings in 26 sub-basins, involving 2,785 people with representation of civil society and economic stakeholders, irrigators, local authorities, and other public entities and organizations. Around 10,000 proposals and contributions of various kinds were collected either during the meetings or subsequently (459 written proposals were received), that helped building a catalogue of potential measures.

IV. Performance of Water planning and Management in Ebro Basin

In formulating the Program of Measures for the Ebro River Basin Plan, the Confederación Hidrográfica del Ebro (CHE) and its partners drew up the Program of Measures, based on an analysis of the feasibility for each measure from various perspectives:

- Technical: ensuring that the option is effective for the achievement of its specific objectives;
- Environmental: assessing positive and negative impacts and mitigation measures, particularly on protected areas, as well as the expected impact on water body status;
- Financial: assessing revenues and costs throughout the lifetime of the project to obtain some indicators of viability and parameters for cost recovery assessment; and
- Socio-economic: determining social and economic impacts on the community: productivity, income, employment generation, welfare, social acceptance, historical, environmental and cultural heritage, and land planning.

Some of the performance results from the planning and management process are described next.

1. Generic Performance

According to the respondents to the questionnaires, the degree of achievement of the objectives outlined the Ebro River Basin Plan is evaluated as high.

Some factors contributing to the successes of the water management plan were listed as follows:

- Cooperation among users;
- WFD & Spanish Water Act requirements;
- Citizen involvement and compromise from Public Administration;
- Transparency of River Basin Authority (CHE);
- WFD, improvement in control networks, public participation, technical studies; and
- RBD needed a new Plan based on WFD & Water Act. The previous one had become obsolete.

Some factors that may have caused unexpected consequences in the plan's implementation were mentioned as follows:

- Delays caused by conflicts among Autonomous Communities and/or stakeholders, territories and administrations: looking for agreement among all stakeholders can be time consuming and can delay the necessary decision-making. Eventually the Plan will have to be approved with some level of disagreement or compromise; and
- The economic crisis after 2008 caused budget constraints that may retard implementation.

The efficiency of the project administration system is qualified as good, though the implementation has accumulated a significant delay (average estimation, 30 months).

Both input costs and transparency were rated very high.

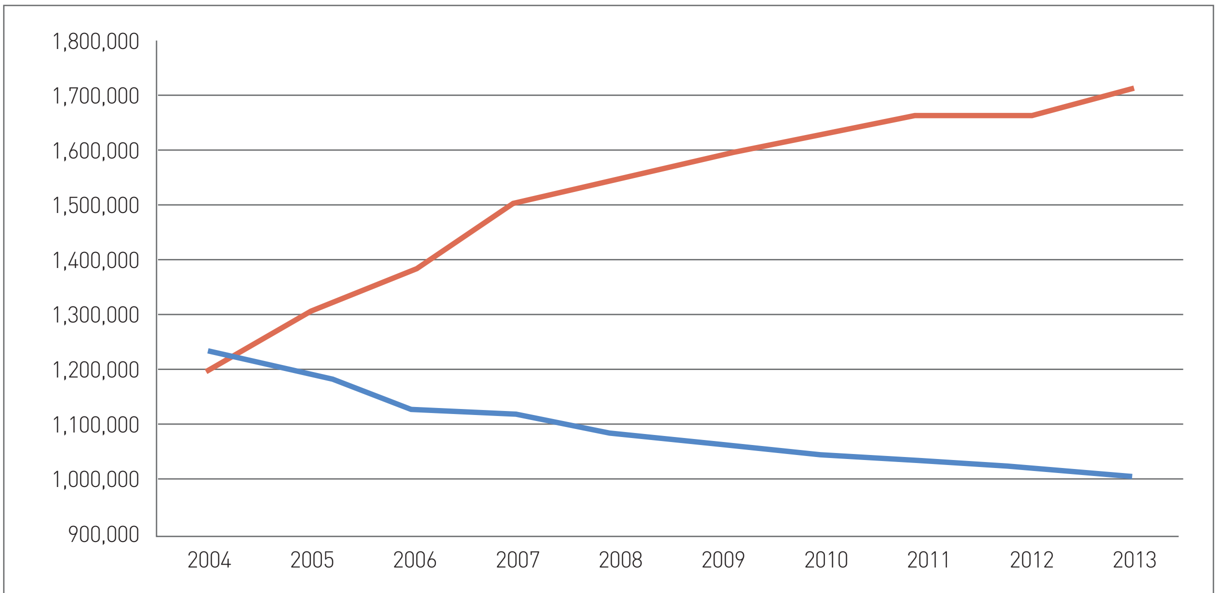
The progressiveness of water institutions based on factors such as effectiveness, flexibility, adaptability, technological applications, innovation, openness to change has been evaluated by some of the respondents:

- CHE has achieved the involvement of stakeholders in decision making, implementation and compliance.
- CHE has an excellent Water Planning Department, also those in charge of hydraulic works and water control. On the other hand, it is not so strong regarding the hydraulic public domain management: it is slow, inefficient and too attached to the rules.
- CHE has provided an example of transparency and of an open attitude to the different stakeholders involved in the case study. It has done an excellent job in transmission of information, collaboration with other administration levels, and respect for user rights.
- The water administration already had experience in planning and implementation of IWRM. The EU Water Framework Directive has introduced a paradigm shift that CHE has tried to incorporate into its new Hydrological Plan. It has given due weight to completing of regulatory structures, even though some conflicts with environmental objectives remain.

2. Economic Performance

Although significant progress has been made, the coordination of agricultural, land use, energy, and other sector policies in the water policy framework has not been achieved. Around 70% of the new irrigation areas proposed in the 1998-2008 planning period were carried out. Many irrigation expansion projects are still pending for implementation or under study, and some of them have been implemented but unable to achieve their objectives due to a lack of sufficient water resources. The importance of sustainable water management and environmental conservation is increasingly being recognised and accepted, in contrast to the sole promotion of local development.

The investment cost of the program of measures amounted to €4,800 million. Over 57% of this amount, equivalent, to €2750 million, is dedicated to measures intended to meet environmental goals, 34% (€1,627 million euros) corresponds to actions for meeting human water needs and 9% (€422 million) to measures related to extreme events.



Source:Informe sobre regadíos en España 2013 (MAGRAMA)

<Figure 22> Evolution of Irrigated Surface (ha) in Spain (in blue, traditional surface systems; in red: drip irrigation)

2-1. Improved Efficiency in Irrigation

The Ebro Valley generates around one fifth of agricultural and agri-business production in Spain. Irrigation facilitates the diversification and intensification of crops: winter cereals, fodder, corn, fruit, vegetables and rice. The effectively irrigated area is around 700,000 ha out of a total 950,000 ha with water rights.

Irrigation is undergoing a remarkable modernization and conversion. Modernization has been a political priority for more than a decade, starting with the Plan Nacional de Regadíos (National Irrigation Plan, 2002) and further consolidated with an additional Plan de Choque de Modernización de Regadíos (Emergency Plan for the Modernization of Irrigated Areas, 2007). The result is a substantial increase in drip irrigation (500,000 ha in 10 years) throughout Spain, as seen in Figure 22.

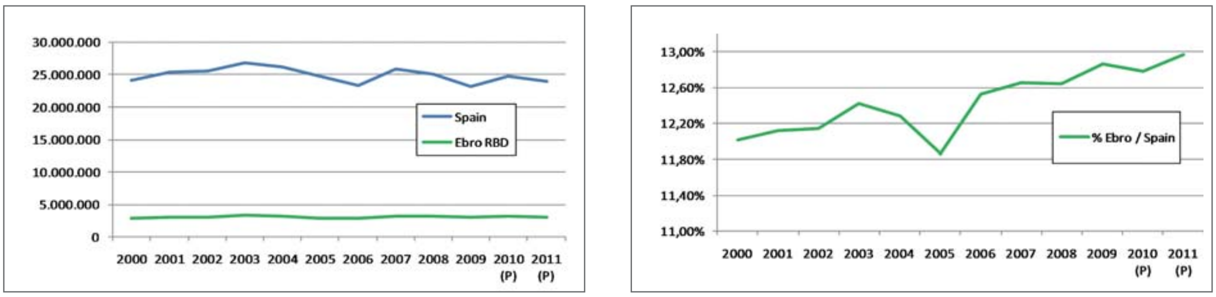
When drip or sprinkler irrigation is adopted, water savings at plot level may be substantial (no proper estimation may be found in the RBMP). At basin scale, if there is consequent intensification of the productive strategy (more demanding crops), the effect of the modernization may be that evapotranspiration increases and water flowing through the hydrological system decreases.

The trend to increase sprinkler and drip irrigation as a percentage of the totalis similar in the Ebro Basin, as can be seen in Table 4.

<Table 4> Percentage of Irrigation from Drip, Sprinkler and Surface Water Systems in the Ebro River Basin District

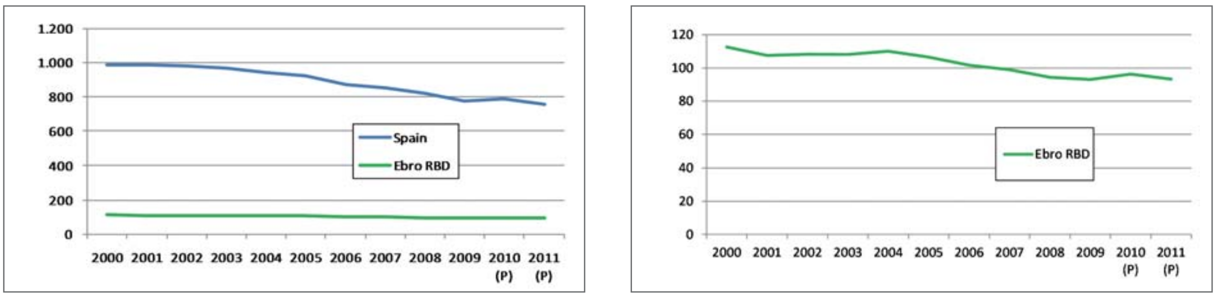
	Census 1999	Census 2009
Sprinkler irrigation	19%	25%
Drip irrigation	11%	20%
Surface irrigation	69%	55%

Agriculture in the Ebro region has performed better than in the rest of the country over the past decade. In the context of economic stagnation, the Ebro Valley has responded better, both in terms of production and employment. Average GDP in agriculture for the latest three-year period (2009-11) is around €3,100 million per year, which represents an increase of 1.8% over the triennium 2000-02, while at the national level, the agriculture sector declined by 4.3% over the same period (see Figure 23). On the other hand,the reduction in agricultural employment was significantly smaller: 14%



Source: Author's elaboration from INE data

<Figure 23> Agriculture, Forestry, and Fishing: GDP at Market Prices (Thousands of Euros) and Ebro as Percentage of Total



<Figure 24> Changes in Employment in Agriculture, Forestry, and Fisheries, Spain and Ebro RBD

against 21% in Spain as a whole (see Figure 24). The decline in employment in agriculture is part of the long-term trend of moving the economy towards the service sector. The combination of these trends results in a greater weight of Ebro agriculture in the Spanish context: 12.9% in terms of production and 12.2% in terms of employment. Moreover the apparent productivity of the labor force (GDP/employment) is also substantially higher, reaching more that €32,000 in the last triennium (18.4% more than a decade ago).

Though difficult to isolate from other factors, it is clear that massive modernization of the irrigation systems must have played a substantial role in the good performance of agriculture in the Ebro Valley, providing stability of production and income, largely supported by the reliability of supply of irrigation.

The Ebro Hydrological Plan is clearly committed to the continuation of this strategy. Most of the 46 actions related to irrigation that have been included in the Program of Measures have a component of gaining efficiency. Water savings in the distribution networks also reduce pollutants being transported in the drainage water from reaching aquatic ecosystems.

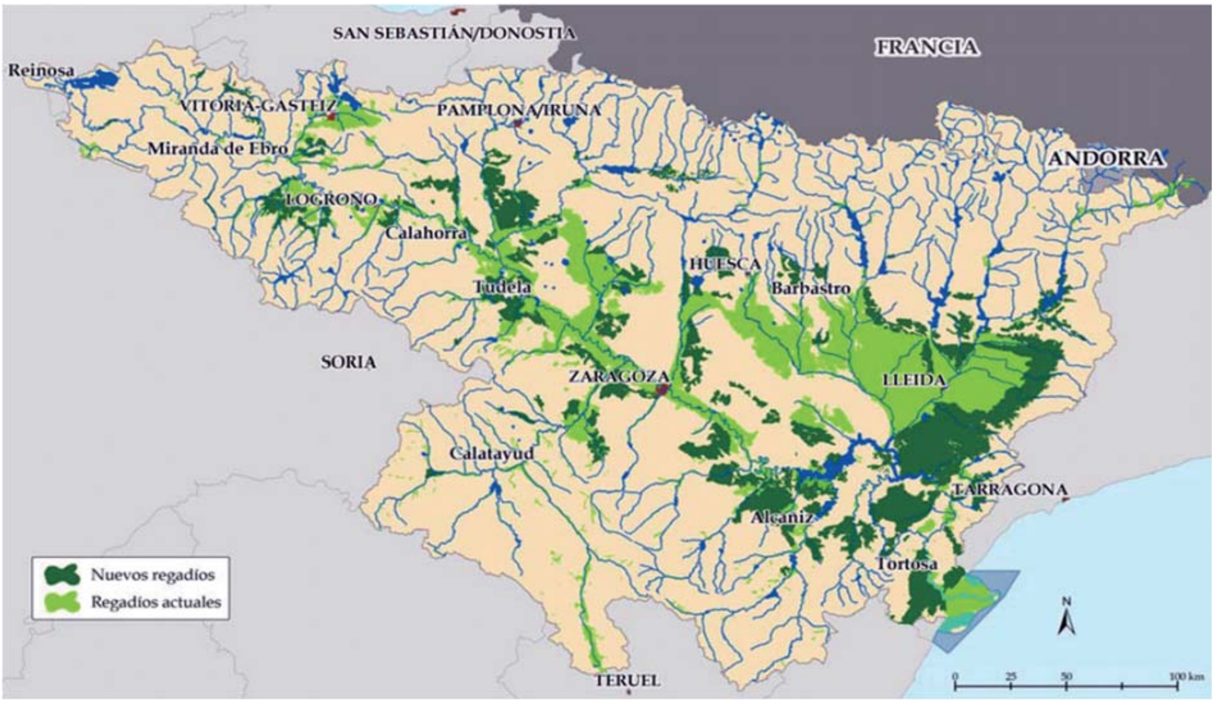
While improving the technical efficiency in irrigation is not the only measure to increase water efficiency, it has a major impact on the improvement of overall water use in agriculture.

Technological adaptation and best practices are critical. From a regional and environmental perspective, the key is to reduce the load of diffuse pollutants exported. Inefficient systems impact water quality and associated ecosystems because of return flows that contain excess nutrients (primarily nitrogen), causing soil leaching of salts and pesticides. Improving irrigation efficiency reduces irrigation return flows and contributes to eliminating or significantly reducing diffuse pollution. Reducing the return flows by improving irrigation techniques tends to increase the concentration of contaminants in irrigation water effluents, but decreases the total load of contaminants exported to water bodies.

All this contributes to an improvement in the economic and financial efficiency of farms, as well as to water management and benefits to society. During the first decade of the 21st century Spain has made a major effort to modernize its irrigated areas. In the Ebro basin about 30% of all irrigated areas have been modernized. It is expected that by 2015 around 50% of the irrigation systems in the Ebro Basin will have been modernized.

In its assessment of long-term irrigation plans of the Autonomous Communities, including new irrigated areas, the Ebro Hydrological Plan considers water availability and the possible effect the irrigation system might have on the water environment. The plan did not assess the economic, social, and environmental viability of the proposed irrigation schemes, which will have to be proved. In any case, the development of new irrigated areas depends on water availability —and strict compliance with regulations and environmental constraints of any kind.

The food and agriculture complex (agriculture, livestock and food industry) constitutes a fundamental productive axis through the Ebro Valley. The major productive specialties are meat production (cereals +feed + livestock), with 32% of Spanish production, and fresh fruit, with more than 60% of Spanish production. Moreover, the water footprint arising from agro-farming activities in the Ebro Valley goes beyond the area where water is abstracted, and includes the amount of freshwater used for products that are consumed (virtual water) outside the area. Whereas the Ebro Valley has a population of around 3 million inhabitants, it bears the water footprint of an additional 6 million people in the large consumption centers of Madrid, Barcelona, Bilbao, and others who depend on the basin for agro-food products. Spain has a virtual water deficit in agriculture,



Source: Propuesta de Plan Hidrológico de la Cuenca del Ebro (2013)

<Figure 25> Long-term Irrigation Strategy of Autonomous Communities (light green: current irrigated areas; dark green: new areas)

so the Ebro valley is contributing to lower the virtual water deficit of the whole country.

The effectively irrigated area totals approximately 700,000 ha (see Figure 25). Water demand is estimated at 7,623 hm^3 (cubic hectometres or million m^3) annually, while the average flow supplied varies each year. Water demand for livestock is not significant, estimated at 57 hm^3/year. Overall, agricultural activities account for 93.8% of the consumptive water demand of the Ebro River Basin.

The Hydrological Plan has estimated an average yearly deficit of 950 hm^3/year linked to two main causes: insufficient water resources, particularly on the right bank (to the southwest of the Ebro), and regulation and transportation shortfalls on the left bank (toward the mountains). The main irrigation areas with actual or future deficits are: Bardenas, Riegos del Alto Aragón, Canal de Aragón and Catalonia; Riegos de Urgel and Segarra-Garrigas; irrigated land in Jalón, Jiloca and Alfamén-Campo de Cariñena; and Guadalope irrigations.

To reach a balanced water footprint in Spain would involve significant growth of the Ebro food and agriculture industry. This would also be required if FAO's predictions of long-term world food shortages come to pass. Moreover, a potential fossil fuel crisis could involve a rise in demand for energy crops, for which the Ebro Valley has great potential.

The Hydrological Plan sets maximum ceilings for water consumption requested by the long-term planning of the Autonomous Communities, keeping in mind the ecologic status compliance as required by the WFD. These regional proposals and strategies are considered with regard to water availability and the potential to affect the water environment, without assessing their social or economic viability. The latter would have to be analyzed case by case.

A package of policy and management actions have been endorsed as part of the regulatory section of the hydrological plan, including among others: maximum irrigation and livestock water needs; specific conditions for new concessions (assessment of water needs, installation of metering systems, availability of internal regulation); limiting of the concession period to a maximum of 40 years; requirements and general and specific conditions for the use of groundwater; and preferential allocation of water savings to ecological flow improvements.

Currently, 12 regulation works that are included in the Hydrological Plan are under construction in the Ebro River Basin at: Albages, Enciso, El Molino, Mularroya, Nagore, Oroz-Betelu, Las Parras, Santolea (dam enlargement), San Salvador Balsa, Soto Terroba, Valdepatao and Yesa (dam enlargement).

2-2. Sustainability of Hydropower Schemes and Thermal Plants

The Ebro River Basin has an estimated potential energy capacity of 11,500 MW, without considering alternative energy sources. Of the total capacity, 34% is from hydropower, 44% from thermal production, and the remaining 22% from nuclear sources. In terms of the actual contribution to national generating capacity, the Ebro produces 32% of the country's nuclear energy, 21% of its hydropower and 11% of its conventional thermal energy.

The Ebro River Basin has achieved considerable hydroelectric development, both in number of plants (360), and in current installed capacity (almost 4,000 MW). The hydroelectric production involves using some 38,000 hm^3/yr of water, and producing around 9,400 GWh of electricity, with an average productivity of 0.5 kWh/m^3, the highest among all Spanish river basins. The Ebro hydroelectric output is essential and of strategic importance for the power grid in northeastern Spain. This capacity is concentrated on the left bank (toward the Pyrenees mountains)—mainly in Segre River and its tributaries (Cinca, Ésera, and Nogueras)— and in the reservoir systems of the lower Ebro: Mequinenza – Riba-roja – Flix where the three most productive plants in the basin are located. Figure 26 shows all the electricity producing plants in the basin.

Source: Propuesta de Plan Hidrológico de la Cuenca del Ebro (2013)

<Figure 26> Electricity Production Plants in the Ebro RBD (red: thermal; purple: combined cycle; green: nuclear power; yellow: hydropower)

The diversion of water for hydropower generation has an impact on the rivers of the Ebro basin. It causes a decreased flow rate along 990 km of the rivers, and it changes flooding patterns along 315 km. Additionally, the barrier effect of dams disrupts the river and alters fish migration patterns.

At the same time, the availability of hydroelectric dams may help to guarantee minimum river flows downstream. This is the case of the lower Ebro; the dams ensure minimum flows essential for delta maintenance, despite the present degree of human impact. In addition, hydropower in the basin generates 9,400 GWh/year of electricity, saving approximately US $490 million per year in Spain's foreign trade balance. It also reduces emission into the atmosphere of 5.3 million tonsof CO_2/year, 60,000 tons of SO_2/year and 11,190 tons of NOx/year.

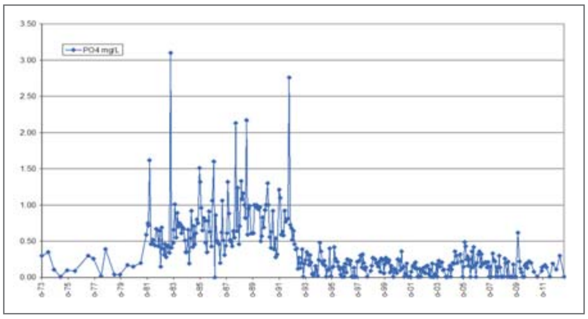
The country's main demand for freshwater for cooling is linked to the nuclear plants in the Ebro RBD, with installed power at 5,430 MW. The main plants use water at Ascó (2,270 hm^3/year) and Santa Mª de Garoña (766 hm^3/year). Both are at risk of not meeting their cooling needs and this imposes rigidity on Ebro operational flows.

The Hydrological Plan includes such policy and management actions as: the promotion of hydroelectric uses in accordance to the Renewable Energy Plan; agreements with irrigation communities for use of hydropower in irrigation systems and the evaluation of energy efficiency in modernization schemes; the resolution of suspended concessions; and modifications for adaptation to environmental flow regimes.

3. Environmental Performance

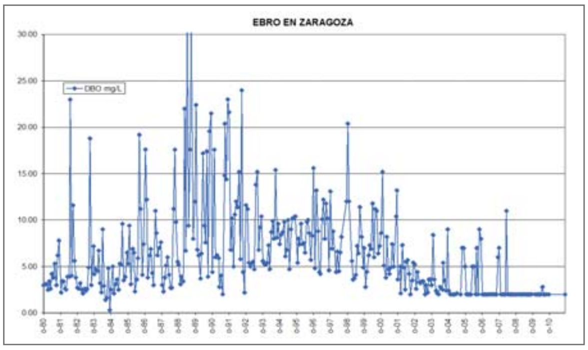
Significant advances have been made in controlling diffuse pollution, mainly through changes in agricultural practices and also through the management of pollution from scattered livestock. In 2008, 74% of the water bodies assessed were already of a good ecological status.

Since water quality monitoring began in the 1960s, a decline in water quality was evident during the following decades. Improvements started in the latter part of the 1990s, especially noticeable for some parameters such as: phosphates, primarily linked to banning of its use in detergents (see Figure 27); and the BOD_5, after systematic implementation of wastewater treatment (see Figure 28). While in 2000 only 50% of the population had access to wastewater treatment, now this ratio has reached 83%. Another significant improvement has been the recovery of natural water pH levels, after correction of the causes of "acid rain" generated by coal-powered plants.



Source: Esquema provisional de Temas Importantes from red CEMAS

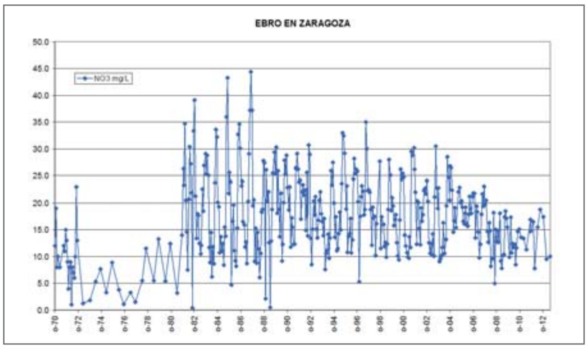
<Figure 27> Phosphate (mg/l PO4) Concentration, Ebro at Zaragoza, 1973-2013



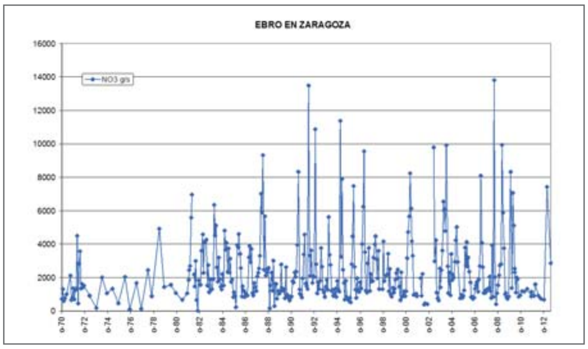
Source: Esquema provisional de Temas Importantes from red CEMAS

<Figure 28> BOD_5(mg/l) Concentration, Ebro at Zaragoza, 1980-2009

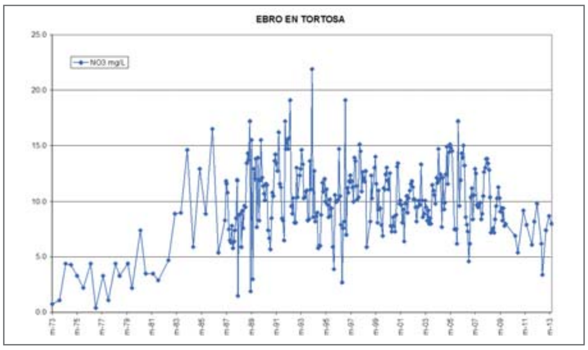
The number of areas subject to official declaration of vulnerable to nitrate pollution has been increasing over the years but it has not been possible to assess clear



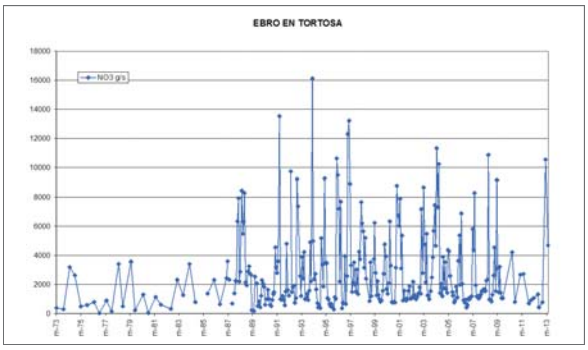
29a. Nitrates concentration (mg/l NO3), Ebro at Zaragoza, 1970-2013



29b. Total amount of NO3 (g/s), Ebro at Zaragoza, 1970-2013



29c. Nitrates concentration (mg/l NO3), Ebro iat Tortosa, 1973-2013



29d. Total amount of NO3 (g/s), Ebro at Tortosa, 1973-2013

Source:Esquema provisional de Temas Importantes from red CEMAS

<Figure 29> Nitrates Concentration at Specific Locations along the Ebro River

trends in the main areas affected by nitrates (see Figure 29). A so-called "Trend Network", recently launched to monitor nitrates and salinity in groundwater, is expected to provide necessary data sets in the forthcoming years.

In the meantime, the Agro-Food Research and Technology Center of Aragón (CITA) has analyzed samples of up to 28 control points in the period 1980-2008, revealing that in 29% there is a positive trend regarding nitrate concentration, while in 93% of the points saline concentration is decreasing. Though there is no conclusive data on the mass of nitrates and other salts exported by the Ebro basin, the pollution load in the medium-low Ebro points to stabilization or even a slight decline, while salts content seems to be growing slowly.

The Basis of the National Strategy for River Restoration has been developed during the last 10 years in parallel to (and in close relationship with) the implementation of the Water Framework Directive and the Directive on the assessment and management of flood risks .The basic principles taken into account may be summarized as follows :[60)]

1. Scientific knowledge on the functioning of river ecosystems must prevail in the management of rivers and the sustainable use of their resources. That knowledge must underpin water planning and regulation of uses in floodplains at the basin scale.
2. The WFD objectives (preventing further deterioration of rivers and 'enhancing and gradually recovering their ecological status') and concepts (ecological quality, biological and hydro-morphological indicators, reference conditions, public involvement) must be included and integrated in any policy related to rivers or the use of their resources.

60) Basis of the National Strategy for River Restoration (Ministry of Agriculture, Food, and Environment, 2010).

3. The characteristics and natural variability of water courses, the traditional use of their resources, the management traditions and inertia within river basin institutions, and also the current demand of Spanish society, more prone to face up to the economic and social costs that may be involved in the restoration and conservation of aquatic ecosystems.

The Basin Organizations have identified numerous projects that would be appropriate for including in this Strategy and are developing and drafting numerous restoration projects that may be looked up on the Webpage of the Ministry. Annex III of the most recent follow-up report on the National Strategy for River Restoration includes tables with the restoration projects in the different RBDs and their current status. Eleven relevant projects are listed for the Ebro RBD, most of them still in process.

Souce: Javier del Valle Melendo

<Picture 9> Flooding in the Ara River, 2007

Only one action — Improvement of lateral connectivity and recovery of riparian vegetation in the lower reach of the Cinca River—has been completed so far and is currently at the monitoring stage.

3-1. Impacts on Environmental Flows

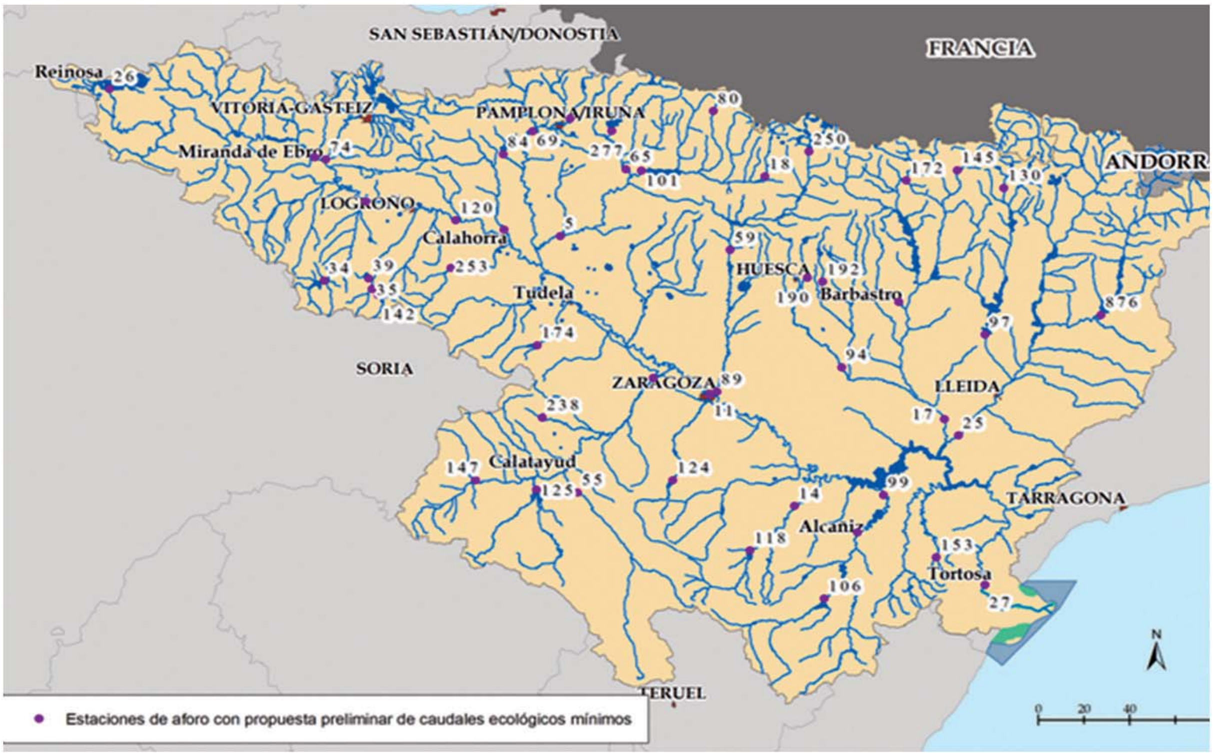
Legislative development in Spain has recently included a major advance in determining environmental flow regimes of rivers. The main milestone is the Hydrological Planning Instruction where environmental flow is defined as "that which helps to achieve good status or good ecological potential in rivers or in transitional waters and maintains at least fish life that naturally inhabit, or could inhabit the river and its riparian vegetation". The establishment of environmental flows will take place in the framework of the Hydrological Plans. Environmental flows will not be regarded as another use, but as a general limitation on operating systems, but subject to the essential needs of water supply for the population.

The process to establish an ecological flow regime must be developed in three stages: (1) development of technical studies; (2) public consultation and active involvement (concertación); and (3) implementation and adaptive monitoring.

For the technical definition of minimum ecological flows, hydrological and biological modelling methods have been applied to a series of river reaches of strategic importance — including sections downstream of the main dams — and, as a result, seasonal flow distribution has been obtained and minimum environmental flows are being implemented in 41 sites (see Figure 30).

The Hydrological Plans have assessed the water allocation by establishing a balance between supply and demand in each one of the basin systems, taking into account water rights and priorities, regulation reservoirs and distribution networks and operation rules, as well as environmental flows, considered a general limitation. The decision support system Aquatool-DMA has been used to integrate all the components.

In addition to minimum flows, and in accordance with the Hydrological Planning Instruction, preliminary technical estimates for other components of the regimes have been made, but additional future work is still needed. These other components are: maximum flows, the flood regime and the rate of change (hydro-peaking conditioning). Further studies for establishing water requirements of lakes and wetlands will also to be made.



Note: In yellow sites out of Natura 2000 Network with an additional minimum flow in the case of drought
Source: Plan Hidrológico de la Cuenca del Ebro (2014):

<Figure 30> Gauging Stations Where Minimum Environmental Flows are Being Implemented

A package of policy and management actions for environmental flows has been included in the regulatory section of the Hydrological Plan. Regimes to be implemented shall be those resulting from the consultation process, once endorsed by the Ebro Water Council. The consultation process will consider water rights, effective uses, and demands.

3-2. Impacts on the Coast and the Ebro Delta

The stretch of coast within the Ebro RBD is small, extending both to north and south boundaries to the point where the delta meets the mainland. However, the influence of the Ebro is enormous, and marine waters affected by the decrease in salinity and increased fertility from the Ebro extend far beyond the limits of the basin's coastline.

The delta coast has a large number of sandy beaches and dunes. These sedimentary formations provide a very broad spectrum of unique characteristics and geomorphologic values, which contribute to one of the most remarkable landscapes of the delta. The delta area is subject to intensive coastal dynamics as a result of movement of sediment by the waves on the coast, and the current inefficiency of rivers in transporting sediment.

Moreover, all the Mediterranean waters around the delta are influenced by the injection of fresh water from the Ebro, markedly in the deltaic bays, and evident in the outer coasts. In the estuary of the Ebro, a saltwater lens intrudes under the flowing freshwater. The strong gradient of salinity, and the fertilization that reaches across the river, lead to a great diversity and abundance of species and fish: sardines, anchovies, pompano, pomfret, bass, rays, and even tuna. The bays are suitable for breeding and for the production of shellfish: mussels, clams, and oysters. However, water quality problems and progressive silting of the bays has affected some species, once abundant but now in clear decline, such as razor fish. The production of mussels has also been affected.

The Ebro Delta itself is the largest wetland area in the basin, covering an area of 320 km^2 and extending out into the sea some 25 km. The area is of great ecological interest and outstanding biological value, as it contains several types of ecosystems such as shallow bays, sandy beaches and dunes, brackish coastal lagoons, salt marshes, freshwater marshes, and ullals (small shallow groundwater-fed gushers). It was declared as a wetland of international importance, listed under the Ramsar Convention, in 1993. The delta hosts 300 protected species and/or threatened species and 23 habitats of Community interest, two of which are of priority interest.

<Picture 10> Fangar Point, Ebro Delta

<Picture 11> Macrophytes in the Ebro Delta

Currently the delta is highly affected by human activity, linked to profound changes in the water regime and its ecosystems. Urban areas and crops (mostly rice) represent 80% of the total area, while only 20% is left to the natural environment. There is a close relationship between freshwater supplied through the channels of the delta and ecosystems, currently dependent on rice cultivation.

All in all, the Ebro Delta is unique in the Ebro river basin. It was transformed completely in the mid-19th century when rice cultivation was introduced, creating since then a special environment where human and natural factors intermingle.

Given this special character, the 1998 Ebro River Basin Management Plan established a constant minimum instream flow of 100 m^3/s, proportionally higher than for the other rivers in the basin. Since then, the flow in the Ebro Delta has not dropped below 100 m^3/s, thanks to the water management plan for the basin.

The new River Basin Management Plan improves the situation, establishing not only a constant flow, but also a controlled flood flow – a monthly environmental flow based on the natural hydrological regime of the river. To define this new environmental flow regime, extensive studies that combine hydrological and habitat methods have been carried out, and more than 100 scientific papers and studies on the delta have been analyzed, along with the various proposals on environmental flows made previously by different entities.

The new Hydrological Plan (2010-15) sets as ecological flow in the delta 20% above the average annual natural run-off to be guaranteed in all cases, even in drought, which represents a formidable achievement for a basin with semi-arid characteristics and high variability such as the Ebro.

4. Social Performance

Public participation has been particularly important for increasing understanding of the trade-offs between the environmental, economic and social objectives that need to be considered in water policy. Water has been key to rural development, for example by providing alternative development opportunities such as rural tourism. These ambitions sometimes conflict with the limited capacity of rural areas to finance their own water management projects or even to pay for the entire cost of the water services they receive. For this reason, with the support of public participation processes, the development of the river basin plan focused on identifying actions with the highest potential for promoting local development in sensitive rural areas. The planning process also assessed and identified low-income areas where social objectives should be prioritized and exceptions to full cost recovery of water prices permitted.

Some actions that will have positive social benefits are included in the Plan:

- Improvement of water quality for domestic water supply. The highest quality water is being produced for human consumption in the larger cities, such as Zaragoza, Huesca and Lleida.
- Extension of sanitation and water treatment throughout the region is in the framework of the plan, pending coverage of minor villages.
- Flood control is supported by information and early warning through SAIH, but also with new systems such as Flood Zone Mapping System and Flood Risk Management plans. These will help minimize the risks of damage to property and persons.
- Enhancement of scenic and landscape values of the water environment, opening possibilities for leisure and recreational uses.
- Improvement of territorial balance by developing irrigated areas in marginal areas and mountain valleys. There are positive support systems for those marginal areas in regard to cost recovery principles.
- Action to alleviate the effects of drought periods, including both management (Drought Management Plans) and strategic measures (regulations and emergency infrastructure).

Some of them are in force (SAIH, Drought Management Plan, new schemes of water supply to main cities), and other ones are in process.

From the social perspective, tensions between economic stakeholders (irrigators, hydroelectric companies) and environmental NGOs will again arise during the implementation stage of some measures. It is also foreseeable that territorial conflicts, largely responsible for the delay in approving the plan, could flare up again.

5. Overall Performance

5-1. Water and Green Growth

Ebro is a semi-arid basin, and water is critical for economic activity and protection of the ecosystem—and the key driver for green growth. At the same time, the magnitude of pressures is relatively low—at least in the Mediterranean context—because of lower population density and less intensive agricultural production than in other areas.

In recent decades, environmental problems linked to the use of water have emerged. By addressing these problems, economic activity has become more sustainable and new positive externalities have appeared. This is the case for irrigation modernization and wastewater treatment, actions that have created new jobs and enhanced economic efficiency.

CHE, one of the oldest RBOs in the world, has shifted emphasis from the design, development and construction of hydraulic structures to water management, where it currently focuses a great part of its activity. One remarkable aspect of water management in the Ebro basin is the long-lasting and strong cooperative structure and particularly, the participation of users in the decision-making processes, a guarantee for the future enforceability of the agreements.

5-2. Measures of the Plan with the Greatest Potential to Generate Green Growth

In the Ebro basin the agri-food complex and its activities are closely linked to water, including irrigation, livestock and agri-business. All measures aimed at improving water use, particularly in irrigation, and at controlling the associated diffuse pollution, are very positive: modernization of irrigation, environmental measures related to agricultural runoff, automation and control of water intakes. These measures are effective both for enhanced productivity (potential new crops, more efficient workforce, and stable water supply) and for environmental improvement (less pollution getting to water ecosystems). Thus the potential to generate green growth is very high.

Also sanitation/sewerage and wastewater treatment —particularly extension to minor villages— are important for human well-being, since water quality improvement can improve health and reinforces the natural and scenic values of the river. This also allows for new recreational activities (sailing, rafting, fishing, adventure tourism). The restoration of rivers, streams and wetlands is also supported by enhanced water quality.

5-3. Technological Innovation

Water administrators are not the direct producers of technology, although they need to generate adequate knowledge to make intelligent decisions.

Administration officials, water experts and users agree in pointing at SAIH as the most transformative innovation. Its effectiveness was tested by two successive floods in the first year of commissioning (1997) and it can be said that the damage avoided in both events served to amortize the entire installation.

The reuse of irrigation return flows saves water and reduces pollutant loads reaching water bodies. The experience of the Bardenas irrigation areamay be highlighted: the water drained by ditchesand full of nitrates is re-pumped back into the canals.

Other examples of technological tools and solutions are: mathematical models for the simulation of water allocation strategies, water quality and quantity modelling, including snow-melt modules, biological quality networks (red CEMAS), and aquifer recharge schemes (Alfamen groundwater body).

5-4. Obstacles

Many measures require significant public investment, and budgetary constraints arising from the economic crisis —or lack of assistance from the government and competent authorities to cope with water planning objectives— cast shadows on compliance of the Program of Measures.

On the other hand, divergence among water policies from the various Autonomous Communities makes it difficult to apply homogeneous criteria under the river basin unity principle.

Moreover, in the late 2000s there was a serious threat of disintegration of the river basin confederation with transfer of powers to the Autonomous Communities (temporarily applied to the Guadalquivir River Basin in Andalusia), but the Constitutional Court reversed this. These tensions, which peaked at a critical moment during the planning process, have been one of the main reasons for the delays in the approval of plans in inter-community basins.

The incomplete cost recovery for water services may also hamper a sound basis for water access, though this is a rather controversial issue among different water experts. This is also true for the valuation of ecosystem services.

5-5. New Measures?

Current water legislation, even though its implementation still needs improvement, is a good instrument for advancing towards cleaner production systems and to generate knowledge and technology to walk in the right direction. More intensive use of economic instruments may be necessary to obtain the required financial support.

Better coordination of water planning with other policies, including energy (more careful consideration of the role of water as an energy vector) and food (placing value on the Ebro role in offsetting the water Spanish footprint) is also considered necessary.

Another aspect is the institutional strengthening of RBOs and river basin management in general. Transcending administrative boundaries through the lens of the natural region of the river basin is much more effective in supporting green growth than a number of fragmented interventions.

Finally, R+D activities are also needed particularly to fill current gaps in knowledge, especially regarding the relationship between pressures and impacts on ecosystems and the effectiveness of the proposed mitigation or correction measures.

V. Lessons Learned and Conclusions

Setting the achievement of a good or fair ecological status of the water bodies as the main objective of river basin management plans in the European Union has been an important element in the Ebro River Basin Management Plan (Hydrological Plan, 2010-15) and has helped make economic development compatible with environmental objectives. Because of the key role played by public participation, the Plan is also focused on social equity, including extending water services to remote and marginal areas. The Hydrological Plan provides a Water and Green Growth framework for the Ebro River Basin.

In 2004 after the government shelved the proposal for large-scale water transfers of the Ebro River from the water-rich north to the water-starved south, it became of paramount importance to manage the water of the Ebro basin very carefully. Thus, the people living in the Ebro Basin have adopted water-saving measures – low water-using irrigation systems, reuse of wastewater and managing demand. This became even more important in light of the WFD imperative to achieve good ecological status for all water bodies. The Ebro set a goal of reaching good status in 83% of the water bodies by 2015, and this status had been achieved in over 71% of surface water bodies and 78% of groundwater bodies by 2011.Improvements in water quality and a more reliable supply have resulted in increases in income, better health and an improved quality of life for people in the Ebro Valley.

Some of the lessons learned and challenges still facing the Ebro River Basin Confederation and its partners as they implement the Hydrological Plan are described below.

Integrated water planning and management have contributed to green growth.

The implementation of the WFD and its incorporation into the Spanish Water Act have expanded the range of actions that support green growth. Actions such as those to protect the environment were already evolving under the Ebro River Basin Confederation (CHE). CHE had experience in integrated water resources management, and the WFD encouraged a paradigm shift that has been incorporated into the current Hydrological Plan. As part of the process, CHE has acquired a multidisciplinary technical staff, and has further opened the planning process to public participation, resulting in a level of ownership by stakeholders.

CHE provides an example of transparency and of an open attitude to the different stakeholders involved in the planning process. The participants appreciate the improved transmission of information, collaboration with other administration levels, and respect for user rights.

The high level of confidence in the Automatic Hydrological Information System (SAIH) mentioned by many respondents has been a major success of the planning process. Now the system will be used for early warning of floods and droughts, as well as for water quality and water allocation purposes.

The river basin planning process has led to a view of economic development, environmental protection and human well-being in a more holistic way. The integration of all actions in the framework of a comprehensive management plan and Program of Measures has resulted in positive improvements in all three areas.

Furthermore, preparation of the Ebro Hydrological Plan has resulted in strengthening the institutions at the river basin and sub-basin levels and has improved water resources management in general. Transcending administrative boundaries through the lens of the natural region of the river basin is much more effective in supporting green growth than a number of fragmented interventions. However, some interest groups continue to lobby for their projects at the expense of others. Compromise is essential in this type of consultative process, and in the larger picture it has had positive results for the Ebro region. This should be instructive to other basins in Spain and around the world.

Measures for promoting green growth need reinforcement.

Spain suffered considerably from the economic shocks in 2008 that undermined its fast-growing economy and halted the expansion of its construction industry and the housing boom. While it is slowly emerging from the recession, Spain has started to grow again, particularly its service sector, fuelled by tourism and exports. To keep the momentum going, reliable water supply is essential. In fact, throughout the period the Ebro region's experience and expertise with water-saving technology and sound planning helped the region weather the economic downturns during the recession.

All measures aimed at improving water use, particularly in irrigation, and at controlling the associated diffuse pollution, are very positive: modernization of irrigation, environmental measures related to agricultural runoff, automation and control of water intakes. These measures are effective both for enhanced productivity (potential new crops, more efficient workforce and stable water supply) and for environmental improvement (less pollution getting to water ecosystems). Thus the potential to generate green growth is very high.

Current water legislation, even though its implementation still needs improvement, is a good instrument for advancing towards cleaner production systems, and for generating knowledge and technology to improve water use efficiency. More intensive use of economic incentives and tariff policy may be necessary to obtain the required financial support and cost recovery.

Technological improvements in modernizing the irrigation systems in the Ebro Valley played a substantial role in the good performance of agriculture in the Ebro Valley, providing stability of production and income, largely supported by a reliable supply of water for irrigation. Modernization has been a political priority for more than a decade, starting with the National Irrigation Plan, 2002 and further consolidated with an additional Emergency Plan for the Modernization of Irrigated Areas, 2007). The result is a substantial increase in drip irrigation (500,000 ha in 10 years) throughout Spain. In the Ebro Basin, private sector companies have been instrumental in developing and disseminating water-saving technologies. Continued involvement of the private sector in promoting water saving practices should be encouraged.

Currently the procedure for approving the River Basin Management Planis very complex and prone to causing delays. It would be useful to examine the possibility for simplifying the process at the basin level. Several reforms are necessary for the proper use of water becoming a key growth factor: administrative simplification and a more rigorous and transparent accounting system; providing signs of water shortages; regulated water markets that allow more efficient uses from the social and economic points of view; an assessment of the environmental services of water and associated ecosystems; and greater public-private participation, properly supervised, and regulated.

Finally, better coordination of water planning with other policies, including energy (more careful consideration of the role of water as an energy vector) and food (placing value on the Ebro role in offsetting the water Spanish footprint) is also considered necessary.

Adequate financial investment and cost recovery are required.

By building large-scale water facilities to support growth in agriculture, manufacturing, energy and provision of drinking water, water policy has played a role as an engine of growth in the region. Indeed the availability of reliable water is perceived as the critical factor underlying both the constraints to and the opportunities for economic growth in the region.

However, the economic crisis after 2008 caused budget constraints that, along with other technical, administrative and political difficulties, delayed and impeded approval and implementation of the Hydrological Plan. Many measures require significant public investment, and budgetary constraints arising from the economic crisis—or lack of assistance from the government and competent authorities to cope with water planning objectives—cast shadows on compliance with the Program of Measures.

Economic self-sufficiency is a key element for water managers in driving the green economy. Another key factor would be the better analysis of the economic, environmental and social consequences of climate change and uncertainty. When a productive activity depends on water, in a scenario of scarcity, it is necessary to know the risks involved, and to have a mechanism for decreasing investments to reduce high risks.

The incomplete cost recovery for water services may also constrain extension of water services to underserved areas. However, it may be necessary to provide support to marginalized areas in the interest of the economic and social well-being of the Ebro Valley as a whole. Territorial balance can be improved by developing irrigated areas in marginal areas and mountain valleys. The Hydrological Plan includes positive support systems for those marginal areas in regard to cost recovery principles. Subsidies for marginal areas and valuation for ecosystem services are still controversial issues among different water experts. Compensation to people living in remote watershed areas for their contributions to ecosystem services might have positive economic, social and environmental results.

Protection of water bodies is essential for green growth.

In recent decades, environmental problems linked to the use of water have emerged. By addressing these problems, economic activity has become more sustainable and new positive externalities have appeared. This is the case for irrigation modernization and wastewater treatment, actions that have created new jobs and enhanced economic efficiency.

Measures aimed at protecting the environment have been effective in controlling diffuse pollution and agricultural runoff. The reduced level of pollution entering water ecosystems enhances the potential to generate green growth.

The environmental objectives set out in the RBMPs and the principle of no further deterioration of water bodies may be understood as basic conditions for a sound and balanced growth. Development options that are not compatible with the preservation of the status of water bodies cannot fall under the concept of "green growth". Alternatively, initiatives that are capable of generating economic growth and social welfare while contributing to the improvement of water status would become paradigmatic actions in this regard.

For the future, more research and development activities will be needed particularly to fill current gaps in knowledge, especially regarding the relationship between pressures and impacts on ecosystems and the effectiveness of the proposed mitigation or correction measures.

Public participation can contribute to local development in rural areas.

WFD gives public participation a fundamental role in the achievement of its objectives. Three levels of differentiation are stated: dissemination of information to society; public examination of documents and opportunity to discuss and suggest amendments; and active participation of the concerned actors (stakeholders) and users.

The level of active involvement has been particularly promoted in the Ebro Basin at different levels of action: scientific expertise, through the establishment of a specific working group to identify major water management issues and contribute to defining strategies of the Plan; stakeholders, by convening representatives of the main economic activities and of citizen's groups; and community, holding more than 100 meetings across the basins, involving almost 3,000 representative of social and economic groups, irrigators, local authorities, and other public entities and organizations.

User communities are supposed to have a say in the type of water supply and sanitation facilities that will be installed and the way they are managed at the local level. The expansion of sanitation, sewerage and wastewater treatment—particularly extension to small and marginalized villages—is important for human well-being, since improved water quality has a positive impact on human health and reinforces the natural and scenic values of the river. Enhanced water quality is essential for restoration of rivers, streams and wetlands, as well as for new recreational activities (sailing, rafting, fishing, adventure tourism).

Public participation has been particularly important for increasing understanding of the trade-offs between the environmental, economic, and social objectives that need to be considered in water policy. Water has been the key to rural development, for example, by providing alternative development opportunities such as rural tourism. These ambitions sometimes conflict with the limited capacity of rural areas to finance their own water management projects or even to pay for the entire cost of the water services they receive. For this reason, with the support of public participation processes, the development of the river basin plan focused on identifying actions with the highest potential for promoting local development in sensitive rural areas. The planning process also assessed and identified low-income areas where social objectives should be prioritized and exceptions to full cost recovery of water prices permitted.

Such local development actions include:

- Flood control measures such as information and early warning systems, flood zone mapping and flood risk management plans. These will help minimize the risks of damage to property and persons;
- Enhancement of scenic and landscape values of the water environment, opening possibilities for leisure and recreational uses; and
- Activities related to water that are expected to expand, such as golf, skiing, adventure sports, recreational boating and fishing.

Ebro leads in technical and economic management tools, but much work remains to be done.

Technical staff and engineers working with the Ebro CHE, and the engineering and consulting firms working in the water sector, have accumulated a great deal of expertise in water management during the past two decades. With broad expertise concerning water and the environment, the Ebro region has become the center of water resources training and development. This has been recognized by the United Nations, which located the UN-Water Decade Program on Advocacy and Communications in Zaragoza. From June to September 2008 Zaragoza was the site of an International Exposition on "Water and Sustainable Development", and the region has established a large number of technical institutes and science and technology parks.

Water administrators are not the direct producers of technology, although they need good technology to generate adequate knowledge to make intelligent decisions. In this sense, spatial data infrastructures, monitoring systems in real time, using satellite imagery, numerical simulation models, and decision support systems have led Spain to occupy a privileged place in the world in terms of planning and integrated water resources management systems within the physical framework of the river basin. Moreover, water scarcity has also contributed to improving and modernizing irrigation and food production, improvements in industrial processes and in human supply. However much work remains to be done.

The hydrological plans should generate technological innovation and growth in the green economy. It would be useful to assess the cost-effectiveness of the measures and action plans. This analysis would lead to a selective process of the most effective and economical technologies to reduce pollution, and would generate competition among companies to find solutions to solve the main problems of the basin. This is already happening, but it would be desirable to expand it. The experience of this planning process should accelerate this type of analysis leading to green growth.

The lack of adequate tools of economic analysis and knowledge gaps relating to the functioning of water ecosystems and the need for better responses to pressures and impacts may be hampering efficient policy measures and cost recovery strategies.

Coordination and agreement among Autonomous Communities and other stakeholders needs to be strengthened.

Divergence among water management objectives from the various Autonomous Communities makes it difficult to apply homogeneous criteria under the river basin unity principle. The Autonomous Communities generally favour getting increased allocations of water for new irrigation projects and other uses. Thus, conflicts among the Autonomous Communities and/or stakeholders, territories and administrations have caused delays in approval of the Hydrological Plan. Looking for agreement among all stakeholders can be time consuming and can delay the necessary decision-making. Eventually the Plan will have to be approved with some level of disagreement or compromise.

In the late 2000s there was a serious threat of disintegration of the river basin confederationsal together, with transfer of powers to the Autonomous Communities, as was temporarily the case in the Guadalquivir River Basin in Andalusia. The temporary transfer of power was eventually reversed by the Constitutional Court. The tensions peaked at a critical moment during the planning process, and have been one of the main reasons for the delays in the approval of plans in inter-community basins.

In general, however, it is clear that most of the stakeholders appreciate the value of planning at the basin level, and it may be the case that delays needed to reach agreement strengthen the Hydrological plan in the long run.

Recently-approved Hydrological Plan needs to be implemented.

Spain has encountered considerable delays in finalizing its hydrological plans under the EU WFD. Though they should have been completed in December 2009, most of the plans were approved only during 2013. Until late February 2014, the Ebro Plan was still pending, but now it has been approved. In the meantime, the Ebro Plan had been endorsed by the Ebro district Water Council and the National Water Council, and therefore the River Basin District had alreadybeen implementing the Program of Measures.

There have also been delays in establishing and constituting the Ebro River Basin Water Council, which is key to the planning process as the top of the whole participatory framework. Therefore its constitution and functioning is essential. Considering that the composition of this new Water Council will be similar to the old one and pending the constitution of new Water Council. The former Ebro River Basin Water Council still has a role in monitoring, discussing and validating hydrological planning documents and activity proposals emerging from the participatory process. It should be supported until the new Water Council is constituted.

The current second water planning process provides an opportunity to correct the major mistakes and shortcomings of the planning model that was derived from the Water Framework Directive. The need for greater connection of the planning process with management and operation of water resources systems should be emphasized. The approaches need to be better coordinated, and appropriate tools need to be developed to implement the Program of Measures and related legislation.

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Interview 1

Ebro is a semi-arid basin; this makes water a critical element for economic activity and ecosystem preservation and a key driver for green growth. In recent decades, environmental problems linked to the use of water have emerged. By solving these difficulties, economic activity has become more sustainable, and new positive externalities have appeared. This is the case with irrigation modernization and wastewater treatment, actions that create new jobs and enhance economic efficiency.

The implementation of the WFD has been crucial to deepening into line of actions already in place that have now seen a major boost. CHE technical staff is multidisciplinary and has opened itself to public participation, and taking into account new aspects to achieve good water status in most of the basin's water bodies. Now the approach to economic development and environmental preservation is more holistic. More than a concrete initiative, the integration of all actions in the framework of a comprehensive management plan and program of measures is to be highlighted. In the last 15 years, Ebro has passed from 30% to 45-50% of sprinkler and drip-irrigated areas.

In the Ebro basin the agri-food complex and its activity is closely linked to water, including irrigation, livestock and agri-business. All measures aimed at improving the water use in this complex are very positive, enhancing productivity and, at the same time, reducing pollution reaching water ecosystems. Thus the potential to generate green growth is maximized. Also sanitation and wastewater treatment —particularly its extension to minor villages— must be mentioned, opening possibilities for highest quality-demanding supplies and giving rise to new recreational activities (sailing, rafting, fishing, adventure tourism). The restoration of rivers, streams and wetlands is also supported by enhanced water quality. All activities related to the monitoring and decision-making based in real-time acquisition of data (SAIH). The reuse of irrigation return flows, saving water and reducing pollution, like in the case of Bardenas irrigated area. Aquifer recharge, to be implemented in Alfamen groundwater body.

Many measures require significant public investment and budgetary constraints arising from the economic crisis cast shadows on compliance of the program of measures. On the other hand, divergence among water policies from the various Autonomous communities may hamper the application of homogeneous criteria under the river basin unity principle. The following must be taken into consideration for measures: Ebro HP is comprehensive but budgetary allocation may be insufficient; and some regulatory measures are important to ensure a more rational and flexible water allocation, such as: environmental flows, limitation to concessions periods, and rules for the joint exploitation of groundwater bodies.

Interview 2

From a holistic point of view, water use in the Ebro basin is decisively contributing to sustainability and also to neutralize Spanish water footprint, also releasing other territories from environmental impacts. Sanitation and water treatment, restoration of rivers, efficiency in irrigation are also linked to improvements in environment and green growth. Hydrological Plan is firmly committed to green growth. The limiting factor is primarily the lack of financial resources, because most of the investments in the Plan are sturdy and long-term, profitable for society as a whole.

The vast majority of measures are strictly related to green growth. Approximately 54% are focused on achieving environmental goals and so closely related to green growth: wastewater treatment, the modernization of irrigation schemes avoiding diffuse pollution, environmental checks for irrigation areas, water metering, and water reuse. Other actions in the medium and long term have a significant green growth effect: water management networks, enhancement of water regulation, R+D initiatives, particularly, the assessment of the impacts of measures on water environment. A fundamental aspect of green growth is the management of water as a renewable energy vector. Water management and energy management must be coordinated.

Currently there are gaps of knowledge regarding the functioning of water ecosystems. Also the effects of a massive water reuse intended to protect the fragile water environment of the Ebro must be analyzed. The use of renewable energy sources in water management and the use of water as an energy vector. Sustainability of energy can be even more important than water, and the later can be essential for a proper management. SAIH and SAICA networks are also important innovations.

The main obstacle is the lack of budgetary compromise from the government and competent authorities to cope with water planning objectives. The completion of the Plan must entail a monitoring and surveillance such that the expected environmental objectives should condition administrations budgets. The most important aspect is compatibility between water management and energy management. The institutional strengthening of Basin Organizations and river basin management, transcending administrative boundaries. Focusing through the lens of the natural region of the river is much more effective and beneficial than a number of fragmented interventions.

Interview 3

In the past two decades Ebro, in partnership with regions and users, has driven water management to the concept of sustainable development and green growth. CHEbro website, the information provided and its approach is proof of this change. Firstly oriented solely to infrastructure investment (this was 50 years ago), secondly integrating exploitation, and from the 1990s evolving to water management (professionals from many disciplines have been incorporated). In parallel, last improvements in infrastructure supply are under way, completing pending regulations; but most work is being developed towards management, to improve efficiency and allocate resources in a more efficient manner.

Water law has evolved in a very positive way, both the state and regional levels. Paradigm has changed from a static definition of water rights to water planning and management. Moreover, discharge fees have allowed Autonomous Communities to develop very good infrastructure and better management of wastewater treatment and sanitation. The risk of the basin unity principle being lost and substituted for Autonomous Community powers was stopped by Constitutional Court. This has been positive for the predominance (and modernization) of management over simply building new infrastructures and, thus, for green growth. Powers in the Confederation Water Council is roughly distributed in one third for Central Government, one third for Autonomous Communities and the remaining one for users. Counterbalance among parts and the participation of users in the decision making processes guarantee the future enforceability of the agreements. Certain issues should be improved, particularly the coordination among agricultural, energy and water policies. The concept is that the water must be at the service of other sectors; inputs and coordination are needed to be more helpful in this regard.

Ebro must put emphasis on many issues at a time, e.g. quantity and quality problems must be faced jointly. Pending regulations in some specific locations must be completed since they help water allocations in a compatible way, for both the needs of ecosystems and productive uses. Interventions on quality are also important for a sound and sustainable green growth. Three lines of work have to be mentioned: 1) an efficient allocation of resources so that applications that are not sustainable or too inefficient to generate enough growth may be put out of consideration; 2) sanitation and water treatment that must be expanded to smaller towns, but on an adequate scale and financial and maintenance scheme; 3) the modernization of irrigation understood as a way to avoid over use and diffuse pollution so that no insecticides or fertilizers reach the water ecosystems. In this regard the modernization of irrigation is essential.

The Automatic Hydrological Information System (SAIH) and Automatic Quality Information System (SAICA) are sources of data that have enabled managers to make decisions on an informed basis. SAIH's effectiveness was tested by two successive floods in the first year of commissioning (1997) and it can be said that the damage avoided in both events served to pay for the entire installation. The Biological Quality Networks (red CEMAS) are also enabling a much better understanding on issues of water quality and its impact on ecosystems. Many new challenges have arisen in water planning and management, as a consequence of the implementation of the Water Planning Instruction and European Guidance Documents. The determination of environmental flows have been established to evaluate the needs of river channels and ecosystems. Other examples of technological tools / solutions are: mathematical models for the simulation of water allocation strategies, water quality and quantity modeling, including snow melting modules. Models have also helped to better manage droughts and floods. All these tools influence green growth through enabling better management of water so that more resources are available and decisions are taken on more solid grounds. Finally, improvements have been made in domestic water supply, by means of infrastructure providing best quality resources for strategic demand (Zaragoza, Pamplona, Huesca and Lleida).

The use of the basin as a management unit has finally been preserved. The water cycle is poorly funded, also the Confederación (CHE). With the available budget, it is difficult to maintain a high technological level, such as for: appropriate levels of security in dams; laboratory and control networks; an expert and multidisciplinary professional team that manages and knows both surface water and groundwater quantity and quality. Also urban water supply system is underfunded. The price of water does not adequately cover costs of water services (including operation and maintenance of hydraulic works) nor reflect environmental externalities. A moderate increase of the prices could be enough, but it is vital to avoid accumulation of "management deficit" that would hamper green growth. There are also risks of predominance of economic interests, potentially deteriorating social and environmental balance. Some rural and mountain areas have a special sensitivity.

The coordination of water planning with energy and agri-business must be improved. Modernized irrigated areas are now more energy dependent. The life cycle of the whole process should be taken into account. Moreover, the social and environmental costs are not well integrated in the financing. In this sense, distinction should be made between types of irrigation, for example, which are competitive and which have a social purpose. Coordination mechanisms as well as the various aspects of socio-economic analysis are not sufficiently explicit. Greater emphasis on a more ambitious dam safety and maintenance program would be necessary.

Interview 4

The advantage of the Ebro basin is that the pressure of population and economic activities is not high. Agriculture is not very intensive in relation to other models along the Mediterranean coast (e.g. greenhouses), with less pressure on the extraction and waste management and reduced pesticide and nutrient loading. The basin is therefore in good status in comparative terms with other Spanish basins. The Confederation does a very good job managing water resource, probably the best RBO of Spain along with Júcar. Another positive feature is cooperation. Spain's advantage over other countries is the institutional aspect. Users are within the RBO and are involved in decision making, so that agreements are prone to be implemented and this is a key condition for moving towards sustainable development and green growth. The predominance of surface water and irrigation communities also facilitates cooperation and the adoption of reasonable policies. Collective action in groundwater is more complex although in Spain there is a very good example of cooperation in the Eastern Mancha aquifer.

The Confederation follows the guidelines of the Central Government. WFD emphasizes the environmental aspects. Even before WFD major investments were made in sanitation and wastewater treatment plants, leading to lower pollution. After the National Irrigation Plan, €6,000 million were invested in irrigation modernization, helping to reduce both point and nonpoint pollution and salinity. It must be pointed out that irrigation modernization increases efficiency but reduces the quantity of water in the basin; this is demonstrated by several studies. Irrigation modernization should be linked with reduction in concessions, but this is complex. WFD has been formulated by northern European countries and focuses on quality problems and flooding. By contrast, drought is not addressed by WFD, nor are environmental flows, which in Spain were already considered in the previous Hydrological Plan. Water exchange centers are possible after 1999 Water Act but have not worked as expected where applied (Segura, Guadiana and Júcar), with little actual reallocation except during some drought periods. From the legal realm, the most important event has been avoiding the disintegration of the confederations, which had begun in Guadalquivir, and tried in the Douro and the Júcar. These tensions have had much impact on the delay of planning documents.

Regarding administrative reforms, works intended to have a register of concessions and land use are very important. Without collaboration of users, registration is difficult, especially for groundwater. The principle of public participation in the sense of enhancing citizens' concern is more a matter of marketing. What really matters is the cooperation of stakeholders, those who must take care of the resource.

They have more concerns beyond investing in modernization expansion, except in cases such as irrigated areas motivated by social concerns. With regard to energy policy, hydropower is well developed and there is not much remaining potential, while the development of renewable energy has slowed down dramatically. Water prices as a measure for better allocation may work for urban supply but not for irrigation because water is a communal good. To be effective prices should increase to such levels that impact for the sector would be very serious. In the Ebro, with corporate management it has been possible to reduce allocations by agreement in drought periods. Cost recovery makes sense, but not prices as a mechanism for reallocation. Institutional arrangements among stakeholders are more useful than demand management (the option postulated in the European Commission' "Blueprint for Water").

Modernization of irrigation schemes, sanitation and water treatment (even reaching tertiary treatment when necessary) account for most of the budget. The protection of the delta should not be at the expense of the rest of the basin ecosystems. There are small measures in budgetary terms, which are important, such as properly maintaining SAIH, hydrological and forest protection, river restoration, control of water intakes.

SAIH, wastewater treatment, modernization and automation of distribution networks, especially in irrigation. (The collaboration with the administration has so much potential: precise knowledge of nutrients, return flows). Riegosdel Alto Aragón' Irrigators Community is introducing renewable energy but recent cuts in subsidies make it difficult. Valuation of ecosystem services is being promoted by the European Union and worldwide. It is one element but the political decision-making will not address the value of ecosystems. Again, institutions are the key for ensuring sustainability. Management is good, pressure is moderate and no major obstacles are present in the Ebro basin, especially in comparative terms with other basins. More emphasis should be placed on diffuse pollution from the knowledge obtained from the network to control irrigation return flows. It might be interesting to involve allocation boards, irrigators and autonomous communities.

Interview 5

The water-related economic activity improvement is twofold: increased efficiency, i.e., less water per unit of production, and improvements in the treatment of water effluent from production processes. These improvements were present in the productive processes and at treatment stage, as well as in the research and manufacturing of equipment, such as membranes, intelligent multi-parameter sensors, bio regeneration, etc. Regulations on water, even though their implementation still needs improvement, is are a good instrument for advancing cleaner production systems and to generate knowledge and technology to help move in the right direction. More intensive use of economic and financial instruments are missing and could give further impetus in this direction.

The Hydrological Plan represents a breakthrough in public awareness and in the design of improvements aimed at green growth. However, we must be critical and not be complacent for these improvements to continue. Several reforms are necessary for the proper use of water becoming a key growth factor: administrative simplification, a more rigorous and transparent accounting system providing signals of water shortage; regulated water markets that allow to assign more efficient uses from the social and economic point of view, an assessment of the environmental services of water and associated ecosystems, and greater public – private participation - properly supervised and regulated. Economic self-sufficiency would be a key element for management entities in driving the green economy. Another key factor would be better understanding of climate variability and hydrological uncertainty and analyzing the economic, environmental and social consequences. When a productive activity depends on water, in a scenario of scarcity, it is necessary to know the risks involved, and to have a mechanism for decreasing investments to reduce high risks.

The hydrological plans should be generators of technological innovation and therefore growth in the green economy. However, for reasons already discussed, there is still much effort required. One of the main mechanisms would result from adequately addressing the cost-effectiveness of the measures and action plans. This analysis would lead to a selective process of the most effective and economical technologies to reduce pollution. This would generate competition among companies by providing the market for advanced mechanisms to solve the main problems of the basin. This is already happening, but it would be desirable to improve. The first experience of this planning process will, no doubt, accelerate this type of analysis and thus green growth. Furthermore, the crosscutting nature of hydrological plans represents an opportunity to generate innovative synergies in many other sectors of the economy necessarily in line with environmental improvements.

Hydraulic administrations are not direct producers of technology, although they need good technology to generate adequate knowledge to make intelligent decisions. In this sense, spatial data infrastructures (IDS Ebro), monitoring systems in real time, using satellite imagery, numerical simulation models and decision support systems have led Spain to occupy a privileged place in the world in terms of planning and integrated water resources management, within the physical framework of the river basin. Moreover, water scarcity has also contributed to improving and modernizing irrigation and food production, improvements in industrial processes and in domestic water supply. However much remains to be done. The main problems of the basin, reflected in Interim Overview of the Significant Water Management Issues, are not being met at the right pace.

The two main obstacles to promote green growth are: first the incomplete recovery of the real costs of water that would promote innovations in water efficiency and links with the energy sector, and would generate a healthy and productive competitive in water supply access. Second, more and better governance that would address the real challenges together is needed. It should be approached with maturity, sharing the same information and knowing the uncertainties, with no hidden interests, distortions or exaggeration of some positions. It must be assumed that environmental issues are constraints that must not be exceeded if we are to ensure sustainable use of water. This will encourage innovations that tend not only to help the green economy, but also to help what is now called the blue economy. The latter is nothing more than an attempt to replicate the behavior of nature, where everything is recycled and reused to generate wealth. This is strongly related to eco-design that should be incorporated into the Hydrological Plan.

Probably the current second water planning process provides an opportunity to correct the major mistakes and shortcomings of the planning model that was derived from the Water Framework Directive. The need for greater connection of the planning process with management and operation of water resources systems should be emphasized. The approaches are still poorly coordinated, because the powers are fragmented and very difficult to harmonize properly. For example, the Program of Measures should be greatly improved both at the design phase and for the generation and selection of alternatives, and for funding for their implementation. Also a more productive approach to water, which would require a broader vision, is relevant. This is because, although water planning is essentially preventive, Spain currently does not have the appropriate tools for the implementation of the legislation it generates. Unresolved problems and externalities, generated around the environmental aspects of water, force us to broaden the focus. It is also necessary to raise additional resources for knowledge, economic analysis and dialogue. There is no reasonable comparison between the importance of water and the relatively small resources allocated to its management.

Turkey

Restoration of an Urban Estuary: Golden Horn, Istanbul

About the Report
This case study report has been prepared as part of Phase 2 of the Water and Green Growth project, a collaborative research effort by the Government of Korea, as represented by the Ministry of Land, Infrastructure and Transport and K-water, and the World Water Council. The Water and Green Growth Report Edition II follows from and further develops the contents of the Water and Green Growth Report Edition I, which was published in March 2012.

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Abbreviations and Acronyms

BERD Business expenditure on R&D

BILGEM Turkish acronym for TÜBİTAK Informatics and Information Security Research Center

BRIC Brazil, Russia, India and China

BTP-UP Turkish acronym for the Implementation Plan for the National Science and Technology Strategy

BTYK (Turkish acronym) Supreme Council for Science and Technology

BUTAL Bursa Test and Analysis Laboratory

DSI State Hydraulic Works

EU European Union

GDP Gross Domestic Product

GERD Gross Domestic Expenditure on Research and Development

GII Gender Inequality Index

GW Gigawatts

HDI Human Development Index

HRST Human Resources Science and Technology

IBB Turkish acronym for Istanbul Metropolitan Municipality (IMM)

IHDI Inequality adjusted HDI

IMM Istanbul Metropolitan Municipality

ISAF International Security Assistance Force

ISKI Istanbul Water and Sewerage Administration

MAM or TÜBİTAK MAM Marmara Research Center

NATO North Atlantic Treaty Organization

NCCAP National Climate Change Action Plan

NSTI National Science, Technology and Innovation Strategy (2011-2016).

NSTI National Science, Technology and Innovation

OECD Organization for Economic Cooperation and Development

RDI Research, development, and innovation

REC Regional Environmental Center

SMIT South Korea, Mexico, Indonesia, and Turkey

STI Science, technology, and innovation

SAGE Defense Industries Research and Development Institute

SUEN Turkish Water Institute

SYGM General Directorate of Water Management

TUSSIDE Institute for Industrial Management

TARAL Turkish Research Area

TEMA The Turkish Foundation for Combatting Soil Erosion, for Reforestation and the Protection of Natural Habitats

TTKD Nature Conservation Association of Turkey

TÜBA Turkish Academy of Sciences

TÜBİTAK Turkish Acronym for Scientific and Technological Research Council of Turkey

TUG National Observatory

TUIK Turkish Statistical Institute

ULAKBİM National Academic Network and Information Center

UME National Metrology Institute

UNCED Conference on Environment and Development

UNDP United Nations Development Program

UNFCCC United Nations Framework Convention on Climate Change

UNIDO United Nations Industrial Development Organization

UZAY Space Technologies Research Institute

VA Value added

WERDEC Water Engineering Research & Development Center

WGG Water and Green Growth

WSA Water and Sewerage Administrations

WWC World Water Council

Executive Summary

Turkey is the 18th largest economy in the world with a Gross Domestic Product of US $786 billion in 2012, according to the World Bank.[1] It is among the founding members of the Organization for Economic Cooperation and Development (OECD) and the G-20 group of major economies. Turkey's economy has been quite resilient despite several slowdowns in economic growth, most recently during the global economic crisis in 2008. In 2012, the per capita income topped US $10,600 (current prices), unemployment had fallen to 8.5% of the workforce, and inflation had been brought under control.[2]

The Golden Horn case study tells the story of the restoration of an extremely important and internationally strategic waterway that flows through Istanbul, Turkey's economic hub and largest city. Turkey is located on the crossroads of Europe and Asia, and the water connection that runs through Istanbul extends from the Black Sea through the Bosporus strait, the Sea of Marmara and the Dardanelles, allowing a natural connection between the Mediterranean and the Black Sea. The Golden Horn (Haliç) estuary is a historic inlet of the Bosporus strait, dividing the city of Istanbul and forming the natural harbour that has sheltered Ottoman and other ships for thousands of years.

The Golden Horn estuary had been an industrial region since 1937, and green areas were destroyed through inappropriate city planning. The industrial zone came with disadvantages, including overpopulation and increased pollution in an area with no infrastructural planning. By 1985, the extensive industrial zone around the Golden Horn, along with the active operation of dockyards, factories, and warehouses, increased pollution of the estuarine waters. The results were devastating: the estuary turned into a shallow, dead lagoon where the boats could not move, where there were no living species, and the smell from anaerobic degradation could be detected for a radius of several km.

The Golden Horn rehabilitation project, implemented by the Greater Istanbul Municipality from 1995 to 2003, has made significant progress in restoring and revitalizing the historic and cultural features of the Golden Horn and surrounding area.

The project, aimed at improving water quality and navigation in the estuary, had five phases: investigation; dredging; construction of wastewater facilities; landscaping; and repurposing the area as a tourism and cultural destination. Much of the initial work was concentrated in dredging the Golden Horn and preventing sewage from entering by collecting and sending it to a treatment facility. Then the landscaping and repurposing of this strategic and historic waterway became an engine for economic growth. As a result of the project, water quality in the estuary has improved, while the tourism potential and recreational areas have increased.

The urban transformation of Istanbul around the Golden Horn succeeded as a result of many intersecting elements, including strong political support, a variety of measures working together to restore the water quality, and many actors on all levels working in tandem to transform the waterfront from an industrial area to a cultural and educational center. A concerted effort was made to preserve the authenticity of historical and industrial structures, while repurposing them for new functions.

1) World Bank. 2014. Country Overview: Turkey. http://www.worldbank.org/en/country/turkey/overview

2) http://databank.worldbank.org/data/views/reports/tableview.aspx

The ecological rehabilitation of the estuary encouraged a flourishing of the service sector. Recreational attractions, museums, and universities replaced the industrial facilities along the shore. The ecological restoration of the Golden Horn has facilitated urban transformation projects with social, economic, and cultural impact.

Some of the lessons learned were the following:

A diversity of actors was needed to make the project work.

There was a mixture of public and private actors that had an impact on the economic and social performance of the project over time. Some of the diverse actors involved in the multi-faceted long-term project included: the Istanbul Metropolitan Municipality, the Fatih District Municipality, the European Union, private enterprise, and local communities. In the Golden Horn ecological restoration project, ISKI and the Istanbul Metropolitan Municipality were the lead actors, with limited involvement of the private sector and the civil society.

Urban transformation requires the involvement and commitment of communities in keeping the environment clean.

The participation level of stakeholders in the Golden Horn project varied. Local people, private sector, academia and NGOs have been consulted to varying degrees and were informed properly at different phases of the Project. But, the overall effectiveness of the community-centred institutions remained low. A positive example of community participation comes from the Fener-Balat rehabilitation project, which was completed in 2008. In total, 121 old buildings were renovated, a multifunctional social center was opened that serves for public meetings and educational activities, and the historic Balat Bazaar was renovated in consultation with shop-owners. To ensure long-term sustainability, a solid waste management strategy was developed, and meetings to raise awareness were conducted for the local people. Residents were given special solid waste bins and the Fatih District Municipality formed a team for collecting solid waste from the residents in the neighbourhood.

The project drew on innovative ideas for repurposing and renovation.

Many private businesses and individuals came up with innovative ideas for repurposing and reusing some of the run-down facilities that led to solid economic investments. For example, Rahmi Koç Museum was one of the first private museums in Istanbul. This was followed by a number of other private museums that opened between 2000 and 2010. The total revenue of private museums reached US $33 million in 2010, compared to US $5 million in 2000. The theme park Vialand was built over an old quarry filled with the mud and debris removed by dredging. Other innovative examples include: an electricity power plant that was turned into an energy museum; an old fez factory became a cultural center; and a cigarette company was transformed into a university campus. This type of innovative repurposing preserves the authenticity of the region and saves money on construction.

Residents may not be direct beneficiaries of waterfront facilities.

The Golden Horn project has made a significant contribution to the region through the construction of high-level education institutions, rowing clubs, cultural centers and museums. Considering that these educational and cultural facilities are open to the public and are not exclusive to inhabitants of the Golden Horn, it should be noted that local residents may not be direct beneficiaries of the renewal process. In fact, many people were displaced from their homes and their jobs when the demolition and renovation of old buildings was carried out. While local residents may be secondary beneficiaries, it is important to include them in the planning process.

Improvements in the Golden Horn's ecosystem and marine environment need to be reinforced with stronger air and water quality regulations.

The project had a positive impact on marine life and biodiversity and resulted in an increase in the fish population. A large increase in number of aquatic species has been observed, and hand-line fishing, which was absent from the region for a long time, is again contributing to the well-being of local residents. Despite improvements in the environment, however, Turkey performs below the OECD average for air and water quality. Therefore, Turkey's strong economic performance needs to be reinforced with focused air and water quality regulations to improve the quality of life.

Political success of the project needs to be combined with social and economic policies.

Because of the social and economic transformation that has taken place around the Golden Horn, the district provides political influence, as it can be promoted both by local and central government politicians. Revival of this once environmentally devastated urban center is a remarkable political success as long as it is combined with fairly implemented social and economic policies.

Improved water saving and reuse technologies can help to meet the future water demand for the city of Istanbul and Turkey.

While Istanbul has made good progress in terms of water supply and treatment, improved water saving and reuse technologies could help meet future water demands for the city. The same measures can be applied to Turkey as a whole. Citizens need to recognize the value of water more. Better technologies for water treatment, storage, transfer, and monitoring are essential to bring about water savings. Citizens, municipalities, farmers, and companies – every actor should pay more attention to produce more with less water. Big cities such as İstanbul should handle leakage problems in an effective way to save every single drop of water.

Better coordination among government and other actors is needed for improved water management, especially at the basin level.

At the institutional level, coordination is needed among public bodies as well as across the private sector, universities, and civil society in order to make more informed decisions. There have not been well-organized water management plans in Turkey in the past, but in the lead up to EU accession, river basin management plans will be implemented in the coming years. Thus, it is expected that a more holistic and inclusive water management system will be developed. The establishment of the Ministry of Forestry and Water Affairs and SUEN strengthens Turkey's attention to water management at the national and international levels and expands its collaboration with global actors. Turkey will have to apply the river basin management plans carefully and consider varying conditions of each basin in order to achieve reasonable tradeoffs and meet the particular needs of basins.

I. Introduction

1. Purpose of the Case Study

Throughout the period since the UN Water Conference was held at Mar del Plata, Argentina in 1977, water resources have been at the center of international discussions on economic and social development. Water was a key chapter in Agenda 21, the outcome of Conference on Environment and Development (UNCED, Rio de Janeiro, June 1992). Since then the United Nations and the international community have considered water as essential to the attainment of sustainable development. Moreover, the concept of sustainable development was the cornerstone of UNCED. The Brundtland Commission defined that concept in 1987, and ever since, it has been accepted that development must include not only economic growth, but also environmental and social dimensions.[3)]

In addition, innumerable international conferences outside of the United Nations system on different aspects of water resources management have been held to build a consensus and cooperation over the years. Among the most prominent are the annual World Water Weeks convened in Stockholm since 1991, and the triennial World Water Forums convened by the World Water Council every three years since 1997. The Fifth World Water Forum was held in Istanbul, Turkey in 2009.

The case study on "Rehabilitation of an Urban Estuary: the Golden Horn (Istanbul, Turkey)" is an example of how the restoration of a water-related ecosystem and water quality improvement provide long-term benefits in terms of public health and well-being, economic growth and improved livelihoods, and environmental protection. In urban areas, restored waterfronts can become lively and popular catalysts for economic growth and urban revitalization. When people get back in touch with their rivers, lakes, and seas, they take better care of those ecosystems in line with conservation and sustainable development efforts. The Golden Horn is considered a good example of Water and Green Growth, and it is thus included as part of the Water and Green Growth (WGG) project, being jointly undertaken by the World Water Council (WWC) and the Government of the Republic of Korea. The WGG project, initiated in November 2010,[4)] began collecting case studies and developed a policy framework. The first edition of the Water and Green Growth study was launched at the sixth World Water Forum in Marseille, France in March 2012.[5)] The case study on "Rehabilitation of an Urban Estuary: Golden Horn" was included in the first edition; the expanded case study included here is an input into phase II of the project, leading up to the Seventh World Water Forum in Daegu, Republic of Korea in 2015. Preparation of the case study has been supported by the World Water Council and the Government of the Republic of Korea, the organizers of the Forum.

2. Case Study Context

Restoration of an urban ecosystem is required when it has deteriorated or been degraded over a long period of time by pollution and development-induced environmental degradation, such as siltation.

3) The World Commission for Environment and Development, led by Norwegian Prime Minister Gro Harlem Brundtland, produced *Our Common Future* (1987, Oxford University Press), also known as the Brundtland Report, as an input to the United Nations Conference on Environment and Development held in Rio de Janeiro Brazil in June 1992.

4) WGG is defined as the (growth) concept that emphasizes the role of water in terms of achieving economic well-being and social equity coupled with protection and revitalization of ecosystems.

5) *Government of Republic of Korea and World Water Council. 2013, March. Water and Green Growth Edition 1*. www.waterandgreengrowth.org.

Ecosystem destruction causes problems that lead to decline in navigation, fisheries, health, productivity, and commerce. It also generates direct costs for dredging and clean-up.

The Golden Horn [Turkish: Haliç (meaning Gulf) or Altın Boynuz (literally "Golden Horn" in Turkish]; is a historic inlet of the Bosporus (also spelled Bosphorus) dividing the city of Istanbul and forming the natural harbour that has sheltered Ottoman and other ships for thousands of years.[6)]

The Golden Horn estuary has been an industrial region since 1937, and green areas were destroyed through inappropriate city planning. The industrial zone came with disadvantages, including overpopulation and increased pollution in an area with no infrastructural planning. By 1985, the extensive industrial zone around the Golden Horn, along with the active operation of dockyards, factories and warehouses, increased pollution of the estuarine waters. The results were devastating: the estuary turned into a shallow, dead lagoon where the boats could not move, where there were no living species and the smell from anaerobic degradation could be detected for a radius of several km.

The Golden Horn rehabilitation project is a multidimensional plan aimed at improving water quality and navigation in the estuary. The project, implemented by the Greater Istanbul Municipality from 1995 to 2003, has made significant progress in restoring and revitalizing the historic and cultural features of the Golden Horn and surrounding area.

The project had five phases: investigation; dredging; construction of wastewater facilities; landscaping; and repurposing the area as a tourism and cultural destination. Much of the initial work was concentrated in dredging the Golden Horn and preventing sewage from entering it by collecting it and sending it to a treatment facility. Then the landscaping and repurposing of this strategic and historic waterway became an engine for economic growth. As a result of the project, water quality in the estuary has improved, while the tourism potential and recreational areas have increased.

3. Case Study Methodology

The Golden Horn Restoration of an Urban Estuary case study explores the transformation of a historic urban waterway from a polluted sewage dump into the center of vibrant economic activity. The case study examines exogenous factors and water institutions at the national and local levels that have had a major impact on the restoration of the estuary and have fueled the rapid economic growth experienced in Istanbul. The work was undertaken based on an institutional approach developed under the Water and Green Growth project supported by the World Water Council and the Government of the Republic of Korea. Details on the institutional approach and methodology can be found in the Lake Sihwa Water Quality Improvement project case study.[7)] The present research explores the exogenous economic, social, political, environmental and technical factors that drive water resources planning and management processes. It examines how the institutional framework in the water and related sectors contributed to green growth.

6) Coastlearn Black Sea, Water Quality Management: Case Study of Golden Horn (Haliç) – Istanbul-Turkey http://www.coastlearn.org/water_quality_management/case-studies/golden_horn_halic.pdf

7) *Research Center for Water Policy and Economy at K-water Institute. 2013, Sept. Lake Sihwa Water Quality Improvement Project: A Water and Green Growth Case Study Report*. Daejeon, Republic of Korea.

The analytical framework used in the study is based on the work of Saleth and Dinar (2004) in *The Institutional Economics of Water*. The framework was the basis for evaluating the water-related projects' outcomes resulting from changes in policies and institutions.[8)]

The questionnaires presented to representatives of the main water-related institutions and other stakeholders in Turkey and the Greater Istanbul Municipality were developed to reflect that framework. Saleth and Dinar define a water institution to be an entity defined interactively by the three main components: water law, water policy, and water administration. The analytical framework is presented in detail in the Lake Sihwa case study.

4. Organization of the Report

This case study investigates the economic, social, political, environmental, and technological context in which the Golden Horn rehabilitation has been implemented. The policies and institutions that have been responsible for the improvements in water management and availability and thus the rapid economic growth of the urban area along the estuary are still evolving and are adapting to changing circumstances. The participation of stakeholders, including the private sector, in consultations related to the plan contributed to this evolution. The case study describes the water management institutions and policies at national, municipal and local levels. It analyses their performance and draws conclusions and lessons learned.

First, the external environment during the rehabilitation and restoration of the Golden Horn is characterized in terms of its economic, social, political, environmental, and technological aspects, i.e. exogenous factors. Chapter IV examines water resources governance, policy, law and institutions in Turkey and the Istanbul Metropolitan Municipality (IMM), including local water governance structures. Information and statistics from international, national and local sources, and from independent academic studies, provide an overview of the situation in the country and the urban area.

Finally, the impact and performance of the various elements of the restoration and management plan for the restoration of the urban waterway are analysed. Survey results and expert interviews are used to examine the current situation and performance of the estuary management plan for the Golden Horn in Istanbul.

II. An Overview: Restoration of an Urban Estuary

The Golden Horn case study tells the story of the restoration of an extremely important and internationally strategic waterway that flows through Istanbul, Turkey's economic hub and largest city. Turkey is located on the crossroads of Europe and Asia, and the water connection that runs through Istanbul extends from the Black Sea through the Bosporus strait, the Sea of Marmara and the Dardanelles, allowing a natural connection between the Mediterranean and the Black Sea. The Golden Horn (Haliç) Estuary is a historic inlet of the Bosporus strait, dividing the city of Istanbul and forming the natural harbour that has sheltered Ottoman and other ships for thousands of years.

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8) Saleth, R. and Dinar, A. 2004. The Institutional Economics of Water: A Cross-country Analysis of Institutions and Performance. Washington, D.C.: The World Bank.

9) World Bank. 2014. Country Overview: Turkey. http://www.worldbank.org/en/country/turkey/overview

Source: http://content.answcdn.com/main/content/img/factbook/maps/tu-map.gif

<Figure 1> Map of Turkey, Showing the Location of Istanbul, the Bosporus Strait and the Sea of Marmara

among the founding members of the Organization for Economic Cooperation and Development (OECD) and the G-20 group of major economies. Economic modernization in Turkey has progressed well, and the country has remained resilient despite several slowdowns in economic growth, most recently during the global economic crisis in 2008. In 2012, per capita income topped US $10,600 (current prices), unemployment had fallen to 8.5% of the workforce, and inflation had been brought under control.[10] A map of Turkey showing the location of the Bosporus Strait and Istanbul is shown in Figure 1.

Turkey has a surface area of 779,452 km^2, of which 765,152 km^2 is land area and 14,300 km^2 is water. Turkey's coastline along the surrounding seas is 8,300 km and the length of political boundaries with eight neighbouring countries is 2,900 km.[11]

The Golden Horn inlet off the Bosporus became so polluted during the 1970s and 1980s that it was practically unusable for shipping. In Turkey's efforts to modernize its economy, it became apparent that the estuary running through Turkey's largest and most important city needed to be restored. The Golden Horn rehabilitation project, implemented by the Greater Istanbul Municipality from 1995 to 2003, has made significant progress in restoring and revitalizing the historic and cultural features of the Golden Horn and surrounding area. As a result of the project, water quality in the estuary has improved, while the tourism potential and recreational areas have been greatly expanded.

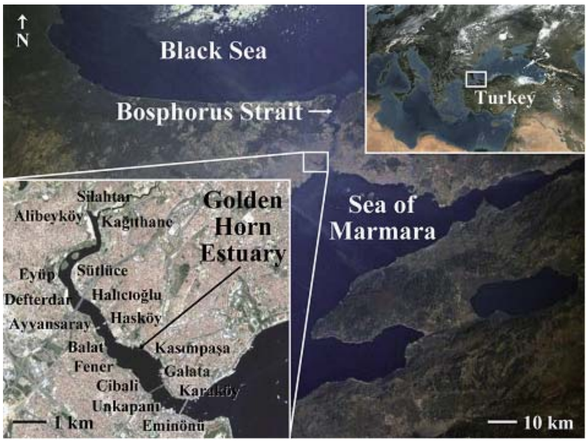
1. About the Golden Horn Estuary (Haliç) in Istanbul

The Golden Horn is a major inlet of the Bosporus in Istanbul (see Figure 2). It is a horn shaped estuary that joins the Bosporus Strait at the point where the strait meets the Sea of Marmara, thus forming an isolated peninsula, the tip of which is old Istanbul (ancient

10) http://databank.worldbank.org/data/views/reports/tableview.aspx

11) Prof. Dr. Veysel Eroğlu, Water Resources Management in Turkey http://www2.dsi.gov.tr/english/congress2007/chapter_2/26.pdf

Byzantion and Constantinople) and Seraglio Point. The Golden Horn geographically separates the historic center of Istanbul from the rest of the city, and forms a natural, sheltered harbor that has historically protected Greek, Roman, Byzantine, Ottoman, and other maritime trade ships for thousands of years.[12)]



Source: Coleman HM, Kanat G, Aydinol Turkdogan FI, 2009.Restoration of the Golden Horn Estuary (Halic). Water Resources Research, 43:20 (December): 4989-5003http://www.ncbi.nlm.nih.gov/pubmed/19781731

<Figure 2> Location of the Golden Horn and Surrounding Districts

The Golden Horn has been the location of many turbulent historical incidents, and its dramatic vistas have been the subject of numerous works of art (Picture 1). Until the 1980s, the Horn was polluted with industrial waste, but today its history and beauty make it a popular tourist attraction in Istanbul.

The Golden Horn is drained by two rivers (the Alibeyköy and Kağıthane Rivers). It is 7.5 km long and is 750 metres across at its widest. Its maximum depth, where it flows into the Bosporus, is about 35 m. It is today spanned by four bridges: the Haliç, literally Estuary Bridge; the restored Eski Galata Bridge, literally Old Galata Bridge; the Atatürk (Unkapanı) Bridge; and the new Galata Bridge, completed in 1994. A fifth bridge, the Haliç Metro Bridge, was completed in February 2014 and connects the subway lines of the Istanbul Metro to the north and south of the Golden Horn.

Source: Courtesy Dr. Murat Ayan, presentation for Marmara Union of Municipalities

<Pictrure 1> A Historical Depiction of Golden Horn

The Bosporus, also referred as the Istanbul Strait, forms part of the boundary between Europe and Asia. The Bosporus, the Sea of Marmara and the Dardanelles Strait to the southwest together form the Turkish Straits. The world's narrowest strait used for international navigation, the Bosporus connects the Black Sea with the Sea of Marmara, which is connected by the Dardanelles to the Aegean Sea and thus the Mediterranean Sea. Between its limits, the strait is 31 km long, with a width of 3.3 km at the northern entrance and 2.8 km at the southern entrance. Its maximum width is 3.4 km between Umuryeri and Büyükdere Limanı, and minimum width 700 m between Kandilli Point and Aşiyan. This part of the strait is a dangerous point for maritime traffic, with rapid currents and difficult course alterations required.

The risks posed by geography are multiplied by the heavy ferry traffic across the strait, linking the European and Asian sides of Istanbul. Most of the shores of the strait are heavily populated, as the city of Istanbul has a metropolitan area of over 12 million people. The Bosporus also remains strategically important. It is a major sea access route for Russia and Ukraine. In recent years, the Turkish Straits have become particularly important for the oil industry. Russian oil, from ports such as Novorossyisk, is exported in tankers primarily to Western Europe and the U.S. via the Bosporus and the Dardanelles straits.

12) http://en.wikipedia.org/wiki/Golden_Horn

2. Timeline for Water Management Milestones and Golden Horn Restoration

Many institutions have responsibility for water resources management in Turkey. The DSI State Hydraulic Works is the responsible authority for water and land resources management under the Establishment Law, Groundwater Law, and Law on Supply of Drinking Water to Ankara, Istanbul and those cities with population higher than 100,000. DSI is also working in cooperation with the General Directorate of Water Management (SYGM) for preparing Basin Management Plans. Sustainable use of water resources requires maintaining the integrity of the hydrologic whole, and Turkey has made great efforts to implement an integrated approach for the rational management of water resources.

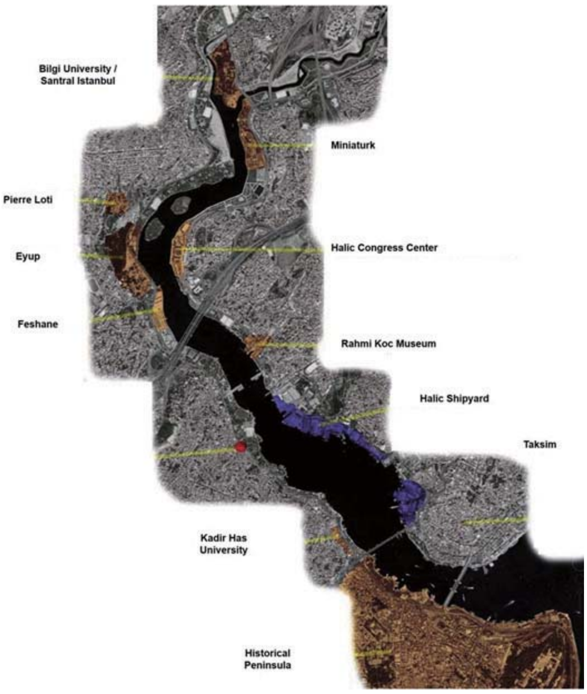
<Box 1> Water Management Milestones in Turkey and Golden Horn Estuary

- 1450s: First environmental management plans
- 1926: Law (no: 831) on Waters (regarding management of public waters)
- 1930: Law (no: 1593) on Sanitationadopted
- 1943: Law (no: 4373) on Protection Against Floods adopted
- 1953: First Municipal Meeting to address foul odours in the estuary
- 1960: Law (no: 167) on Groundwaters adopted
- 1960: Sludge dredging of Golden Horn
- 1965: Haskoy/Alibeykoy Dredging
- 1966: Plan to limit construction of large facilities in the vicinity of the estuary
- 1968: Law (no:1053) on Domestic and Industrial Water Supply on Municipal Provinces adopted
- 1971: Law (no: 1308) on Fisheries adopted
- 1974: Eyup Dredging
- 1981: Law (no: 2560) established the General Directorate of Istanbul Water and Sewerage Administration (ISKI) and defined its tasks
- 1983: Ministry of Environment established
- 1983: National Environmental Law promulgated
- 1984: Municipality approved the Golden Horn project
- 1984-91: Demolition and relocation of factories
- 1991: National Ministry of Environment created
- 1996: Completion of sewerage network
- 1997-98: Major dredging
- 2000: Opening of Old Galata Bridge
- 2001 – present: Construction of cultural facilities
- 2003: Ministry of Environment and Forestry established
- 2005: Law (no: 5302) on Special Provincial Administrations adopted
- 2009: Opening of Environment Chapter in 2009 as a part of the EU accession process
- 2011: Ministry of Forestry and Water Affairs, General Directorate of Water Management and Turkish Water Institute established
- 2011:Law (no: 6172) on Irrigation Associations adopted
- 2014: Opening ofHaliç Metro Bridge
- 2015: Secondary treatment (planned)

Institutionally the sector is fragmented. Policy, regulatory and planning functions are dispersed between different Ministries. Water Supply and Sanitation Service provision is the responsibility of about 2,400 municipalities and 29 utilities in the largest cities. In Istanbul, this is the responsibility of the Istanbul Water and Sewerage Authority (ISKI). Water governance and institutions will be covered in detail in Section III. Box 1 outlines some of the major milestones in water management in Turkey and for the restoration of the Golden Horn estuary.

III. The Case Study

The rehabilitation scheme for the Golden Horn from 1995-2003 moved heavy industrial plants away from the area along its shores and cleaned up the industrial pollution, resulting in the creation of vacant green areas on the coastline. Over the last two decades, abandoned industrial buildings along the waterfront have been repurposed and are used as museums, multifunctional cultural centers, and universities. All those developments have resulted in the redefinition of the area as an educational-cultural urban zone. Remediation of "brownfields" and the retrofitting of historically significant abandoned buildings for cultural and educational purposes have helped to define a new economy and social life, as well as create green areas along the coastline (see Figure 3).

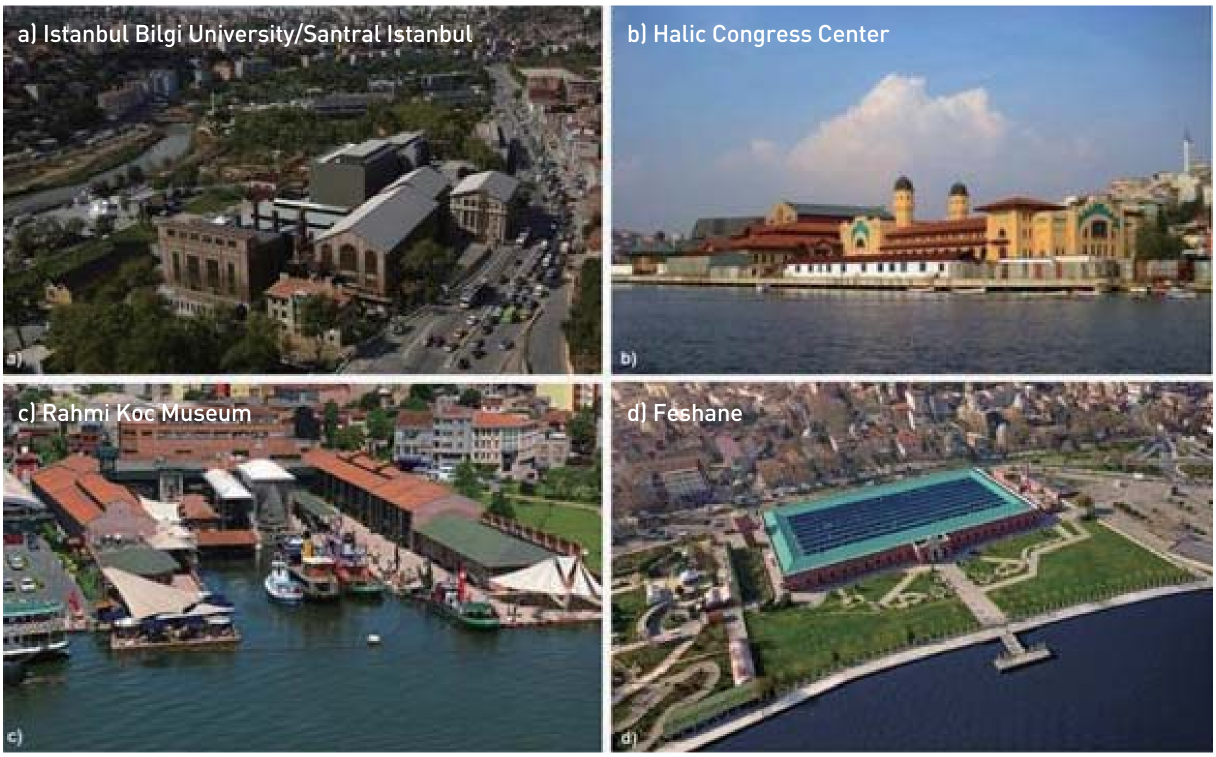


Source:http://yunusemrekara.wordpress.com/2009/01/02/istanbul-resimheykel-muzesi/

<Figure 3> Redevelopment of Golden Horn Estuary

The total cost of the project was US $653 million. As an outcome, oxygen levels in the Golden Horn have reached saturation levels, over 30 species of fish have reappeared and sea transportation has been re-established. International water sports events are held there, and the waterfront area hosts cultural centers, museums, and entertainment and exhibition halls (see Picture 2). The water quality measurements in the Golden Horn, Marmara Sea, Bosporus, and the Black Sea outlets are monitored regularly by the Istanbul University, Institute of Marine Sciences and Management. The quality of water continues to improve.

This case study demonstrates how a polluted urban waterway can be restored and become the center of vibrant economic activity. The success of such a project in a large city through collaboration among a wide range of stakeholders provides a model for other major urban centers. Participants at the 5th World Water Forum in 2009, which was held on the banks of the Golden Horn, observed first-hand the results of this green growth project.



Sources: http://www.santralistanbul.org/pages/index/about/tr/;http://www.rmk-museum.org.tr/default.aspx;http://www.beltur.com.tr/galeri/feshane/bgaleri4.jpg; http://www.valeadamlar.com/wp-content/uploads/2012/07/halic-kongre-merkezi.png

<Picture 2> Educational-cultural Urban Zone around the Estuary

1. Exogenous Factors

This section presents the exogenous factors that helped shape the context in which key water resources management decisions were made and implemented in Turkey and the Istanbul Metropolitan Municipality (IMM). It describes some of the economic, social, political, environmental, and technological elements that influenced those decisions and that contributed to the achievement of green growth.

1-1. Economic Factors

Turkey is the 18th largest economy in the world with a Gross Domestic Product of US $786 billion (current prices) in 2012, according to the World Bank.[13] It is among the founding members of the Organization for Economic Cooperation and Development (OECD) and the G-20 group of major economies. Economic modernization in Turkey is progressing well, despite some setbacks during recent global recessions.

From 2000 until 2012, per capita income in constant 2005 prices registered an annual average growth rate of 2.7%. Total GDP in constant prices has grown by an average of 4.1% from 2000 to 2012, a very solid growth rate even through the recession following 2008 (see Table 1). Per capita GDP in Turkey now exceeds $ 10,600 in current prices. In current prices, growth in GDP per capita over the period averaged 8.0% per year. Turkey has remained resilient despite several slowdowns in economic growth, most recently the global economic crisis in 2008. It is now seen as an example from which other countries in the region can learn with its rapid rate of growth. According to OECD Economic Outlook No: 86, Turkey is expected to be the fastest growing economy of the OECD members during 2011-2017, with a projected annual average growth rate of 6.7%.

The real GDP growth rate from 2002 to 2007 (see Table 1) averaged 6.8% per year, which made Turkey one of the fastest growing economies in the world during that period. However, growth slowed to 0.66% in 2008, and in 2009 the Turkish economy was affected by the global financial crisis, with a decline in GDP of 4.83%. The economy was estimated to have returned to 9.16% growth in 2010 and a solid recovery is underway.

<Table 1> Turkey: Growth in GDP and GDP per capita, 2000-2012 (Constant 2005 US $)

	Total GDP (billion US $, 2005 prices)	Growth in GDP (%/year)	GDP/capita (constant 2005 prices)
2000	387	6.77	6,119
2001	365	-5.70	5,687
2002	387	6.16	5,952
2003	407	5.27	6,179
2004	446	9.36	6,665
2005	483	8.40	7,130
2006	516	6.89	7,523
2007	540	4.67	7,776
2008	544	0.66	7,730
2009	518	-4.83	7,267
2010	565	9.16	7,834
2011	615	8.77	8,413
2012	628	2.24	8,493

Source: World Bank Dataset: http://www.worldbank.org/en/country/turkey/overview;
http://databank.worldbank.org/data/views/reports/tableview.aspx

1-1-1. Economic Reforms

During the first six decades of the Republic, between 1923 and 1983, Turkey had mostly adhered to a quasi-statist approach with strict government planning of the budget and government-imposed limitations on private sector participation, foreign trade, foreign currency flows, and foreign direct investment. However, in 1983 Prime Minister Turgut Özal initiated a series of reforms designed to shift the economy from a statist, insulated system to a more private sector, market-oriented model. These reforms spurred rapid economic growth, although

13) World Bank. 2014. Country Overview: Turkey. http://www.worldbank.org/en/country/turkey/overview

this growth was punctuated by sharp recessions and financial crises in 1994, 1999 (following the Izmit earthquake) and 2001.

Since the economic crisis of 2001, fundamental reforms initiated by the finance minister at the time, Kemal Dervis, have allowed Turkey's finances to remain relatively strong. The rate of inflation in Turkey was over 50% in 2000 and 2001, dropping to 45% in 2002, and 25% in 2003. It finally levelled off at around 10% in 2004 and 2005. Turkey's currency, the Turkish lira, was revalued on 1 January 2005, in order to cement the economic reforms in the country and to alleviate the consequences of an unstable economy. As a result of continuing economic reforms, inflation dropped to 10.1% in 2005 and 9.6% in 2006. On 1 January 2009, the new Turkish lira, as well as new banknotes and coins were introduced.

Turkey has gradually opened up its markets through economic reforms by reducing government controls on foreign trade and investment and on the privatization of publicly-owned industries. The liberalization of many sectors has continued to allow for broader private and foreign participation. The public debt to GDP ratio peaked at 75.9% during the recession of 2001, falling to an estimated 26.9% by 2013. Over the past decade, Turkey has become a competitive contender on world markets, moving ahead in the World Economic Forum's Global Competitiveness Index. Since 2008, Foreign Direct Investment (FDI) has grown from just over $1 billion to an average of $ 13 billion per year.[14] Its principal exports include foodstuffs, textiles, clothing, iron, and steel.

Turkey has a deep-rooted, but complex relationship with the European Union (EU). The EU remains Turkey's largest economic partner, accounting for 46% of Turkish trade in 2011.[15] Turkey became a candidate for full membership in the EU at the Helsinki summit in 1999. Accession negotiations began in October 2005 and continue to progress, despite a number of political obstacles (including relations with Cyprus).

1-1-2. Economic Sectors

In 2012, the agricultural sector accounted for 9% of GDP (and 23.6% of the workforce), while the industrial sector accounted for 27% of GDP and 26% of the workforce, and the services sector 64% of GDP and 50% of the workforce. The rate of female employment to female population in Turkey was 26.3% in 2012, the lowest among all OECD countries.[16] Male employment was almost 65% of the male population (Tables 2 & 3).

Value added in agriculture as a percentage of GDP in Turkey has gradually declined, falling from 11.3% in 2000 to 9.1% in 2012 (see Table 2). Over the same

<Table 2> Valued Added by Sector as a Percentage of GDP in Turkey, 2000-2012

	Value added in agriculture/GDP (%)	VA in industry/ GDP (%)	VA in services/ GDP (%)
2000	11.3	31.5	57.2
2001	9.9	30.2	59.8
2002	11.7	28.7	59.6
2003	11.4	28.6	60.0
2004	10.9	28.5	60.6
2005	10.8	28.5	60.7
2006	9.5	28.7	61.8
2007	8.7	28.3	63.1
2008	8.6	27.7	63.7
2009	9.3	25.9	64.7
2010	9.6	26.9	63.4
2011	9.1	27.9	62.9
2012	9.1	27.0	63.9

Source: http://databank.worldbank.org/data/views/reports/tableview.aspx?isshared=true&ispopular=country&pid=14

14) World Bank. 2014. Country Overview: Turkey. http://www.worldbank.org/en/country/turkey/overview
15) Ibid.
16) *Deliveli, E. 2013, 7 March. No Woman, No Growth. Hurriyet Daily News*. http://www.hurriyetdailynews.com/no-woman-no-growth.aspx?pageID=449&nID=42539&NewsCatID=430

period the workforce in agriculture has declined much more, from 36% of the total to 23.6% (Table 3). This indicates that productivity in agriculture has improved, at least partially a result of improvements in irrigation and access to a reliable water supply for agriculture. It is one of the world's largest producers of hazelnuts, chickpeas, pistachios, cherries, figs, apricots, almonds, olives, tea, tobacco and apples. It is also a large producer of cotton and wheat. Turkey has been self-sufficient in food production since the 1980s. In the year 1989, the total production of wheat was 16.2 million tonnes, and barley 3.44 million tonnes. The agricultural output has been growing at a respectable rate. However, since the 1980s, agriculture has been in a state of decline in terms of its share in the total economy.

Value added in the industrial sector has also declined as a percentage of total GDP over the same period, from 31.5% in 2000 to 27.0% in 2012. Employment in the industrial sector has remained around one quarter of the total workforce over the period and was at 26.0% in 2012 (see Table 3).

Turkey has a large automotive industry, which produced 1.07 million motor vehicles in 2012, ranking as the 16th largest producer in the world.[17] The Turkish shipbuilding industry realized exports worth US $1.2 billion in 2011.[18] The major export markets for ships are Malta, the Marshall Islands, Panama and the United Kingdom. Tuzla, Yalova, and İzmit have developed into dynamic shipbuilding centers and in 2011, there were 70 active shipyards in Turkey, with another 56 being built. These yards are also highly regarded in the production of large yachts.

In electronics, Turkish brands like Beko and Vestel are among the largest producers of consumer electronics and home appliances in Europe, and invest a substantial amount of funds for research and development in new technologies related to these fields. Other important industries include oil refining, construction, textiles, petrochemical products, food, mining, iron and steel, and the machine industry.

As for the services sector, both employment and value added have grown rapidly over the 12-year period. While value added in the service sector has risen from 57% to 64% from 2000 to 2012, the percentage of the workforce has increased from 40% to 50% (Tables 2 and 3). Tourism in Turkey has experienced rapid growth in the last 20 years, and constitutes an important part of the economy. In 2012, 35.5 million foreign visitors came to Turkey, which ranked as the sixth most popular tourism destination in the world.[19] Other key sectors of the Turkish service economy are banking, finance, insurance, transportation, and communications.

<Table 3> Workforce by Sector, Employment of Men and Women to Total Population and Total Unemployment (% of Total)

	2000	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Agriculture	36.0	37.6	34.9	33.9	34.0	29.5	33.9	23.5	23.7	22.9	23.7	24.2	23.6
Industry	24.0	22.7	23.0	22.8	23.0	24.8	22.8	26.7	26.8	25.3	26.2	26.5	26.0
Services	40.0	39.7	42.1	43.4	43.0	45.8	47.3	49.8	49.5	51.7	50.1	49.4	50.4
Employ/pop 15+ Female	24.7	24.9	25.0	23.7	20.9	20.8	21.1	21.1	21.7	22.4	24.1	25.6	26.3
Employ/pop 15+ Male	67.8	65.4	62.7	61.5	62.4	62.9	62.6	62.5	62.4	60.6	62.6	64.9	64.7
Unemployment	6.5	8.4	10.4	10.5	10.8	10.6	9.9	10.0	10.7	14.0	11.9	9.8	9.2

Source: http://databank.worldbank.org/data/views/reports/tableview.aspx?isshared=true&ispopular=country&pid=14

17) http://www.oica.net/category/production-statistics/
18) http://www.webcitation.org/6EK10Y6Kx
19) UNWTO Highlights, 2013 Edition, p.6: http://dtxtq4w60xqpw.cloudfront.net/sites/all/files/pdf/unwto_highlights13_en_lr_0.pdf

1-1-3. Economic Situation in Istanbul

Istanbul has the distinction of having been the capital city of three Great Empires. Although the city did not become the political capital for the new Turkish Republic, established in 1923, it has always been the country's main economic center and has never lost its status as the most prominent city in Turkey. Historically, Istanbul has been the center of the country's economic life because of its location as an international junction of land and sea trade routes. Istanbul has always been the financial capital of Turkey, even after Ankara became the new political capital in 1923. The opening of specific markets in the city during the 1980s further strengthened this status.[20)]

In 2012, the City of Istanbul had a GDP of $ 332.4 billion in current prices, 42% of the country's total. While Turkey and the city currently have strong economies, in the late 1990s, the economy of Turkey, and Istanbul in particular suffered several major recessions. The Asian financial crisis between July 1997 and the beginning of 1998, as well as the crisis in Russia between August 1998 and the middle of 1999 had negative effects in all areas of the Turkish economy, particularly on exports. A major earthquake in August 1999 with its epicentre at nearby Kocaeli triggered one of the largest economic shocks for the city. Apart from the capital and human losses caused by the disaster, a decrease in GDP of approximately 2% occurred. Despite these setbacks, a reorganization of the economy of Istanbul occurred in 1999, and Istanbul's economy has recovered and strongly improved in recent years.[21)]

Inaugurated at the beginning of 1986, the Istanbul Stock Exchange (ISE) is the sole securities market of Turkey, established to provide trading in equities, government bonds, treasury bills, revenue sharing certificates and corporate bonds, and to carry out overnight transactions. The Istanbul International Stock Exchange Free Zone has experienced rapid growth among the globally known stock markets. In 1993, the ISE decided on gold market liberalization, and in 1995, the Istanbul Gold Exchange was established, which ended the gold bullion imports monopoly of the Turkish Central Bank and transferred it to the private sector members of the gold exchange.[22)] Almost all insurance companies operating in the country are located in Istanbul. Istanbul will continue to move increasingly towards becoming a financial center associated with liberalized financial markets and active stock markets. With the decision of moving the Turkish Central Bank from Ankara to Istanbul, it is expected that the city will become an important world financial centre.

The growing service sector in the city, including finance, tourism, insurance and banking, as well as head offices, has been taking over from industry in recent years. While the industrial sector contracts, the service sector and money markets are continuing to grow in Istanbul. Due to Istanbul's geographical location, the first four hours of the business day overlap with Asian countries and the other four hours with European countries. Because of its unique location, Istanbul has become a natural financial center for the entire region.[23)]

Many of Turkey's major manufacturing plants are still located in Istanbul. The city and its surrounding province produce cotton, fruit, olive oil, silk, and tobacco. Food processing, textile production, oil products, rubber, metal ware, leather, chemicals, electronics, glass, machinery, paper and paper products, and alcoholic drinks are

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20) http://www.ibb.gov.tr/sites/ks/en-US/0-Exploring-The-City/Location/Pages/Economy.aspx

21) Ibid.

22) Economy of Istanbul http://en.wikipedia.org/wiki/Economy_of_Istanbul

23) http://www.ibb.gov.tr/sites/ks/en-US/0-Exploring-The-City/Location/Pages/Economy.aspx

among the city's major industrial products. The city also has plants that assemble automobiles and trucks. The Turkish pharmaceutical industry started in 1952 with the establishment of Eczacıbaşı Pharmaceuticals Factory in Levent, Istanbul. Today, approximately 300 companies operate in the Turkish pharmaceutical industry, a significant part of which is based within or near Istanbul.[24)]

Istanbul is one of the most important tourist spots in the country. There are thousands of hotels and other tourist-oriented industries in the city, catering to both vacationers and visiting professionals. In 2012, a total of 35 million tourists visited Turkey, most of whom entered the country through the airports and seaports of Istanbul and Antalya. In 2011, Istanbul's two international airports (Atatürk International Airport and Sabiha Gökçen International Airport) handled more than 50 million passengers, many of whom were in transit in this major international transportation hub. Istanbul is also the center of the country's air transport industry. Furthermore, 14 of the 153 museums in Turkey are to be found in Istanbul, and 34% of the 2.4 million pieces on display throughout the country are exhibited in Istanbul.

Istanbul is also one of the world's major conference destinations and is an increasingly popular choice for the world's leading international associations. Istanbul's conference appeal developed with three separate conference and exhibition areas: the "Conference Valley" (Istanbul Convention & Exhibition Center, Istanbul Hilton Convention & Exhibition Center, the Military Museum Cultural Center and the Cemal Reşit Rey Concert Hall); the Airport & Exhibition District; and the Business and Financial District (with many distributed centers). These cluster areas feature a combination of accommodations, meeting facilities, and exhibition space. They can be used individually, or collectively through transportation with the Istanbul metro, and are linked together for accommodating events with 10,000 or more participants.[25)] Istanbul was the site of the Fifth World Water Forum in 2009; 35,000 participants attended this event.

Istanbul has central importance in both domestic and international trade. Trade is the second most important sector in Istanbul after industry. In Turkey, Istanbul accounts for 27% of the general value added in the commercial sector and is the most important export and import gate of Turkey. Exports from Istanbul make up 46% of Turkey's total of about US $208 billion in 2012, and imports into Istanbul make up 40% of Turkey's total ($249 billion in 2012).[26)]

1-1-4. Golden Horn Area of Istanbul

The Golden Horn estuary supported thriving fisheries until the latter part of the 20th century. It connects the Alibeykoy and Kagithane Rivers to the Bosporus Strait and has played a substantial role in Istanbul's culture for thousands of years, particularly because of its numerous harbours, abundant fish population, and recreation grounds. In the mid-15th century, it was subject to one of the world's first management policies when Sultan Mehmet the Conqueror limited settlement, encouraged afforestation to combat erosion, banned local agriculture, and encouraged use of alluvial mud by exempting ceramic artisans from taxes.

In the first half of the 18th century, the Golden Horn was famous for its tulip gardens where upper-class people came to enjoy nature and row their boats into sunsets. Many poets called it *Sadabad* in their poems, or

24) http://www.vergidegundem.com/documents/10156/78907/xLAx_SEKTxRx_SUNUM_NxHAx.pdf

25) Economy of Istanbul http://en.wikipedia.org/wiki/Economy_of_Istanbul

26) Istanbul 2010: European Capital of Culture http://www.ibb.gov.tr/sites/ks/en-US/0-Exploring-The-City/Location/Pages/Economy.aspx

"place of bliss". President Mustafa Kemal Atatürk did not allow factories to be built near what was known as "the most romantic waterway in Europe" in the 1920–1930s. As a result, the most substantial environmental problems up to that point were shipping discharges and the accumulation of silt on the floor of the estuary.[27)]

With the population explosion of Istanbul in the 1950s and the announcement of an industrial area in the Haliç region in 1954 after World War II, the Golden Horn became an ugly storage area of grey city-sewage and industrial waste with a terrible odour (Picture 3). One-third of the estuarine surface area was filled to accommodate factories and their associated tenements with no provision for stability, or for industrial or domestic waste disposal or treatment. By 1975, 696 industrial plants had occupied a total of 1.6 km^2 along the estuary and nearby river shores in a haphazard, unplanned way. Metal smelting, electrical appliance, machinery, textile, wood, food and meat production facilities comprised 71% of this area, 28% was made up of shipyards and docks, and 8% supported warehouses.

At that time, 200,000 tons of liquid (67% chemical waste, 27% wash water, 4% cooling water, and 2% wastewater) were discharged into the Golden Horn daily. Additionally, wastes from shipping and passenger transport contributed 3.1 million tons of industrial materials and coal per year. Furthermore, the shores of both streams feeding the estuary were also developed, leading to the local annual release of 1.9 million tons of liquid and 49,000 tons of solid waste from 364

Soure: Murat Ayan

<Picture 3> Golden Horn before 1996 Restoration

27) http://www.coastlearn.org/water_quality_management/case-studies/golden_horn_halic.pdf

industries.[28] It has been estimated that in 1980, all of these industries discharged 24,000 tons of chromium, 300 tons of copper, 130 tons of nickel, and 7500 tons of zinc.

Another major source of pollution, Istanbul's sewer system, consisted of drains dating back to Roman and Ottoman periods, as well as isolated cesspools and septic tanks until the 1980s. Crude housing developments discharged 100,000 m^3 of raw domestic wastewater per day into 123 major and at least 500 minor sewers that led to the Golden Horn.

Unplanned, uncontrolled urban development around the Golden Horn and related waste generation soon gave rise to anoxic sediment build-up, a stifling hydrogen sulphide odour, high concentrations of harmful bacteria, mosquitoes, disease and a lack of formerly abundant biota.

Industrial waste, largely due to slaughterhouse activities, shipbuilding, repairing, and dockyard operations, as well as erosion via chaotic urbanization, deforestation, and livestock grazing was the third major source of pollution.

Restoration of the Golden Horn area took place from 1995 to 2003 and is still on-going. Heavy industry was moved out of the area and industrial pollution was cleaned up. Over the last 20 years derelict buildings along the waterfront have been transformed into educational and cultural centers. These waterfront developments have breathed in new economic and social vitality, and have vastly improved the marine and coastal environment in the area (Picture 4).

Source: Murat Ayan

<Picture 4> Golden Horn after Restoration of the Estuary

28) *Coleman, H.M., Kanat, G., and Turkdogan, F.I.A. 2009. Restoration of the Golden Horn Estuary (Halic). Water Resources Research.* 43(20): 4989-5003. http://www.ncbi.nlm.nih.gov/pubmed/19781731

1-1-5. Demographic Trends

The population of Turkey has greatly increased over the last half century, having more than tripled since 1960, when the population was 27.55 million.[29] The growth of the country has remained fairly steady with a normal increase of approximately 1 million every year thus keeping the annual growth rate between 1.2 and 1.5% (see Table 4).

The population in the municipality of Istanbul has also been growing rapidly, and the city had over 10.8 million people in 2012. It is the largest city in Turkey; about one seventh of the total population of Turkey lives there—and that has not changed much over the past decade (see Table 4). The population of Istanbul will likely continue to grow as it has in the past, with new business opportunities and potential for growth, attracting many to revitalized urban areas, such as the Golden Horn.

According to the World Bank, the population of Turkey reached 74.00 million at the end of 2012, an increase of 0.94 million over 2011. A little over 50% of the total population in Turkey were males and 49.8% were females. Furthermore, the proportion of population living in the province and district centers was 91.3% in 2013 while this figure was 77.3% in 2012. The main reason for this sharp rise was the establishment of 13 new metropolitan municipalities and enlarging the municipal borders by abolition of towns and villages in all of the 30 metropolitan provinces.[30]

The Bosporus Strait divides Istanbul province into the European side and the Asian side. Roughly 3.85 million people live on the Asian side and 9.4 million on the European side.[31] The capital of the province is the city of Istanbul, which, since 2004, has the same boundaries as the province.[32] Istanbul province had the highest population density in 2009, as shown in Figure

<Table 4> Population Growth in Istanbul, Percentage of Turkish Population in Istanbul, Total Population of Turkey and Population Growth in Turkey, 2000-2012

	Population in Istanbul (million people)	Population in Istanbul Metropolitan area as % of total population	Population of Turkey (million people)	Population growth rate (%/year)
2000	8.74	13.8	63.17	1.48
2001	8.94	13.9	64.10	1.45
2002	9.13	14.0	65.02	1.43
2003	9.33	14.1	65.94	1.41
2004	9.52	14.2	66.85	1.37
2005	9.71	14.3	67.74	1.33
2006	9.89	14.4	68.62	1.30
2007	10.06	14.5	69.50	1.26
2008	10.22	14.5	70.36	1.24
2009	10.38	14.6	71.24	1.24
2010	10.52	14.6	72.14	1.25
2011	10.66	14.6	73.06	1.27
2012	10.80	14.6	74.00	1.28

Source: World Bank DataSet: http://databank.worldbank.org/data/views/reports/tableview.aspx?isshared=true&ispopular=country&pid=14

29) http://databank.worldbank.org/data/views/reports/tableview.aspx#

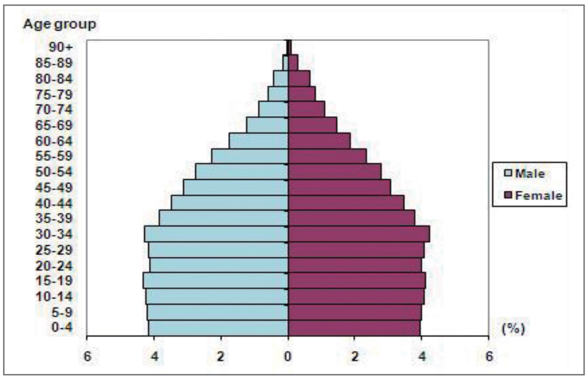
30) http://www.turkstat.gov.tr/HbGetirHTML.do?id=15974

31) http://www.citypopulation.de/php/turkey-istanbulcity.php

32) *In Turkish: On the date this law goes in effect (10 July 2004), the metropolitan city boundaries, in the provinces of İstanbul and Kocaeli, are those of the province.*

4. The population density in Turkey was measured at 94.53 people per km^2 in 2010, according to the World Bank. Population is based on the de facto definition of population, which counts all residents, regardless of legal status or citizenship-except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. The province with the highest number of persons per km^2 was İstanbul, with 2,725 persons/km^2. At a far second place was Kocaeli, with 464 persons/km^2, followed by İzmir with 338 persons, Gaziantep with 270 persons and Bursa with 263 persons.[33)]

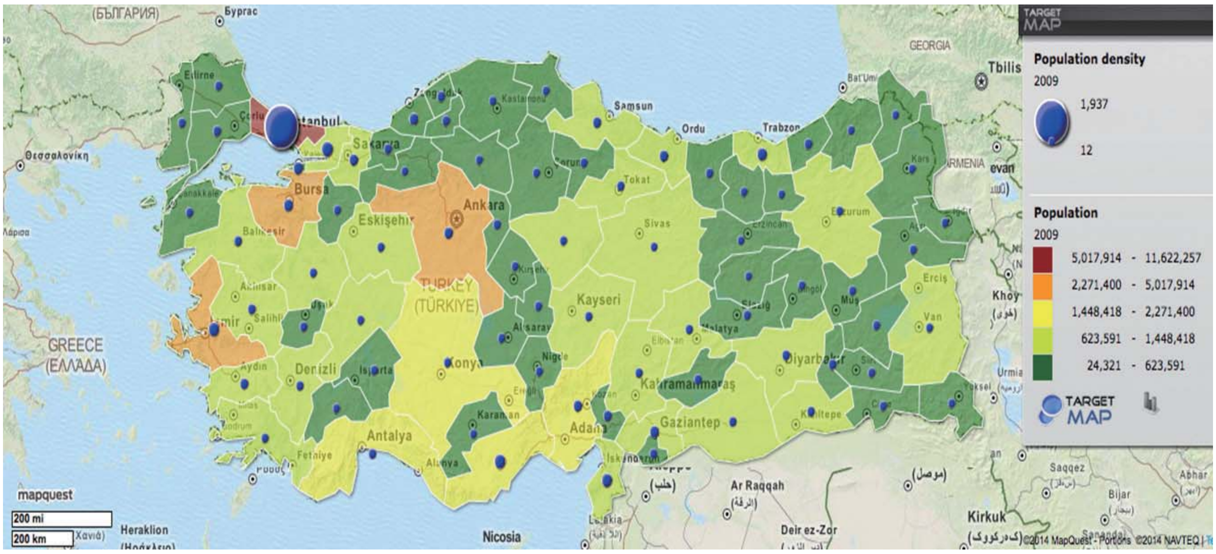
As can be observed from the population distribution in Figure 5, the greater part of the population is youthful and thus the population is in a pyramid structure. The median age of the population in Turkey was 30.4 in 2013 - 29.8 for males and 31 for females. Provinces with the highest median ages were Sinop (38.2), Balıkesir (37.7) and Edirne (37.6) respectively. Provinces with the lowest median ages were Şırnak (18.7), Şanlıurfa (19) and Ağrı (19.7).



Source: http://www.turkstat.gov.tr/HbGetirHTML.do?id=15974

<Figure 5> Population Distribution in Turkey, 2013

According to the Population nnce Bureau, 26% of the Turkish population was under 15 years old in 2012.[34)] This is considerably higher than most OECD countries, which all seem to be in the range of 13 to 18% of the population being below the age of 15 (except for the USA, which is at 20%). Most of the emerging market countries have more than 20% of their population below the age of 15 (i.e., Brazil 24%; Chile 23%; Egypt 32%; India 31%; South Africa 31%). The exception is China, with 16% of its population below 15 years of age, as a result of its one-child policy.



Source: http://www.targetmap.com/viewer.aspx?reportId=2981

<Figure 4> Population Density in Turkey, 2009

33) http://www.turkstat.gov.tr/HbGetirHTML.do?id=15974

34) Population Reference Bureau. 2012. World Population Data Sheet.

1-1-6. Effects of Economic Factors

In order to understand the effect of economic factors on rehabilitation of the Golden Horn estuary, it is useful to review the evolution of the economy's main drivers from rural to industrial and industrial to service sectors. In general, industrialization accompanied the decline in rural economic activities. The rise in industrial investments meant an increase in migration from rural Anatolia to Istanbul to fulfil the labor requirements of the rapidly expanding industries and increasingly to the service sector. The second half of the 20th century reflected the emergence of Istanbul as an industrial metropolis. In particular, the domestic migration wave of the 1960s transformed the already multicultural city by the expansion of emerging shantytowns in the very core districts of the city. The Golden Horn area was no exception; small and medium sized industrial facilities grew up on the shores of the estuary and poorly built residences with no proper infrastructure appeared around the city. Although this industry-intensive model was needed to boost the economy of developing Turkey, by the 1990s industrial production spread more to the peripheral towns around Istanbul.

In time, industrial production in the city was replaced by the service and finance sectors. The Golden Horn district had a lot to offer to make this economic transformation possible. The central location of Golden Horn estuary and its physical proximity to the historical peninsula and financial districts made such a comprehensive project crucial for the dynamics in Istanbul. As an outcome of the rehabilitation project, a formerly old-fashioned industrial zone became a center of attraction. The area now hosts remarkable landmarks that ensure socio-economic added value. There are several private university campuses, two full-fledged international convention centers and museums that attract not only the local people, but also thousands of tourists from all around the world. After the environmental rehabilitation of the estuary is completed, the urban transformation will continue to create an economically dynamic Golden Horn that deserves to be appreciated.

1-2. Social Factors

1-2-1. Turkey's Human Development Index[35] value and Rank

Turkey's Human Development Index (HDI) value for 2012 was 0.722—in the high human development category—ranking 90 out of 187 countries and territories. Between 1980 and 2012, Turkey's HDI value increased from 0.474 to 0.722, an increase of 52% or an average annual increase of about 1.3%.[36]

Table 5 presents Turkey's progress in each of the HDI indicators. Between 1980 and 2012, Turkey's life expectancy at birth increased by 17.7 years, mean years of schooling increased by 3.6 years and expected years of schooling increased by 5.5 years. Turkey's Gross National Income (GNI) per capita increased by about 133% between 1980 and 2012.

Turkey's 2012 HDI of 0.722 is below the average of 0.758 for countries in the high human development

35) The Human Development Index (HDI) is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. In the HDI, a long and healthy life is measured by life expectancy. Access to knowledge is measured by: mean years of schooling for the adult population; and expected years of schooling for children of school-entrance age. Standard of living is measured by Gross National Income (GNI) per capita expressed in constant 2005 international dollars converted using purchasing power parity (PPP) rates.

36) UNDP. 2013. Turkey's HDI Value and Rank Changes in the *2013 Human Development Report*. http://www.tr.undp.org/content/dam/turkey/docs/Publications/hdr/Turkey.pdf\

<Table 5> Turkey's Human Development Index (HDI) Trends Based on New Methodology

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2005 PPP$)	HDI value
1980	56.5	7.4	2.9	5,872	0.474
1985	60.1	8.3	4.0	6,583	0.530
1990	63.1	8.8	4.5	7,960	0.569
1995	66.1	9.5	4.8	8,539	0.598
2000	69.5	10.6	5.5	9,675	0.645
2005	72.1	11.7	6.1	11,320	0.684
2010	73.7	12.9	6.5	12,440	0.715
2011	74.0	12.9	6.5	13,344	0.720
2012	74.2	12.9	6.5	13,710	0.722

Source: UNDP: http://www.tr.undp.org/content/dam/turkey/docs/Publications/hdr/Turkey.pdf

group and below the average of 0.771 for countries in Europe and Central Asia. From Europe and Central Asia, countries which are close to Turkey in 2012 HDI rank and population size are Serbia and Azerbaijan, which have HDIs ranked 64 and 82 respectively (see Table 6). It is notable that there is a large difference of 6.4 between the expected years of schooling (12.9 years) in Turkey and the mean years of schooling (6.5 years). This gap is much larger in Turkey than in the Europe and Central Asia group or in Serbia or Azerbaijan (Table 6). On the other hand, Turkey's per capita income is well above the comparison countries.

<Table 6> Turkey's HDI Indicators for 2012 Relative to Selected Countries and Groups

	HDI value	HDI rank	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (PPP US $)
Turkey	0.722	90	74.2	12.9	6.5	13,710
Serbia	0.769	64	74.7	13.6	10.2	9,533
Azerbaijan	0.734	82	70.9	11.7	11.2	8,153
Europe and Central Asia	0.771	—	71.5	13.7	10.4	12,243
High HDI	0.758	—	73.4	13.9	8.8	11,501

Source: UNDP: http://www.tr.undp.org/content/dam/turkey/docs/Publications/hdr/Turkey.pdf

1-2-2. Social Factors in Istanbul

The population of Istanbul was counted as 14.16 million as of 1 January 2014, having increased from 10.04 million in 2000. Istanbul accounts for 18.5% of the total population of Turkey. Population density in Istanbul averages 2,725 person/km^2, 27 times the average in Turkey as a whole. The population growth rate in Istanbul was 1.68% per year on average since 2000.

Approximately 35% of the population of the Metropolitan area live on the Asian side (Anatolia), and 65% live on the European side (Thrace). Over 84% of Istanbul's residents were born outside of Istanbul.

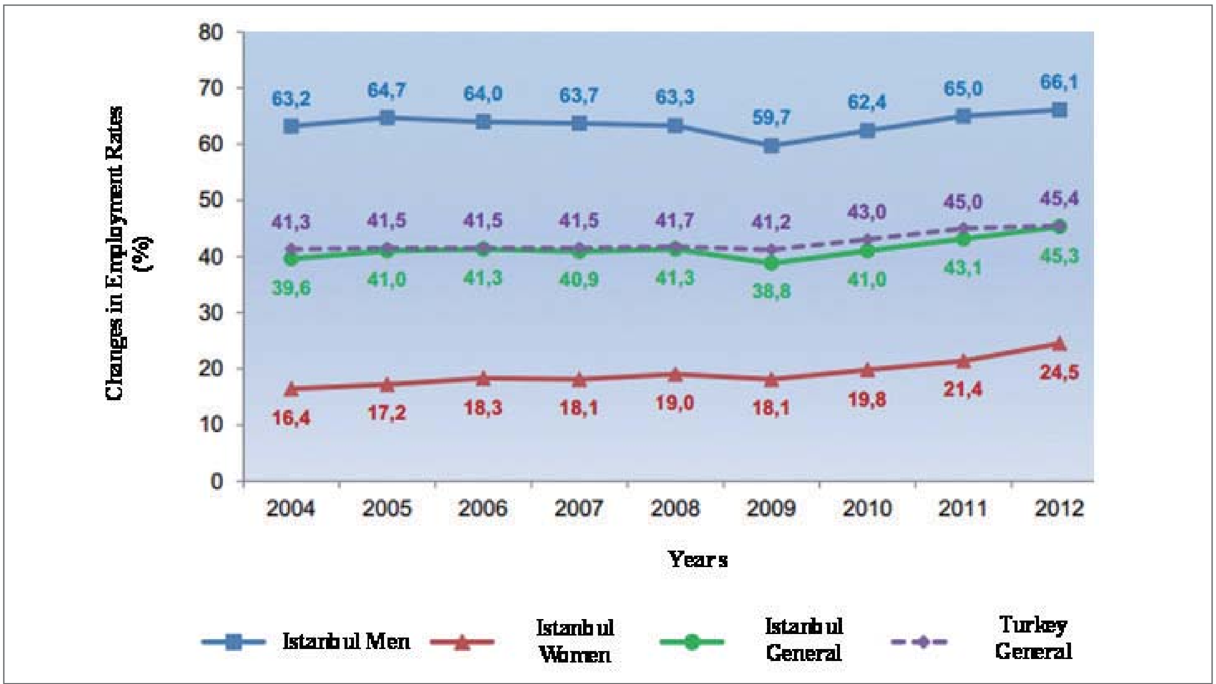
The literacy rate in Istanbul is 97.3%, which is higher than the average of 95.8% for Turkey as a whole. There are 45 universities, 914 high schools and 1,488 elementary schools in Istanbul. About one third (30%) of the total universities in Turkey are located in Istanbul. Approximately 70% of the students attend state universities, whereas the rest of the students study at private universities.[37)]

The employment rate for Istanbul was 45.3% in 2012, which is similar with Turkey's employment rates (see Figure 6). The employment rates demonstrate a steady increase over the years except in 2009 at the time of the global crisis (see Figure 6).

There is a direct correlation between education and employment. The employment rates increase directly as education levels rise. The employment rate for higher education graduates is around 72%, whereas the employment rate (in the formal sector) for people with little or no educationis about 28%.[38)]

37) Istanbul in numbers: http://www.greatistanbul.com/numbers.htm

38) ISKUR (in Turkish) http://www.iskur.gov.tr/kurumsalbilgi/raporlar.aspx#dltop



<Figure 6> Changes in Employment rates in 2004-2012(%)

1-2-3. Inequality-adjusted HDI (IHDI)

The HDI is an average measure of basic human development achievements in a country, but it does not show inequality in the distribution of human development across the population at the country level. The 2010 HDR introduced the Inequality Adjusted HDI (IHDI), which takes into account inequality in all three dimensions of the HDI by 'discounting' each dimension's average value according to its level of inequality. The HDI can be viewed as an index of 'potential' human development and the IHDI as an index of actual human development. The 'loss' in potential human development due to inequality is given by the difference between the HDI and the IHDI, and can be expressed as a percentage.

Turkey's HDI for 2012 is 0.722. However, when the value is discounted for inequality, the HDI falls to 0.56, a loss of 22.5% due to inequality in the distribution of the dimension indices. Serbia and Azerbaijan show losses due to inequality of 9.5% and 11.4% respectively. The average loss due to inequality for high HDI countries is 20.6% and for Europe and Central Asia it is 12.9%. This indicates a relatively high degree of inequality in Turkey.

For example, the Gender Inequality Index (GII) reflects gender-based inequalities in three dimensions – reproductive health, empowerment, and economic activity. Reproductive health is measured by maternal mortality and adolescent fertility rates; empowerment is measured by the share of parliamentary seats held by each gender and attainment at secondary and higher education by each gender; and economic activity is measured by the labor market participation rate for each gender.

Turkey has a GII value of 0.366, ranking it 68 out of 148 countries in the 2012 index. In Turkey, 14.2% of parliamentary seats are held by women, and 26.7% of adult women have reached a secondary or higher level of education, compared to 42.4% of their male counterparts. For every 100,000 live births, 20 women die from pregnancy-related causes; and the adolescent fertility rate is 30.5 births per 1000 live births. Female participation in the labor market is 28.1% compared to 71.4% for men.[39)]

1-2-4. Other Measures of Education and Health

Having a good education is an important requisite for finding a job in Turkey, but there is still much work to be done to improve schools and the level of instruction that Turkish people receive in schools and universities. An estimated 31% of adults aged 25-64 have earned the equivalent of a high-school degree; this is surprisingly only about half of the average for other OECD, which stands at 74%. The situation is better for men than for women, as 36% of men have successfully completed high school compared with 26% of women. This suggests that women's participation in higher education could be encouraged and strengthened. In terms of the quality of the educational system, the average student scored 455 in reading literacy, maths, and science in the OECD's Program for International Student Assessment (PISA), lower than the OECD average of 497. On average in Turkey, girls outperformed boys by 15 points, more than the average OECD gap of 9 points.

In terms of health, life expectancy at birth in Turkey is 74 years, six years lower than the OECD average of 80 years. Life expectancy for women is 77 years, compared with a much lower figure of 72 for men. The level of atmospheric PM10 – tiny air pollutant particles small enough to enter and cause damage to the lungs – is 37 micrograms per m^3, considerably higher than the OECD average of 21 micrograms per m^3. Turkey also performs below the OECD average in terms of water quality, as 61% of people say they are satisfied with the quality of their water, below the OECD average of 84%.[40] Therefore, although Turkey's economic output may be strong, much more focus is needed on the social and environmental factors in the country.

In terms of employment, 48% of people aged 15 to 64 in Turkey have a paid job, less than the OECD employment average of 66%. Some 69% of men are in paid work, compared with 28% of women. People in Turkey work on average 1,877 hours a year, more than the OECD average of 1,776 hours. Around 46% of employees work very long hours, much higher than the OECD average of 9%, with 50% of men working very long hours compared with 35% for women.[41]

1-2-5. Historical Social Trends in Istanbul and the Golden Horn

Istanbul has been a cosmopolitan city throughout much of its history, but it has become more homogenized since the end of the Ottoman Empire. Still, most of Turkey's religious and ethnic minorities remain concentrated in Istanbul. The vast majority of people across Turkey, and in Istanbul, consider themselves Muslim, and more specifically members of the Sunni branch of Islam. The largest non-Sunni Muslim sect, accounting for 4.5 million Turks, is the Alevis; a third of all Alevis in the country live in Istanbul. Mystic movements, such as Sufism, were officially banned after the establishment of the Turkish Republic, but they still have numerous followers.[42]

The Patriarch of Constantinople has been designated Ecumenical Patriarch since the 6th century, and has subsequently come to be widely regarded as the leader of the world's 300 million Orthodox Christians. Since 1601, the Patriarchate has been based in Istanbul's Church of St. George. Into the 19th century, the Christians of Istanbul tended to be either Greek

39) These figures are different from the World Bank statistics used in table 3, but they show the same disparity in labor force participation.

40) OECD Better Life Index http://www.oecdbetterlifeindex.org/countries/turkey/. OECD figures are slightly different from those cited by UNDP in Table 6.

41) OECD Better Life Index http://www.oecdbetterlifeindex.org/countries/turkey/. OECD figures are slightly different from World Bank employment data in Table 2.

42) Religion in Istanbul http://en.wikipedia.org/wiki/Religion_in_Istanbul

Orthodox or members of the Armenian Apostolic Church. Because of a number of events during the 20th century—including the population exchange between Greece and Turkey in 1923 and the 1955 Istanbul riots—the Greek population, originally centred in Fener and Samatya, has decreased substantially. At the start of the 21st century, Istanbul's Greek population numbered just 3,000 (down from 130,000 in 1923). The Armenian population in Turkey also saw a decline, in part due to the relocation of Armenians starting in 1915, but it has been on the rebound because of recent immigration from Armenia; today, there are between 50,000 and 70,000 Armenians in Istanbul, compared to 164,000 in 1913.[43)]

The largest ethnic minority in Istanbul is the Kurdish community, originating from eastern and south-eastern Turkey. Although the Kurdish presence in the city dates back to the early Ottoman period, the influx of Kurds into the city has accelerated since the late 1970s. About 2 to 3 million residents of Istanbul are Kurdish, meaning there are more Kurds in Istanbul than in any other city in the world. Levantines, Latin Christians who settled in Galata during the Ottoman period, played a seminal role in shaping the culture and architecture of Istanbul during the 19th and early 20th centuries; their population has dwindled, but they still remain in the city in small numbers.[44)]

The Golden Horn area, along the natural harbour dividing Istanbul, is now surrounded by parks and promenades with ancient sites scattered among them. Its name comes from the colour of the water when it shines with a gold colour at sunset because of the sun’s reflection.

The Golden Horn was an old trading harbour and a popular residential area during the Byzantine period (~330 CE to 1453). A huge chain historically blocked its entrance to stop unwanted ships from entering. During the Ottoman period (~1300-1922), it was largely inhabited by Jewish immigrants from Spain. The mixture of Armenians, Greeks, Gypsies, and Turks living along its shores reflected the city's colourful ethnic mosaic.

With the population explosion in the 1950s and ineffective building laws, the Golden Horn became an ugly storage area of grey city sewage and industrial waste with a terrible odour. But in the 1980s the urban rehabilitation began, clearing up these factories and building proper sewage systems around the Golden Horn. Now its shores are green once again with parks, promenades, and playgrounds. Although much still remains to be done, people enjoy the area and can even fish there.

Fener and Balat are old neighbourhoods of the Golden Horn, with traditional old wooden houses, Byzantine churches, and a few old synagogues belonging to the first Jewish community that settled there. The neighbourhood of Balat used to be home to a sizable Sephardic Jewish community, first formed during the period of the Spanish Inquisition after 1492. As a result of emigration to Israel, the Jewish population in Turkey declined from 100,000 in 1950 to just 18,000 in 2005, the majority of whom lived in either Istanbul or İzmir. The Orthodox Patriarchy is also located along the banks of the Golden Horn estuary.

The Eyup neighborhood towards the end of the Golden Horn is an important site for Muslims who come to visit and pray at the tomb of Eyub El Ensari, a companion of the Prophet Muhammad who died during the Arab siege of Constantinople in the 7th century. Around the mosque and the hills are cemeteries from the Ottoman period.

43) Religious and Ethnic Groups http://en.wikipedia.org/wiki/Istanbul#Religious_and_ethnic_groups
44) Ibid.

There was no bridge over the Golden Horn before the 19th century. Small boats provided transportation between the two shores. The first Galata Bridge, which connects present day Karaköy to Eminönü, was built in 1836, then rebuilt first in 1845, and again in 1912 and in 1993.

The Unkapani (also named as Ataturk) Bridge further up the Golden Horn handles the flow of traffic between Beyoglu and Saraçhane. A third bridge over the Golden Horn is called the Haliç Bridge, and has a highway passing through it. The new Galata Bridge was completed 1994, and the Haliç Metro Bridge was completed in February 2014.

1-2-6. Effects of Social Factors

Turkey as a whole has witnessed a rapid social transformation due to the replacement of the Ottoman Empire with the Republic of Turkey. A dynamic modernization process brought about significant changes in life styles, places and institutions. Istanbul is the main first hand witness of this social transformation, as it represents the former capital of successive empires and is now the financial and cultural capital of a modern nation state. Through the early decades of the Republic, Istanbul welcomed millions of domestic migrants from Anatolia, the majority of whom struggled to preserve their genuine lifestyle, which in turn led to a disrupted socio-cultural environment. This disordered social environment revealed the social and economic gaps between people in different parts of the metropolitan area.

The Golden Horn area constitutes an exciting case from which to observe the social transformation of Turkey in general and Istanbul in particular. The neighbourhoods dominated by non-Muslim residents, such as Fener and Balat from the Ottoman Era, now host an increasing number of mobile world citizens once again. The Golden Horn has become a favourable residential area for temporary ex-patriots, including overseas students, journalists, academics, artists, and other adventurous young professionals. The implicit impact of the Golden Horn Project is this mobilization of young people resulting from the urban transformation that has escalated since the early 2000s. The trends in Table 7, however, show that the social impact of the rehabilitation of the Golden Horn area coincided with an overall population decrease in the area, mainly because of removal of industrial facilities and poorly constructed housing. This has been accompanied by a large increase in population in the inner and outer rings of the metropolitan area.

<Table 7> Population Change in Different Parts of Istanbul (thousand people)

Area	1985	2000	2011	Change: 1985-2011 (%)
Historic Core: Fatih	591	459	429	- 27
Balance of Core	1,336	2,175	1,270	- 5
Inner ring	2,635	5,747	7,800	+196
Outer ring	1,044	2,424	3,598	+245
Exurbs	147	240	386	+162
Total	5,753	11,045	13,483	+134

Note: Historic core includes Golden Horn area
Source: http://www.newgeography.com/content/003020-the-evolving-urban-form-istanbul

The urban transformation of the Golden Horn area has two basic forms: one is to renovate the old residences with no change of ownership either for self-use or for renting; the other is to buy and sell the old residences, demolish and reconstruct them as attractive big projects. Although the latter method has the potential to derive greater added economic value, it may cause an increased gap among social strata due to disregard for the equitable allocation of benefits.

Looking from the lens of human development, the Golden Horn project has achieved a significant contribution to education capacity by opening a healthy urban waterfront environment suitable for construction of high-level education institutions, rowing clubs, cultural centers and museums. Considering that these educational and cultural facilities are open to the public and are not exclusive to inhabitants of the Golden Horn, it should be noted that locals are not the direct beneficiaries of the renewal process. The project also ensured a healthy environment for marine life and resulted in an increase in the fish population a positive impact on biodiversity. Hand-line fishing, which was absent from the region for a long time because of the pollution, is continuously increasing and contributing to well-being at the micro level for the local residents. All in all, improvements in the Golden Horn's ecosystem affect the aesthetic quality of the region, which in turn leads to improvements in the social fabric of the district.

1-3. Political Factors

The political system in Turkey is a parliamentary democracy. The Turkish Constitution structures the Republic of Turkey as a democratic, secular, and social state in which the executive, legislative, and judicial powers are separated.[45] The Prime Minister of Turkey is the head of government, and of a multi-party system. The President of Turkey is the head of state who holds a largely ceremonial role, but with substantial reserve powers. The president is elected for a seven-year term by direct elections. Abdullah Gül was elected as president in August 2007, by a popular parliament round of votes.[46]

Executive power is exercised by the Prime Minister and the Council of Ministers that make up the government, while the legislative power is vested in the unicameral parliament, the Grand National Assembly of Turkey. The judiciary is independent of the executive and the legislature, and the Constitutional Court is charged with ruling on the conformity of laws and decrees with the constitution. The Council of State is the tribunal of last resort for administrative cases, and the High Court of Appeals for all others.

The prime minister is elected by the parliament through a vote of confidence in the government and is most often the head of the party having the most seats in parliament. The current prime minister is the former mayor of İstanbul, Recep Tayyip Erdoğan, whose conservative Justice and Development Party was elected for a third consecutive time in the 2011 general elections. Although the ministers do not have to be members of parliament, ministers with parliament membership are common in Turkish politics.

1-3-1. Administrative Units

The general administration is divided into two jurisdictions as the central government and local governments. The central government administration is divided into 81 provinces (see Figure 7), which are in turn divided into 923 districts. The centralized administrative bodies that function under a given ministry are in charge of fulfilling public services on a national scale, and linked with associated agencies at the provincial level. In this respect, the local governments are the bodies that provide the services for citizens in provinces, municipalities and villages. The two separate Ministries of Environment and Forestry were merged in 2003. The result of this merger bolstered the administrative capacity of the state's environment and forestry related activities. In 2011 the Ministry was again divided into two separate ministries: the Ministry of Forestry and Water Affairs and the Ministry of Environment and Urbanization. The former one has the primary authority in water resources management with the integration of significant water-related administrative responsibilities.

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45) http://www.eea.europa.eu/soer/countries/tr/country-introduction-turkey
46) http://www.bbc.com/news/world-europe-17992010

Source: http://www.resimseli.com/data/media/401/map_turkiye.gif

<Figure 7> Map of Provinces in Turkey

Istanbul is not only a city, under this system, but also a province in its own right. Both metropolitan and provincial municipalities have decision-making powers in so far that the metropolitan administration is responsible for macro-level decisions concerning the entire city, while districts are responsible for decisions related to traditional municipal services. A powerful mayor (currently Mr. Kadir Topbaş) is generally in charge of the administration of the Istanbul Metropolitan Municipality (IMM). The mayor makes macro-level decisions, which are then passed to a municipal council.

As with other cities that have grown rapidly and that urgently need solutions for their basic infrastructure problems, city-wide decisions to address the concerns of citizens are vitally important in Istanbul. However, since local administrations are not financially autonomous, they are engaged in a never-ending search for new resources to implement their decisions.

Therefore, good relations with the central government are crucial. In Istanbul, most problems have occurred when the political party of the metropolitan municipality differed from that of the central government. Currently, Istanbul's local administration and the central government in Ankara are politically aligned and share common political views. In addition, the Prime Minister was formerly the mayor of Istanbul, and considers himself as an 'Istanbul lover.'

However, when it comes to the making of macro-level decisions, the central government exerts a strong influence on Istanbul. Moreover, Istanbul's residents have generally supported decisions taken even by the central government because of their efficiency at the local level.

In fact, there is considerable popular support for an administration that is addressing the fundamental and urgent infrastructural problems that they face. The Prime Minister seems content that the public recognizes and supports the central government's role in projects concerning the city's infrastructure. Indeed, these investments boosts popular support just like social relief for the poorer citizens. Just recently (February 2014) Mayor Topbaş and Prime Minister Erdoğan opened a new metropolitan bridge (officially named Haliç Metro Bridge) on Istanbul's Golden Horn, marking the latest step in a plan to expand railway transportation in Turkey's largest city.

Istanbul is thus being governed by a strong leader with a populist approach and close ties to the central government. In this context, it is worth mentioning that a strategic planning ethos now guides the city's growth. Responsibility for this strategic vision has been transferred to the Istanbul Metropolitan Planning and Urban Design Center (IMP), a new organization that operates alongside political and bureaucratic bodies of the Istanbul Metropolitan Municipality.

1-3-2. Foreign Policy

Turkey's foreign policy has often been in line with most of Western Europe. The country was a founding member of the Council for Europe in 1949 and became an associate member of the European Economic Community in 1963. Turkey applied for membership in the European Communities on 14 April 1987. The European Commission issued an opinion in 1989 which concluded that, while Turkey was eligible for membership, it would be appropriate to postpone the decision to be made on Turkey's membership. In a decision concluded on 6 March 1995, a customs union between Turkey and the European Communities was fully established in the area of industrial products. In accordance with the Decision, the customs union between Turkey and the European Communities began to operate on 1 January 1996. Following Turkey's request to take part in the new enlargement process launched in 1996, Turkey was admitted as a candidate for the EU membership on an equal basis with the other candidate countries at the European Council held in Helsinki on 10-11 December 1999.[47)]

In December 2004, the European Council stated that, "Turkey sufficiently fulfils the Copenhagen criteria to open accession negotiations." Based on this decision, EU-Turkey accession negotiations were opened on 3 October 2005 with an analytical examination of the EU legislation, finalized on 13 October 2006. Since then the negotiations have been on-going in nine chapters. However, its support for Northern Cyprus in the Cyprus dispute between Turkey and Greece over the Republic of Cyprus, has complicated Turkish relations with NATO and with EU member states. Turkey maintains 36,000 troops in Northern Cyprus, though their presence is controversial.

Turkey was not only a founding member of the United Nations in 1945 and of the OECD in 1969, but it was also a founder of the Organization for Security and Cooperation in Europe (OSCE) in 1973, and of the G-20 major economies in 1999.

Turkey also has strong ties with the United States, which supports Turkey's bid to join the European Union. These strong relations date back to the Cold War when Turkey kept close bilateral relations with the U.S.

Turkey has maintained forces in international missions under the United Nations and NATO since 1950, including peacekeeping missions in Somalia and former Yugoslavia, and support to coalition forces in the First Gulf War. Turkey has had troops deployed in Afghanistan as part of the United States stabilization force and the UN-authorized, NATO-commanded International Security Assistance Force (ISAF) since 2001.

1-3-3. Effects of Political Factors

Politics at local and national levels have mostly been mutually responsive to each other. Istanbul has a special place in this equation, with its economic and symbolic

47) European Environment Agency. 2010. Country Profile: Turkey. State of the Environment Report (SOER). http://www.eea.europa.eu/soer/countries/tr/country-introduction-turkey

values. The fact that the current Prime Minister was formerly the Mayor of Istanbul has ensured that attention to urban improvements, particularly around the Golden Horn, has continued without interruption. Political support is crucial to the success of Water and Green Growth case studies.

As the financial capital of the country, Istanbul hosts a very important business group that has the capability of acting as an interest group with a rather pro-EU stance to politics. Yet, it would be misleading to consider the business group as a homogeneous unit. Especially through the last decade, there has been a process of resource redistribution and emergence of new elites that is caused by the relative proliferation of wealth. As the economic shares grow larger, the number of political opportunities are enhanced. Looking from the symbolic perspective, Istanbul is often valued as a micro replica of Turkey with a massive number of habitants who are domestic migrants in a way. Due to its socio-economically heterogeneous population, its historical significance and its international credibility, the city holds political relevance well above than of an average city. The combination of economic and symbolic indicators in turn is reflected in everyday politics that implies 'one who rules Istanbul, rules Turkey'.

The Golden Horn area had good times and bad times like many other urban zones globally. Its central location in Istanbul makes it relevant for symbolic political influence. As the environmental rehabilitation is fostered by social and economic transformation, the district provides political influence, as it can be promoted both by local and central government politicians. Revival of this once environmentally devastated urban center is a remarkable political success as long as it is combined with fairly implemented social and economic policies.

1-4. Environmental Factors

1-4-1. Water and Sanitation

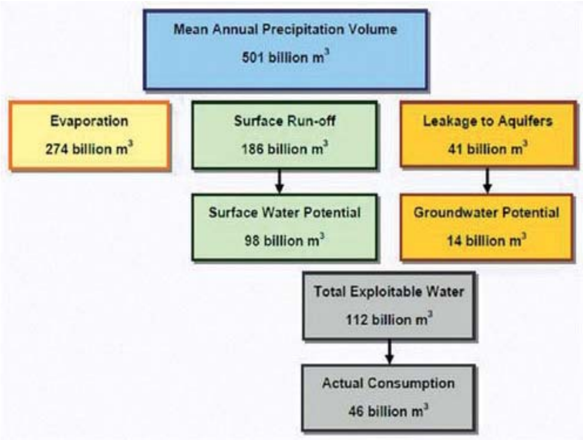
Turkey is one of the most water rich countries of the Mediterranean, but due to significant population growth, from 28 million in the 1960s to 74 million in 2012, the availability of water resources has already decreased from around 4000 m^3 to 1500 m^3 per capita/year. The annual water budget is presented in Figure 8. Water demand in Turkey approximately doubled in the second half of the 20th century. The overall water demand in Turkey continues to increase, even more in the light of the effects of drought and/or climate change.[48)] It is estimated that Turkey will suffer from water scarcity within the next several years. Over 73% of the total water supply of Turkey is used for agricultural irrigation, while about 15% is for domestic water supply and 11% for industrial purposes respectively.[49)]

There has been a strong growth in access to improved water supply, from 85% of the population in 1995 to 99% in 2011. The proportion of the population with access to improved sanitation has increased from 84% in 1995 to an overall level of 91% of the population of Turkey in 2011(urban 97%, rural 75%), including households with connections to the public sewer system, a septic system or a simple pit latrine.[50)]

48) Center for Climate Adaption. n.d. Europe in a Changing Climate: Fresh Water Resources in Turkey http://www.climateadaptation.eu/turkey/fresh-water-resources/

49) Dogdu, M.S. and Sagnak, C. 2008. Climate Change, Drought and Over Pumping Impacts on Groundwaters: Two Examples from Turkey. Paper submitted to the Third International BALWOIS Conference on the Balkan Water Observation and Information System.

50) WHO/UNICEF Joint Monitoring Program. 2013. Progress on Sanitation and Drinking Water, 2013 Update. http://www.wssinfo.org/fileadmin/user_upload/resources/JMPreport2013.pdf.(Accessed 27 03 2014)

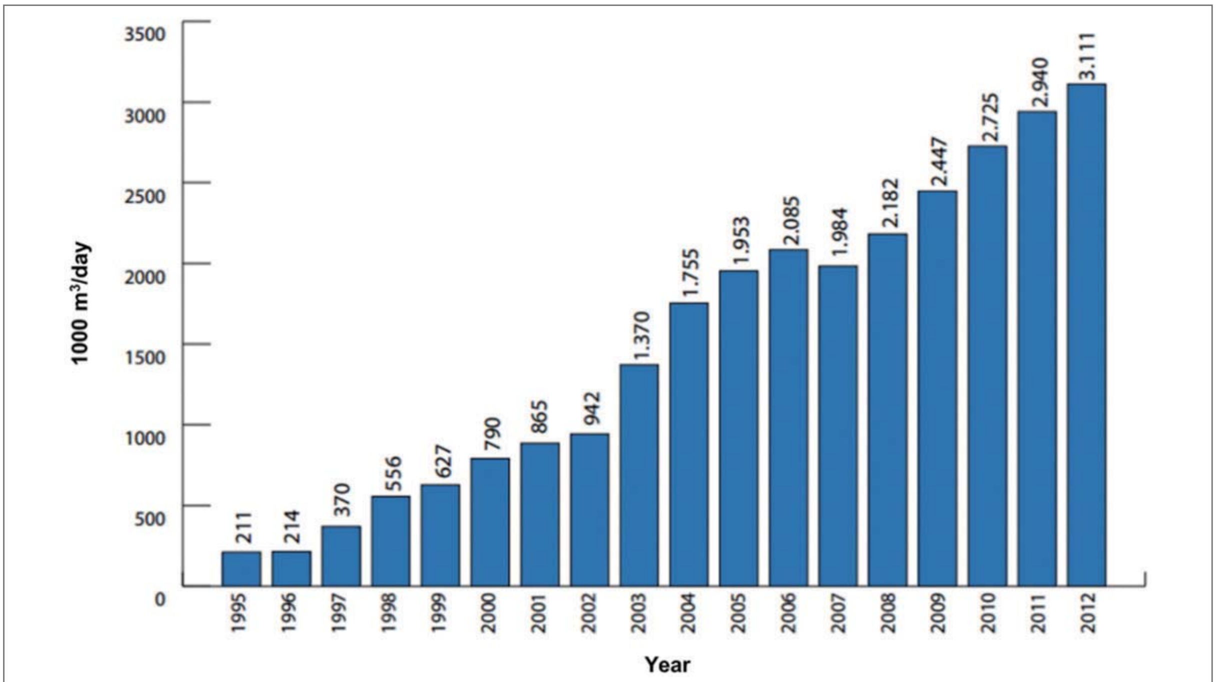


Source: http://www.eea.europa.eu/soer/countries/tr/country-introduction-turkey

<Figure 8> Annual Water Budget in Turkey

A Municipal Wastewater Statistics Survey conducted by the Turkish Statistical Institute showed that 2,300 municipalities out of 2,950 municipalities were served by sewerage systems in 2012. Out of 4.1 billion m^3 of wastewater discharged from the sewerage systems in 2012, 3.3 billion m^3 or 80% were treated in wastewater treatment plants. The rate of advanced treatment was 38.3%, biological treatment was 32.9%, physical treatment was 28.5% and the rate of natural treatment was 0.3%. Approximately 52.7% of the treated wastewater was discharged into the sea, 39.2% was discharged into a river, 3.0% was discharged into a reservoir or lake, and 4.8% was discharged into other receiving bodies.[51] The survey showed that 78% of Turkey's total population were served by sewerage systems in 2012, with 92% of urban residents being connected to sewers. Approximately 58% of Turkey's population and 68% of the municipal population were served by wastewater treatment plants.

The average amount of wastewater discharged from municipal sewerage systems per capita per day was determined as 190 litres. The average for Istanbul was calculated as 224 litres per capita per day. The increase in the treated wastewater flow rates is presented in figure 12. Within the last 20 years the percentage of treated wastewater has increased from 15% to 95% in Istanbul.



Source: İSKİ Annual Report 2012

<Figure 9> Changes in the Treated Wastewater Flow Rates in Istanbul

51) Turkish Statistical Institute. 2012. Municipal Wastewater Statistics. http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=16169

1-4-2. Pollution Concerns

As Turkey's economy experienced high levels of growth in the 1970s to mid-1990s, the country's boom in industrial production resulted in high levels of pollution and environmental degradation.

The Golden Horn in Istanbul was one of the places hit worst by the overuse of natural resources and the disposal of waste beyond the assimilative capacity of the ecosystem. Degradation of the ecosystem was caused by a combination of unregulated industrialization, unplanned urbanization, heavy use of chemicals and pesticides in the agricultural sector, ill-managed tourism activities, large energy and irrigation projects, with little regard for environmental dynamics. Other factors that put pressure on the ecological systems of Turkey were high population growth, uneven development and income distribution, and persistent poverty. Also contributing to environmental degradation were air pollution in cities and industrial sites, surface and groundwater pollution, erosion, salination of soils, deforestation, loss of biodiversity, and visual and noise pollution.[52)]

Furthermore, with domestic energy consumption on the rise from all this economic activity, Turkey has been forced to import more oil and gas, meaning more oil tanker traffic in the Black Sea and Bosporus Straits, again increasing environmental threats in the Golden Horn region. This has added to the heavy shipping traffic from the construction of oil pipelines from the Russian Federation to Europe, i.e., the Baku-Tiflis-Ceyhan oil pipeline. Turkey has become a major energy corridor in the region for this trade in recent years and is still addressing the environmental impacts of the sudden surge.[53)]

The importance of strong environmental protection measures, as well as the fragility of Turkey's environment, was driven home by a catastrophe that struck the Tisza and Danube rivers in south-eastern Europe in January 2000. After a reservoir wall at a gold mine in Romania collapsed, cyanide-tainted water was dumped into the Tisza River, and the toxic spill killed thousands of fish in Hungary as it flowed downstream into the Danube. Although the spill was supposed to be diluted by the time it reached the Black Sea, and it was not expected to cause any damage there or in the Sea of Marmara, Turkey took no chances, taking water samples in the Bosporus Straits to measure any effects from the toxic spill.

While the impacts of the spill on waters around Turkey seemed minor, it called for preparedness on the part of the Turkish authorities. Increased shipping traffic through the narrow Bosporus Straits has heightened fears of a major accident that could have serious environmental consequences and endanger the health of the 12 million residents of Istanbul who live on either side of the Straits.

The Straits are 31 km long and have 12 abrupt, angular windings, and with the large increase in shipping traffic since the end of the Cold War (now over 45,000 vessels per year – one every 12 minutes), are in danger of environmental disasters. Already, between 1988 and 1992, increased congestion led to 155 collisions in the Straits.[54)] In 2013, there were several maritime incidents in the Bosporus Straits, including two ferries colliding in heavy fog, a cargo ship that ran aground and several ships that had to be towed due to engine failure, engine fires or mechanical problems.[55)]

52) European Environmental Agency. Country Profile - Distinguishing Factors: Turkey. http://www.eea.europa.eu/soer/countries/tr/country-introduction-turkey.
53) Middle East Forum. 2009. Turkey at the Energy Crossroads. http://www.meforum.org/2108/turkey-at-the-energy-crossroads
54) U.S. Energy Information Administration. 2000. Turkey Environmental Issues. http://www.nuce.boun.edu.tr/turkey.html
55) http://en.wikipedia.org/wiki/List_of_maritime_incidents_in_the_Turkish_Straits

1-4-3. Oil and Gas Shipments through the Bosporus

With the high volume of oil being shipped through the Bosporus, oil tanker accidents can release large quantities of oil into the marine environment. This danger was underscored in March 1994, when the Greek Cypriot tanker Nassia collided with another ship, killing 30 seamen and spilling 20,000 tons of oil into the Straits. The resulting oil slick turned the waters of the Bosporus into a raging inferno for five days. Fortunately, because the accident occurred in the Straits a few miles north of the city, a potential urban disaster was averted.[56)]

In the aftermath of the 1994 Nassia disaster, Turkey passed regulations requiring ships carrying hazardous materials to report to the Turkish Environment Ministry. However, Turkey's power to regulate commercial shipping through the Straits is limited by the 1936 Treaty of Montreux that delineates the Straits as an international waterway. Although subsequent international agreements have given Turkey the right to regulate the right of passage through the Straits to ensure a steady and safe flow of traffic, Turkey has not been stringently enforcing the shipping laws passed in 1994 because of pressure from some Black Sea border countries.

Traffic will likely increase even more in coming years as the six countries surrounding the Black Sea develop economically. With tonnage on the rise as well, the threat of collision is not the only danger: on December 29, 1999, the Volgoneft-248, a 25-year old Russian tanker, ran aground and split in two in close proximity to the southwest shores of Istanbul. More than 800 tons of the 4,300 tons of fuel-oil on board spilled into the Marmara Sea, covering the coast of Marmara with fuel-oil and affecting about 13 km^2 of the sea.[57)]

In addition, while major spills can bring about immediate environmental consequences, the presence of large oil- and gas-carrying ships in the Straits causes other problems, such as the day-to-day release of contaminated water as the ships ballast their holds. Pollution in the Straits contributed to a decline in fishing levels by more than 96% of their former levels.

To reduce the strain on the marine environment caused by ship traffic, Turkey has supported alternative means of transporting oil and gas from Central Asia, such as the Caspian oil pipeline route from Baku to the Turkish Mediterranean port of Ceyhan. It was also in favour of the Trans-Caspian gas pipeline from Turkmenistan across Azerbaijan and Georgia to Turkey. Turkey continues to support the Ceyhan terminal for the long term to reduce the amount of oil shipped to Black Sea ports (which then must pass through the Bosporus to world markets). However, a recent Kazakh-Russian deal to ship more oil to the Russian Black Sea port of Novorossiisk guarantees that more oil will continue to flow through the Straits.[58)]

Turkey imports practically all the oil and gas it uses and these imports may almost double over the next decade. A key part of Turkey's policy is energy diplomacy with the supplier countries in the region, which together hold more than 70% of the proven oil and gas reserves of the world. Turkey has been quite successful, as is evidenced by agreements with Russia, Iran, Iraq, Egypt, the Caspian region (Azerbaijan), and Central Asia (Turkmenistan). These agreements and the related projects also strengthen Turkey's role as a transit country, an energy corridor between its neighbouring supplier regions and the European and other international markets. Ceyhan on the

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56) U.S. Energy Information Administration. 2000. Turkey Environmental Issue. http://www.nuce.boun.edu.tr/turkey.html. (Accessed 27 March 2014)

57) Ibid.

58) Ibid.

Mediterranean coast is developing as a major oil terminal in the region. The IEA recognizes that Turkey's proactive stance benefits both the country itself and the wider international community.[59)]

1-4-4. Energy Consumption

According to the IEA's 2009 assessment,[60)] Turkey will likely register the fastest medium- to long-term growth in energy demand among the IEA member countries. It has a young and urbanizing population, and energy use is still comparatively low. Therefore, ensuring sufficient energy supply to a growing economy remains the government's main energy policy concern, with lower priority being given to market reform and environmental protection. However, Turkey has made good progress in balancing the three areas of energy policy since 2005. Affordable energy is essential for increasing the living standards of the Turkish people. Large investments in energy infrastructure, especially in electricity and natural gas, are needed over the coming years to avoid bottlenecks in supply and to sustain rapid economic growth. Turkey will rely largely on the private sector as the source for such large energy investments.

Closely related to economic growth, energy use in Turkey is expected to double over the next decade, with electricity demand rising even faster. Such rapid growth requires not only large investments, but also measures to ensure energy security and environmental protection. Turkey has large coal reserves and it will use them to meet the needs of the growing population and expanding economy. The government is also determined to utilize Turkey's large remaining potential for hydro and wind power, as well as solar and geothermal energy. It is also planning to introduce nuclear power to further diversify its power generating capacity.

Although analysts have said that Turkey's continually increasing energy consumption is needed to power the country's growing economy. However, environmental critics believe that Turkey's economic policies have encouraged energy waste. Because the Turkish energy sector is mainly state-owned, critics charge that the government's pricing policy has encouraged the inefficient use of energy. Experts claim that about 22% of energy generated in Turkey is lost because of inefficient distribution and relay systems. In turn, they argue, this energy waste has necessitated the accelerated growth in energy demand and imports.

The Turkish government and municipalities have taken several measures to reduce pollution from energy sources. In order to meet EU environmental standards, in recent years, Turkey has improved its policies to control air pollution. For example, old coal-fired power plants are being equipped with flue gas desulphurization (FGD) units, and in the transport sector, environmental performance has improved thanks to several new regulations on emissions from motor vehicles and quality standards for motor fuels. Air pollution control will continue to require attention, especially in light of the expected rapid growth in fossil fuel use.[61)] The IEA has recommended that Turkey increase investments in public transport, especially in urban areas, as well as improve the implementation of existing regulations on air quality. There is a large potential for further energy efficiency improvements in transportation and buildings, since cars are becoming more and more popular and significant new construction is foreseen.

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59) International Energy Agency. 2009. Energy Policies of IEA Countries: Turkey 2009 Review.. http://www.iea.org/publications/freepublications/publication/turkey2009.pdf

60) Ibid.

1-4-5. Climate Change Efforts

Smog is a particularly bad problem in many Turkish cities, especially Istanbul. Rising energy consumption and the increase in car ownership have increased air pollution, and as Turkey continues to develop its economy, the problem will be exacerbated unless preventive actions are undertaken.

Energy-related CO_2 emissions have more than doubled since 1990 and are likely to continue to rise rapidly over the medium and long term, in parallel with significant growth in energy demand. Turkey ratified the United Nations Framework Convention on Climate Change (UNFCCC) in February 2004 and became a Party to the Kyoto Protocol in 2009. However, as a rapidly developing economy with low emissions per capita, Turkey has preferred not to set a quantitative overall target to limit emissions. This exemption is based on the decision 26/CP.7 of 2001 by the Parties to the UNFCCC. Turkey is the only Annex-I country that had not (by May 2010) set mitigation targets for the post-2012 period or proposed mitigation actions to support them, as required under the Copenhagen Accord. It is also the only OECD country that does not have a national emission target for 2020.[62)]

Now Turkey has established a National Coordination Board on Climate Change, which has prepared a National Climate Change Action Plan (NCCAP) under an agreement between the Ministry of Environment and Forestry and UNDP.[63)] The NCCAP, completed in 2011, provided no target for the reduction of greenhouse gas emissions. The plan explains how Turkey aspires to integrate its climate change policies into development policies, enhancing the use of clean and renewable energy sources, and participating actively in the international negotiations on climate change within the scope of its "special circumstances". The issue of adaptation was also included in the Action Plan in order to ensure a holistic approach to climate change.[64)]

1-4-6. Energy Mix

Turkey is building an extensive network of hydroelectric energy sources in the southeast part of the country, and cleaner-burning natural gas is moving to replace coal in power generation. Hydroelectricity accounted for about 34% of total installed electricity capacity in 2012. It ranked 11th in the world in hydropower installed capacity, amounting to 15.83 gigawatts (GW). Hydropower accounts for 86% of the renewable energy sources in the country. More than 60% of Turkey's energy needs continue to be supplied by conventional sources.[65)]

Other renewable energy sources account for 5.4% of energy supply. Turkey is encouraging the construction of wind power plants, mainly in the Aegean and Marmara regions. The Turkish government has a goal of greatly increasing wind capacity by 2020. The country has also extended its involvement in geothermal energy projects, supported by loans from the government. The potential is large, and geothermal energy is expected to increase substantially.

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61) International Energy Agency. 2009. Energy Policies of IEA Countries: Turkey 2009 Review. http://www.iea.org/publications/freepublications/publication/turkey2009.pdf

62) Ibid.

63) Republic of Turkey. 2009. Turkey's Climate Change Action Plan. https://seors.unfccc.int/seors/attachments/get_attachment?code=2HVA6PJFX1J4OKDWZXOR5F1D8HOB2SQY

64) Climate Policy Watcher. Turkey. http://www.climate-policy-watcher.org/?q=Turkey

65) Renewable Facts. Turkey Hydropower. http://www.renewablefacts.com/country/turkey/hydro

As Turkey steers itself towards meeting EU membership criteria, it should see increased energy efficiency. The growth in energy consumption should wane as state subsidies are eliminated and prices more accurately reflect costs. Yet, there will still be much room for improvement, and Turkey's vigilance in safeguarding its environment will be key to the continuance of its economic development. Continuing to educate the public about the benefits of saving energy, as well as involving large industries in energy efficiency programs, will also lead to long-term positive effects for Turkey's economy and environment.

1-4-7. Effects of Environmental Factors

Due to its geographical uniqueness as a meeting point of different climate regimes, Turkey has a rich biodiversity. Endemic species and fauna show varying characteristics in several hydro-geographic regions of the country. The abundance of water resources is a leading factor in boosting this biological richness. Yet, these given advantages cannot be taken for granted. Although once considered as a water-rich country, several factors exacerbated by rapid population growth are causing the threat of deterioration for the future, unless necessary measures are taken in a timely manner. Not only has the consumptive use of water increased, but also the demand from the energy sector has escalated, to meet the needs of production for both export and domestic needs. These factors double the need for precautionary actions now.

Because of the high environmental stakes, Turkey has made progress in environmental policy in recent years. The establishment of the Ministry of Forestry and Water Affairs with two new sub-divisions, the General Directorate of Water Management and the Turkish Water Institute, are two major steps for developing comprehensive water policies that comply with European Union standards. Among all environmental EU regulations, the Water Framework Directive is the one that Turkey pays most attention to in adapting to its domestic policies.

The Golden Horn area has suffered severely from environmental degradation for obvious reasons, as mentioned above. The importance of the rehabilitation project is not to be underestimated, when comparing the current environmental status of the estuary with the past. Considering the intense sea traffic on the Bosporus and the treated wastewater discharge rate, the current condition of the region can be regarded as a sign of good progress. The area is characterized by a constantly increasing fish population and expanded water sports activities. Turkey’s bid for membership in the EU along with its motivation to improve domestic living standards promise continued improvements in the future.

1-5. Technical Factors

Turkey has a dynamic economy, characterized by a complex mix of modern industry and commerce and a traditional agriculture sector. The largest industrial sector is textiles and clothing and accounts for one-third of industrial employment. The automotive and electronics industries are growing in importance and have surpassed textiles in Turkey’s export composition. While Turkey’s science and innovation indicators lag those of most OECD countries, there has been some strong performance in recent years.[66)]

Turkey’s gross expenditure on research and development (GERD) in 2012 was 0.92% of GDP and has increased substantially from 0.37% in 1998 and 0.54% in 2001 (see Table 8). GERD in real terms increased by an average annual 11% since 1998 and by 15% per year from 2003 to 2008. Industry financed 47% of GERD in 2008, and

66) OECD. Science and Innovation Country Notes: Turkey. http://www.oecd.org/sti/inno/46666009.pdf

the government funded 32%. Industry-financed GERD was a small 0.3% of GDP in 2008 but doubled from 1998 to 2008. Turkey's business expenditure on R&D (BERD) totalled 0.3% of GDP in 2008, the fifth lowest in the OECD, but has increased sharply. BERD in real terms grew by an average annual 18% in the ten years from 1998 to 2008. [67)]

Turkey's indicators measuring human resources in science and technology (HRST) are weak. In a comparison with 33 European countries, Turkey ranked last with 23.1% of the labor force considered HRST in 2012. The percentage of HRST grew from 18.4% in 2006. In 2008 18% of all new degrees were in science and engineering. This compares to an average of 42.9% of the workforce being in science and technology professions in the EU countries as a whole (28 countries), which had grown from an average of 34.5% in 2001 in the EU.[68)]

According to the results of R&D Activities Survey 2012 conducted by TurkStat, R&D Expenditures (GERD) in Turkey increased by 17.1% from 2011 to 2012 and reached US $12.6 billion in 2012. The share of GERD in GDP was 0.92%, and the total number of full time equivalent (FTE) R&D personnel was 105,000, an increase of 13.3% over 2011. The number of FTE researchers was 82,000 in 2012. Regarding FTE R&D personnel distribution by sectors, 49.7% was employed in business enterprises, 38.8% were employed in higher education sector and 11.7% was employed in the government sector in 2012. The total number of FTE R&D personnel and researchers per 10,000 employed persons was 42 and 33 respectively in 2012.[69)]

<Table 8> Gross Expenditure on Research and Development to GDP (GERD/GDP) in Turkey 2001-2012 (%)

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0.54	0.53	0.48	0.52	0.59	0.58	0.72	0.73	0.85	0.84	0.86	0.92

Source: Turkish Statistical Institute: http://www.turkstat.gov.tr/UstMenu.do?metod=temelist

Dividing into statistical regions in Turkey, R&D expenditure in 2012 was the highest in the West Anatolia region, with 28.5%, followed by East Marmara with 20.6 % and Istanbul with 20%. Regarding R&D personnel, West Anatolia was first with 22.8% of personnel being HRST, followed by Istanbul with 21.8%, and East Marmara with 15.4%.[70)] The sectors that used the R&D funds in 2012 were mainly: the business enterprise sector (46.8%); the higher education sector (43.9); and the government sector (11.3%). Regarding the sources of financing for R&D expenditure, 46.8% came from business enterprises, 28.2% from the government sector, 21.1% from higher education, 3.4% from other national sources, and 0.6% from foreign funds in 2012.[71)]

1-5-1. Science and Technology Research and Policy Developments

The goals and objectives of innovation policy in Turkey are set out in the Ninth Development Plan (2007-2013), the Medium-Term Program (2008-10), the Implementation Plan for the National Science and Technology Strategy (Turkish acronym BTP-UP, 2005-10), and the National Innovation Strategy (2008-10).[72)]

67) OECD http://www.oecd.org/sti/inno/46666009.pdf

68) European Commission Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/main_tables

69) Scientific and Technological Research Council of Turkey. 2012. R&D Activities Survey. http://www.tubitak.gov.tr/en/news/rd-activities-survey-2012-results-are-announced

70) Turkish Statistical Institute (in Turkish). http://www.tuik.gov.tr/PreHaberBultenleri.do?id=13630

71) Turkish Statistical Institute http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=13630

The National Science, Technology and Innovation (NSTI) Strategy, 2011-2016 document was approved in December 2010. Much of the new strategy drew on the improvements made in research, development and innovation (RDI) capacity through the BTP-UP (2005-2010).[73)]

The vision of the NSTI Strategy (2011-16) is to disseminate a culture of multilateral and multidisciplinary RDI cooperation, stimulating RDI in areas such as energy, water and food, encouraging small and medium sized enterprises (SMEs) to become stronger actors within the national innovation system, and enhancing the contribution of research infrastructure to building the Turkish Research Area (TARAL).

The Supreme Council for Science and Technology (Turkish acronym BTYK) is the highest science and technology policy-making body in Turkey. In tandem with the Vision 2023 Action Plan, which sets goals to be achieved for the 100th anniversary of the establishment of the Republic of Turkey, BTYK listed the following eight priority areas in its Strategy Document: 1) Integrated circuit and design technologies; 2) Health technologies, and biological and genetics technologies; 3) Renewable energy and environmental technologies; 4) Boron technologies and intelligent materials; 5) Mechatronics; 6) Nanotechnology; 7) GRID design technology; and 8) Product process technologies. The development of the strategy under Vision 2023 will facilitate funding for the priority areas.[74)] At the 25th meeting of the BTYK, held in January 2013, the health sector was included within national priority areas.

The Scientific and Technological Research Council of Turkey (Turkish acronym TÜBİTAK) is the leading agency for developing Science, Technology and Innovation (STI) policies, supporting and conducting research and development activities; and playing a leading role in the creation of a science and technology culture in Turkey since 1963. Headquartered in Ankara, TÜBİTAK is an autonomous public institution, governed by a Science Board. TÜBİTAK also acts as an advisory agency to the Turkish Government and is the secretariat of BTYK.

TÜBİTAK manages a number of R&D institutes that support the priority areas identified by BTYK and the Turkish Academy of Sciences (TÜBA). TÜBİTAK is responsible for the development and coordination of scientific research in line with the national priorities and targets. More than 2,500 researchers work at the 15 different research institutes and research centers attached to TÜBİTAK, where both contract-based and targeted nation-wide research is conducted. TÜBİTAK represents Turkey in international research efforts including memberships in the European Science Foundation and the EU Framework Programs for Research and Technology.

TÜBİTAK oversees the following research centers and institutes :[75)]

Marmara Research Center (MAM):

- Energy Institute;
- Food Institute;
- Chemistry Institute;

72) OECD, op. cit.

73) The Scientific and Technological Research Council of Turkey http://www.tubitak.gov.tr/en/about-us/policies/content-national-water-rd-and-innovation-strategy

74) Kadir Has University http://www.khas.edu.tr/en/research/strar/strar-s-aims-and-responsibilities-5/strar-s-aims-and-responsibilities-7.html

- Environment Institute;
- Materials Institute;
- Earth and Marine Sciences Institute; and
- Genetic Engineering and Biotechnology Institute.

TÜBİTAK Informatics and Information Security Research Center (BILGEM):

- Advanced Technologies Research Institute,
- National Research Institute of Electronics and Cryptology,
- Information Technologies Institute,
- Research Institute of Fundamental Sciences,
- Research Institute for Software Development,
- Cyber Security Institute,

- Defense Industries Research and Development Institute (SAGE),
- Space Technologies Research Institute (UZAY),
- National Metrology Institute (UME),
- Institute for Industrial Management (TUSSIDE),
- Technology Free Zone and Technopark,
- National Academic Network and Information Center (ULAKBİM),
- Bursa Test and Analysis Laboratory (BUTAL), and
- National Observatory (TUG).

1-5-2. Scientific Research

Over the last decade, Turkey's GDP has grown significantly, prompting the government to increase its R&D spending. Turkey increased GERD expenditure from 0.54% of GDP in 2001 to 0.92% in 2012, according to the Turkish Statistical Institute (TUIK). As part of long-term plans, the government has set a goal to increase the share of R&D investments to 3.00% of GDP by 2023, the centennial of the founding of the Republic of Turkey.[76)]

Elsevier Science organized a research performance and evaluation event on 12 March 2013 in collaboration with Hacettepe University in Ankara, Turkey.[77)] The evaluation found that in research output, Turkey ranked number 18 of the world's top 20 countries (based on number of articles published between 2006 and 2010) and is already a definitive global competitor. Although it is on the lower end in terms of the number of articles published, it is at the top in terms of the rate of growth – at number 4, behind only China, India and Brazil. In scientific papers that have been cited, nearly half (49.9 %) of Turkish papers were cited between 2006 and 2010. Despite its smaller GERD percentage, Turkey is producing proportionately more "quality" papers than rapidly growing countries like China and India.

Going deeper into the analysis of Turkey's research output, findings show that Turkey's strength lies in chemistry, engineering, and medicine. Research in Turkey has also become increasing interdisciplinary, as shown by a 2011 study conducted by Elsevier.

The key to increasing international scientific influence is to increase international collaboration, which in Turkey is relatively low, compared to other developed and developing countries such as Brazil, Iran and Italy. Turkey could benefit from a higher level of international research funds if it were to increase the level of international collaboration in scientific research.

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75) http://www.tubitak.gov.tr/en/about-us/policies/content-national-water-rd-and-innovation-strategy

76) *Basal, T. and Keskin, G. 2013, 15 Apr. Turkey Scientific Research Output is Booming - But What about the Quality? Elsevier Science*. http://www.elsevier.com/connect/turkeys-scientific-research-output-is-booming-but-what-about-the-quality

77) Trends in International Cooperation within the Framework of Outcomes and Opportunities in Turkey and Turkish Universities. 2013, 12 March. Elsevier Conference at Hacettepe University. http://www.elsevierturkiye.com/etkinlikler/

Turkey is the leading country in scientific research in the Middle East – far outpacing the other SMIT countries[78] in impact and output. The SMIT countries – South Korea, Mexico, Indonesia and Turkey – are considered the four emerging markets with the most potential for growth after the BRIC countries (Brazil, Russia, India and China), based on population growth and position economic growth.

1-5-3. Communications

The communications satellite TURKSAT 4A was launched from the Baikonur Space Center in Kazakhstan on 15 February 2014. The satellite was manufactured through a partnership of Turkish and Japanese engineers by Mitsubishi Electric (MELCO). The satellite project is a concrete outcome of the Turkey-Japan partnership in the field of space programs, aviation, science and technology. The TURKSAT 4A and TURKSAT 4B satellites were produced under the supervision of the president and engineers of TURKSAT, an institution of the Ministry of Transport, Maritime Affairs and Communication. As a result of the new satellites, Turkish TV and communication signals will reach all of Europe and much of Asia and Africa. TURKSAT 4B, Turkey's sixth satellite, will be launched in the second quarter of 2014.[79]

The TURKSAT 4A is equipped with two 3-panel solar arrays for power generation, a chemical propulsion system for apogee manoeuvres, as well as orbital adjustments and navigation and stabilization equipment. It has a total mass of 4,850 kilograms, and is capable of providing 15KW of power to facilitate powerful communication payloads for mission durations of 15 years and beyond. Turksat 4A will provide TV broadcasting and communication services for commercial and government customers, with communication payload consisting of 2 Ka-Band and 28 Ku-Band transponders.

TURKSAT 4B Internet services provider fees will be 50% cheaper in the country, officials say. Turkcell, the leading company on communication and technology, has made data declaration related to mobile service in 2013. The use of SMS, MMS, mobile Internet and apps by Turkcell's customers has transformed the communication and technology sector over the last year. Data use has increased by almost 4000% since 2009. Turkcell has broken new records with its infrastructure that was serving 35 million clients by the end of the 3rd quarter in 2013.

As indicative of its innovative approaches in all sectors, Turkcell has increased its patent applications to 287. A total of 2,500 trainees graduated from Microsoft Istanbul's academy for software developers. From mid-2012 to late 2013, Microsoft was assisting to move Turkey from merely a consumer to a technology developer.

1-5-4. Textiles and Apparel Growth Areas

The textiles and apparel sector is a vital contributor to Turkey's economy, accounting for approximately 10% of the country's GDP. It is the largest industry in the country, constituting approximately 15% of manufacturing and about one-third of manufactured exports. Textiles, apparel and carpet exports totalled over US $24 billion in 2011.[80] Turkey has around 40,000 manufacturing companies and 1.9 million employees in the textile and

78) SMIT Countries: South Korea, Mexico, Indonesia and Turkey
79) http://www.portturkey.com/high-tech/6093-turksat-4a-in-orbit
80) http://www.turkishtextiles.com/apparel-and-textile-export-volumes.html

apparel sector. According to Turkey's Export Promotion Center (IGEME), the country's apparel exports rank sixth globally, and home textile exports rank third.[81)]

Turkey's production of textile polymers and chemicals has increased concurrently with its growing textiles sector; consequently, it has been building large plants for polyamide, polyester, and acrylic fibre production. The country produces the eighth-largest volume of man-made fibres in the world, at 1.2 million tons per year.

Turkey's recent increase in GDP per capita has stimulated demand for technical textiles and nonwoven products such as feminine hygiene items, diapers, medical textiles, and disposable products. Growth in the automotive, construction, filtration, agriculture, and chemical industries also has created demand. Turkey produces more than 110,000 metric tons of nonwovens per year. The country's expanding technical textiles industry is expected to gain even more importance in the next 15 to 20 years. Main exports are big bags, tire cord fabrics, nonwovens, glass fibres and articles, technical fabrics, seat belts, and high-tenacity yarns.

At the same time, it is recognized that the textile and garment industries cause water pollution. All the industrial facilities in Turkey are obliged to attain the wastewater discharge limits set in the Water Pollution Control Regulation. Most of the industrial facilities are now located in Organized Industrial Zones (OIZs) all around Turkey. These zones provide pre-treatment facilities before wastewater is discharged to sewer systems. Also the textile industry around the Golden Horn area is currently located in an organized industrial zone in Istanbul. Facilities located outside the OIZ are required to treat wastewater in their own facilities.

1-5-5. Steel Industry

Turkey is a significant world player in the production and exportation of steel and steel products, and has established a sound reputation for producing quality products to meet market needs, including those of shipbuilding, where steel is a major input.

The impetus for this investment in steel production came from the liberalization of the economy during the 1980s, which was a turning point, not only for the Turkish economy as a whole, but for the iron and steel industry in particular. The 1980s inaugurated a period of significant growth for the Turkish iron and steel industry, which began with the establishment of the first electric arc furnace mills. This provided the platform for the industry to become one of the most developed sectors in Turkey, and today counts as the third largest contributor to the Turkish economy.

Today, all steel production companies in Turkey are privately held following the privatization of state owned facilities, and Turkish steel makers now rely on private capital markets to fund technological developments to enhance the long-term viability of the industry in the global marketplace.

Currently, Turkey has 18 electric arc furnaces with capacities ranging from 0.5 to 2.5 million tons, while its integrated plants (plants that combine both steel making and rolling processes) in Erdemir, Isdemir and Kardemir - have capacities ranging from 1.1 to 3.0 million tons. Its melting capacity in 2010 was around 43.4 million tons, composed of 34.0 million tons arc furnace capacity and 9.4 million tons capacity of the older, basic oxygen furnaces. This capacity is expected

81) http://www.textileworldasia.com/Issues/2009/April-May-June/Country_Profiles/Turkey_Textile_Industry_Profile

to grow to beyond 50 million tons by 2015, with the majority of growth coming through newer and more efficient electric arc furnaces.

1-5-6. Istanbul and Sea of Marmara Region

The Marmara Research Center (known as TÜBİTAK MAM) was established in 1972 by TÜBİTAK. It carries out basic and applied science research in fields where research is needed to improve the global competitiveness of the country. MAM has participating institutes in the following fields: energy; food; chemistry; environment; materials; earth and marine sciences; genetic engineering, and biotechnology. It is located in Gebze, Kocaeli Province, close to Istanbul, bringing a number of research units of of TÜBİTAK formed in the past under one umbrella.[82)]

In the years after 1976, many research projects were funded by the United Nations Industrial Development Organization (UNIDO) and NATO's Science for Stability Program. In the years 1982 and 1984, the number and value of contracted projects became quite significant. Also in 1991, TÜBİTAK MAM started a process of transformation adopting industrial research and development in principle as its main strategy and studies. In 1995, the center was recognized as more dynamic and became half autonomous.

In the following years, the center underwent structural changes as a result of expansion of its affiliated research units. The Electronics Research Department, the National Metrology Institute and the Research Institute for Genetic Engineering and Biotechnology were reorganized as separate institutes directly reporting to TUBITAK headquarters in Ankara. In the beginning of 2009, the Chemical and Environmental Institute was split in two institutes: the Chemical Institute and the Environment Institute. And finally in 2010, the Information Technologies Institute was transformed into the Turkish National Research Institute of Electronics and Cryptology (UEKAE), also located in Gebze. It is an Institute of the TÜBİTAK Informatics and Information Security Research Center (Turkish acronym BİLGEM).

The Gebze Institute of Technology (GIT) İzmir Institute of Technology are located in Kocaeli Province, close to Istanbul. GIT is a university for undergraduate and graduate studies and research activities located in a specifically selected area in Gebze, one of the most industrialized parts of the Marmara region. GIT was founded in 1992, with the aim of becoming an academic institution of learning whose priority is educating innovative and broad-minded researchers, thus establishing itself among the international science and technology producers and helping the Turkish industry gain a strong competitive position in the global arena.[83)]

GIT has offers undergraduate and graduate level courses in physics, mathematics, materials science computer engineering and electronics engineering. It added architecture and business degrees in 2008. All education programs are supported with English language courses (30%). GIT has 926 undergraduate and 1275 graduate students and employs a total of 388 academic personnel, 158 of whom held doctoral degrees.

Pharmaceutical industry. The Government of Turkey and Association of Research-Based pharmaceutical companies (Turkish Acronym AIFD) include in

82) http://en.wikipedia.org/wiki/TÜBİTAK_Marmara_Research_Center
83) Ibid.

Vision 2023 the goal to make Turkey a global center for pharmaceutical R&D and production and regional shared service center location.[84)]

The pharmaceutical industry already has an important presence in Gebze, close to Istanbul. Roche Mustahzarlari completed construction of its pharmaceutical facility at Gebze in 2003. The facility is Roche's second-largest solid forms production plant. The drug manufacturing facility makes solid dosage forms, including packaging of the finished products. The facility, which has a floor space of 18,000 m^2, includes new quality control laboratories, warehousing, offices, and administration buildings.[85)] The major markets of Roche Mustahzarlari Sanayi AS include North and South America, Western and Eastern Europe, East Asia, Southeast Asia, the Middle East, and Africa.[86)] Roche Pharmaceuticals, based in Switzerland, is one of the largest pharmaceutical companies in the world in terms of revenue.

As water pollution from pharmaceutical companies is a major concern, the wastewater from this industry is subject to the Water Pollution Control Regulation as mentioned earlier. All industrial facilities are obliged to attain the discharge standards set out in the Regulation.

Shipbuilding.[87)] Shipbuilding in Turkey has evolved from an old traditional activity in Anatolia to an internationally-recognized industry, especially since the early 1990s. The industry has modern, quality certified shipyards that can build ships, yachts, mega-yachts, and sailing boats, as well as carrying out extensive repair and conversion works. Turkey's shipyards are mainly located in the Marmara Region, namely Tuzla, Yalova, and İzmit, which have developed into dynamic shipbuilding centers. Also, in recent years the emerging Black Sea and Mediterranean Regions have increasingly attracted shipyard investments.

Turkish shipyards have a tradition spanning eight centuries. At the time of the Ottoman Empire, shipyards were able to build large, powerful naval vessels, and yards continued their modernization following the foundation of the Republic of Turkey. After 1983, yards began to move from Haliç İstanbul (Golden Horn) to the Tuzla Shipyards Region. Having started to operate in this region, Turkish shipyards struggled to complete their infrastructure investments to comply with advancing shipbuilding technology and so initially performed shipbuilding and repair works simultaneously.

In the last decade, in parallel with developments in the global market, Turkish shipbuilding experienced a several-fold increase in its shipbuilding and export capacity, including a significant product diversification. According to order books, this resulted in Turkey being regularly placed in the top ten countries on the basis of its deadweight (dwt) production, and in the top five countries by the number of ships.

In recent years, Turkey has increasingly tapped into niche markets, which in turn has led to a growing participation by Turkish shipyards in the international trade in new ships. In parallel, there has also been strong growth in the manufacture of marine equipment, which could increasingly tap into the export market. These developments reflect in part the strategic location of the yards, the experienced workforce, the quality of

84) Association of Research-based Pharmaceutical Companies. Turkey's Pharmaceutical Sector: Visoin 2023 Report. http://www.aifd.org.tr/PDF/2023_Rapor/2023_strat_en.pdf

85) Pharmaceutical Technology. Roche Pharmaceutical Manfacturing Plant, Turkey. http://www.pharmaceutical-technology.com/projects/gebze/

86) http://www.tradebanq.com/company/2054798/Roche-Mustahzarlari-Sanayi-A-S.html#sthash.RSLBD6f9.dpuf

87) http://www.oecd.org/turkey/48641944.pdf

production and Turkey's significant role as a political, cultural and economic bridge between Europe and Central Asian and Middle Eastern economies.

1-5-7. Effects of Technical Factors

Turkey's dynamic economy has depended in large part on technical innovation and investment in research and development, science and technology, and promotion of technical education for both Turkish citizens and international students who study at Turkey's many educational institutes. Turkey is in the process of exporting its technical know-how to other countries in the Middle East and North Africa.

The vision of the National Science, Technology and Innovation (NSTI) Strategy, 2011-2016 is to disseminate a culture of multilateral and multidisciplinary research, development and innovation (RDI) cooperation in areas such as energy, water and food, encouraging small and medium sized enterprises (SMEs) to become stronger actors within the national innovation system, and enhancing the contribution of research infrastructure to building the Turkish Research Area for the future.

1-6. Concluding Remarks

The dynamic economy of Turkey's economic hub (Istanbul) is no longer led by industrial production, but rather by the service and finance sectors. The Golden Horn district had a lot to offer to make this economic transformation possible. The central location of Golden Horn estuary and its physical proximity to the historical peninsula and financial districts made such a comprehensive project crucial for the dynamics in Istanbul. As an outcome of the rehabilitation project, a formerly old-fashioned industrial zone became a center of economic and cultural attraction. The area now hosts remarkable landmarks that ensure socio-economic added value. There are several private university campuses, two full-fledged international convention centers and museums that attract not only the local people, but also thousands of tourists from all around the world. After the environmental rehabilitation of the estuary is completed, the urban transformation will continue to create an economically dynamic Golden Horn that deserves to be appreciated.

Considering that these educational and cultural facilities are open to the public and are not exclusive to inhabitants of the Golden Horn, it should be noted that locals are not the direct beneficiaries of the renewal process. Nonetheless, the improvement in the environment for marine life and increase in the fish population has had a positive impact on biodiversity. Hand-line fishing, which was absent from the region for a long time because of the pollution, is contributing to well-being of the local residents. All in all, improvements in the Golden Horn's ecosystem affect the aesthetic quality of the region, which in turn leads to improvements in the social fabric of the district. Revival of this once environmentally devastated urban center is a remarkable political success as long as it is combined with fairly implemented social and economic policies.

Because of the high environmental stakes, Turkey has made progress in environmental policy in recent years. The establishment of the Ministry of Forestry and Water Affairs with two new sub-divisions, the General Directorate of Water Management and the Turkish Water Institute, are two major steps for developing comprehensive water policies that comply with European Union standards. Among all environmental EU regulations, the Water Framework Directive is the one that Turkey pays most attention to in adapting to its domestic policies.

Regarding technical aspects of the Golden Horn project, sludge dredging removed heavy metals and improved the overall quality in the estuary. The odour problem was resolved and anaerobic conditions ceased. Additionally, the seawater transfer project from the

Bosporus to the Golden Horn further enhanced the dissolved oxygen levels in the estuary, thereby enriching the ecological life.

The Golden Horn area has suffered severely from environmental degradation, and the importance of the rehabilitation project cannot be underestimated. Considering the intense sea traffic on the Bosporus and the treated wastewater discharge rate, the current condition of the region can be regarded as a sign of good progress.

2. Water Resources Governance and Institutions

2-1. State-driven Institutions

2-1-1. National Water and Sanitation Legislation and Law

The preliminary Law on Water (1926) targeted the supply and management of water resources, but it did not include any provisions on water rights.[88] Nevertheless, the Constitution of the Republic of Turkey of 1961 acknowledged that water is a public good under the trusteeship of the State. Additionally, the Groundwater Law (Law Act No. 167), enacted in 1960, stated that the rights of groundwater resources are in the public domain. The Law basically regulates the allocation, utilization and protection of groundwater resources. The General Directorate of State Hydraulic Works executes the provisions of this Law on behalf of the State. In addition, the by-law on Groundwaters (Law Act No. 1465) sets priorities for the use of underground water, i.e., for drinking, cleaning, animal care, and for agricultural irrigation.[89] The Constitution of 1982 incorporated an extra provision on delegating the government's rights to legal entities and/or real persons for exploration and management of water resources for a certain period of time.[90]

According to the Law on Domestic and Industrial Water Supply (Act No. 1053), the DSI is responsible to provide domestic and industrial water to Ankara, Istanbul and to cities with a population over 100,000.[91] The DSI analyzes the investments of the transfer pipelines, water treatment plants, pumping stations and main clean water storage, collects data, prepares master plans, final projects, demonstration projects and constructs them.[92] The rehabilitation of Golden Horn was based on the by-law of ISKI on Discharge of Wastewater to Sewerage Systems (Act No 3009).[93]

The Law on the Environment (Act No. 2873) provides that the Ministry of Environment is responsible for the utilization and protection of natural resources and for the prevention of water, soil, and air contamination. The By-law on the Control of Water Pollution (RCWP) was later adopted based on the Law on the Environment in order "to maintain the potential of the country's underground and surface springs and to utilize them in the most appropriate manner with the prevention of contamination."[94] This by-law has been revised since to align with the standards of the EU WFD.

In 1981, the Istanbul Water and Sewerage Administration (ISKI) was founded, which is affiliated to IMM, with

88) http://www.dsi.gov.tr/docs/mevzuatlar/831kanun.pdf?sfvrsn=0
89) http://www2.dsi.gov.tr/english/pdf_files/TurkeyWaterReport.pdf
90) http://www.imo.org.tr/resimler/dosya_ekler/03f0de3afe0fba3_ek.pdf?dergi=144
91) http://www.mpfpr.de/fileadmin/media/Water_Law/Nationales_Recht/Treaties_Turkey/Kibaroglu_Turkish_Water_Law_English.pdf
92) http://www.abgs.gov.tr/tarama/tarama_files/27/sorular%20ve%20cevaplar_files/SC27_Water.pdf
93) http://www.uenco.com.tr/docs/mevzuat/cevre/32.pdf
94) http://www.loc.gov/law/help/water-law/turkey.php

the promulgation of the Law of ISKI (Act No. 2560 - Establishment of General Directorate of Istanbul Water and Sewerage Administration (ISKI) and defined its tasks. ISKI has been the responsible entity for the supply of water, infrastructure and construction, operation and maintenance of necessary facilities to take measures for the prevention of water pollution.

In the meantime, legal and institutional frameworks have been revised following the opening of Environment Chapter in 2009 as a part of the EU accession process of Turkey. In this regard, the new drafted Water Law is intended to incorporate involvement of more stakeholders.[95] This new Law has been prepared in accordance with the Water Framework Directive and it will mainly be based on river basin water management.[96] The new Law will comprise provisions on water allocation and rights on water use.[97]

2-1-2. National Water Policy

Turkey's water policy is basically focused on using water resources effectively in order to gain independence from imported energy resources, to enhance agricultural production, and to meet both the industrial and domestic requirements; thereby improving the living standards of the country.[98] Until the 1980s, Turkey's water policy initiatives were basically shaped by national considerations. The water management policy was centralized in terms of decision-making. Planning focused on extending water supply, expanding irrigated lands, developing hydropower potential and controlling floods.Yet,the decisions were taken at the national level and water infrastructure projects were financed publicly.

The Stockholm Conference in 1972 promoted environmental protection and nature conservation which in return paved way to legislative and institutional reforms in the 1980s. During this period, Turkey promulgated the Law on Environment in 1983, the Water Pollution Control By-law in 1988 and the Environmental Impact Assessment (EIA) By-law in 1993. National laws and regulations in this era involved provisionson protecting national parks, wildlife and wild animal settlement areas. Additionally, Turkey acknowledged and undertook several international environmental conventions.

On the other hand, the existing water supply and sanitation services failed to satisfy the water demand in metropolitan areas due to rapid urbanization and industrialization. The need for new mechanisms in water management inevitably resulted in the establishment of autonomous municipal water services administrations (e.g. ISKI). This was the first move from a centralized management to a more decentralized and 'privatized' water management. These administrations are independent on budgetary basis which allows them to seek external funding.

Irrigation management also went through certain transformations in the early 1990s when irrigation associations (IA) were established. These associations become responsible for the operation and maintenance of large-scale irrigation systems. Nowadays, the IAs manage nearly 2 million hectares of land.

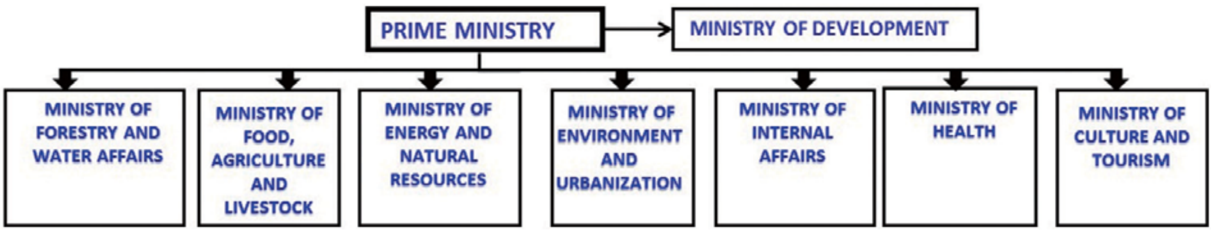
Since Turkey became a candidate for EU membership, a new wave of changes have emerged in Turkey's water management policies. The main task in water management is the harmonization with the Water

95) http://www.loc.gov/law/help/water-law/turkey.php
96) http://www.orsam.org.tr/tr/sukaynaklari/analizgundemgoster.aspx?ID=3505
97) http://suyonetimi.ormansu.gov.tr/AnaSayfa/su_kanunu_taslagi.aspx?sflang=tr
98) http://www2.dsi.gov.tr/english/congress2007/chapter_3/76.pdf

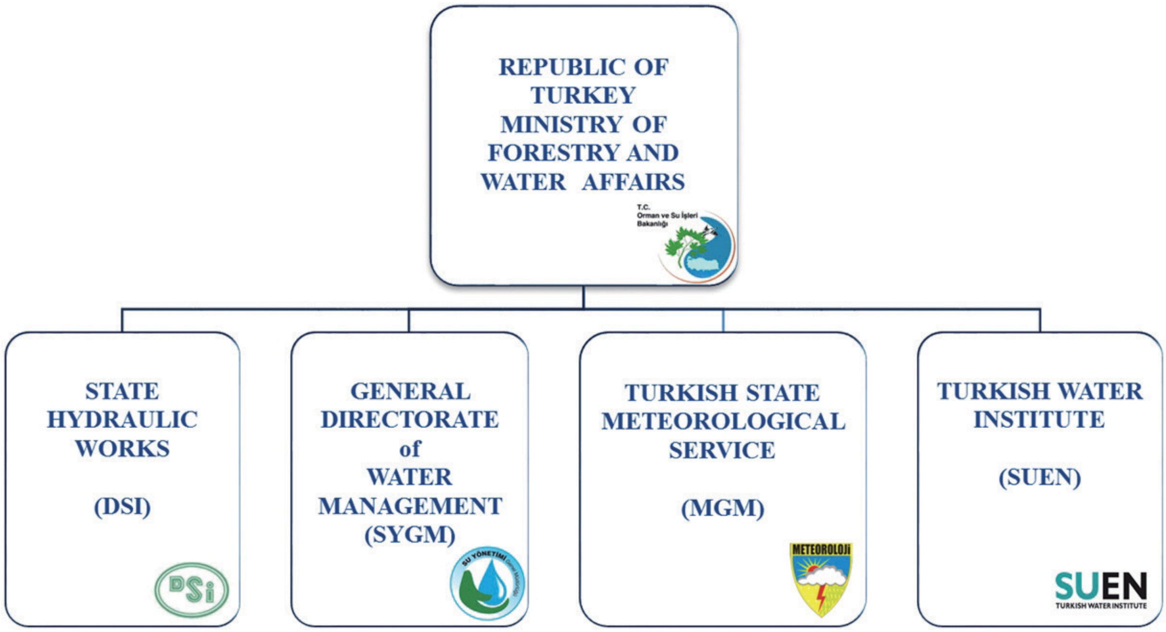
Framework Directive (WFD). The major steps to be accomplished during this phase are to:establish a reliable inventory of the status of water bodies and proper monitoring systems; set up pricing systems for all sectors (by taking into account the "full cost recovery" principle of the WFD); allow public participation in water development plans; and prepare river basin management plans. Current legislation is being revised and a new water law has been drafted to comply with the WFD as explained in Section 1.1 of Chapter III. The accession phase will reinforce the coordination among water-related institutions and a more ecosystem-based framework will be integrated into sector policies.[99]

2-1-3. National Water Management Institutions

In Turkey, the main authority responsible for water-related legislation, protection and monitoring of water resources, strategy and policy development and investments on water projects is the Ministry of Forestry and Water Affairs. The Ministry of Environment and Urbanization is responsible for pollution control and the protection of water resources and oversees the Environmental Impact Assessment Plans for all projects. All the ministries that have responsibilities for water management and investments are shown in Figure 10.



<Figure 10> Organizational Chart of Ministries Related with Water Management in Turkey



<Figure 11> Administrations under the Ministry of Forestry and Water Affairs

99) *Kibaroglu, A., Sumer, V., and Scheumann, W. 2012. Fundamental Shifts in Turkey's Water Policy. Mediterranee*, 119: 27-34.

Figure 11 shows the organizational chart of the main water-related administrations working under the Ministry of Forestry and Water Affairs: the State Hydraulic Works (DSI), the General Directorate of Water Management (SYGM), the Turkish State Meteorological Service (MGM) and the Turkish Water Institute (SUEN).

Being one of the oldest institutions in Turkey, DSI has been responsible for the implementation of major water projects including construction of dams for irrigation and hydropower, water transmission lines, water treatment plants and irrigation systems since the 1950s. Investments for the optimal utilization of surface and groundwater sources are made by DSI. Execution of the irrigation projects and their management are done in cooperation with the Ministry of Agriculture at the national level and with the Water Users' Associations at the local level.

As a candidate country for the European Union, Turkey has adapted its activities and regulations to meet EU requirements. These include the legislation on water and environment. As it is known that the EU Water Framework Directive (2000/60/EC of the European Parliament and of the Council) established a framework for Community action in the field of water policy, Turkey needed to make some revisions in its law and the administrative structure to be in line with the EU Water Framework Directive. The General Directorate of Water Management was established to implement the water policies and take the necessary actions.

Turkey has been divided into 25 river basins. As the first step to basin protection, action plans were prepared and currently studies are continuing to convert action plans into River Basin Management Plans. Currently a new "Water Law" is being prepared as a framework directive that intends to incorporate all existing water legislation. This new water law foresees the establishment of "Basin Steering Committees" at national level and 25 "Basin Management Commissions" at basin level.

The Turkish Water Institute (SUEN) was established in 2011 as a research institute coordinating water-related research among the administrations of the Ministry, universities, private sector and the local authorities. Its goal is to produce water policy recommendations through conducting interdisciplinary research. SUEN can be defined as a think tank that aims to develop short and long term strategies and national policies for good governance of water. SUEN works in close collaboration with national and international organizations on sustainable water management, development of water policies, sustainable energy issues and capacity building for the solution of local and global water problems.

According to the legislation, the main roles given to SUEN can be listed as follows:

- To conduct and support scientific research to develop national and international water policies;
- To collaborate with national and international organizations and follow the recent developments through the studies, knowledge production and statistical activities;
- To organize national and international education programs;
- To contribute to national and international forums, conferences, meetings, seminars, symposiums and training programs; and
- To carry out activities to enable cooperation among national and international water sectors and to collaborate in projects with institutions and persons distinguished in the water sphere.

2-2. Municipal Water and Sanitation Institutions

Local institutions in the field of water management are village authorities, municipalities, water and sewerage administrations of metropolitan municipalities, special provincial administrations, and irrigation associations.

According to the Law on Waters (1926) Municipalities are responsible for supplying and managing water for human use. Article 4 of this law states that supply, operation and maintenance costs should be met by municipalities. They are also responsible for ensuring the protection of water resources according to article 9 of the Law on Waters.

Metropolitan municipalities implement water management through water and sewerage administrations (WSA). The Istanbul Water and Sewerage Administration (ISKI) is the pioneer for this model and the other administrations have taken the founding law of ISKI as their basis. ISKI has not only been adapted as a structural model by other municipalities, but it also inspires them to closely follow the recent technology in the water sector.

WSAs share similar responsibilities of supplying water for citizens from the source to end use including getting rid of wastewater or reusing it. WSAs are financially autonomous in that they can buy and sell properties or expropriate them in order to realize their purpose to supply water for human needs. Furthermore, WSAs can contract with third parties to undertake certain tasks, instead of doing it by themselves. The main sources of income for WSAsare the fees collected for provision of water supply and treatment of wastewater. They can also get subsidies from the central government in cases of large investment projects. The law also allows for receiving donations from third parties. Finally, they have the authority to borrow from provincial banks and international organizations.

ISKI, with a total annual budget of approximately 5 billion Turkish Lira [US $2.5 billion] and with approximately 8,000 employees,[100] is responsible for the whole water and wastewater infrastructure in Istanbul, including the water and wastewater treatment plants. The revenues obtained from the collection of water tariffs cover almost the whole budget. Water tariffs in Istanbul are determined by ISKI based on a full capital and service cost recovery principle. The tariff covers the wastewater treatment costs, in line with the "polluter pays" concept of the EU Water Framework Directive. ISKI executes some of the water and wastewater projects using its own financial resources. Approximately 40% of the budget is allocated for new investment. Some of the drinking water reservoirs and large water treatment plants are constructed under the responsibility of DSI and then handed over to ISKI for operation. Operation and maintenance of all water and wastewater treatment plants are conducted by ISKI. The EU wastewater discharge regulations are considered in the design of all new treatment plants.

ISKI also contributes both financially and technically to extensive environmental pollution control projects of the IMMas in the case of Golden Horn Rehabilitation project. In this project ISKI's financial contribution was US $480 million and IMM's contrıbution was US $173 million.

2-3. Market-oriented Institutions

Users in Turkey require a licence for the exploitation of water resources from the relevant ministries.[101] The Ministry of Energy and Natural Resources is obliged to grant licences for the utilization of naturally carbonated (sparkling) water resources. On the other hand, the DSI issues licenses to use groundwater and to develop small hydropower stations on rivers. The licence enables the

100) Zaman Istanbul (in Turkish) http://www.zaman.com.tr/bolge-haberleri_iskinin-yatirim-butcesi-2-milyar-tl_2168743.html
101) Istanbul Saglik (in Turkish) http://www.istanbulsaglik.gov.tr/w/sb/gcs/kaynak.asp

prospective user the right only to use the resource, yet it cannot be transferred or sold to another entity.

Among the most significant improvements in terms of private sector involvement in the water sector was the encouragement of private sector participation in energy production. The Electricity Market Law in 2001 and the Law on Utilization of renewable Energy Resources for the Purpose of Generating Electrical Energy in 2005 nurtured the conditions for private enterprise in the energy sector. In this way, the burden on DSI was partly shifted to the private sector, which became the lead actor in construction of small dams and hydropower stations while allowing DSI to carry on constructing big multipurpose dams. Unlike the energy sector, public investment is still the lead actor in irrigation investments.

2-4. Community-centered Institutions

Public participation of civil society in water management of Turkey is mostly realized in the field of irrigation. An Irrigation Association is a form of water user association that is mainly responsible for water management in the irrigation field. Turkey's experience with irrigation groups dates back to the 1960s, when these groups were encouraged to become involved in the operation and maintenance (O&M) activities of large-scale irrigation schemes. Since 1993, the process has been accelerated with the support of the World Bank. Farmers gradually established numerous irrigation associations and cooperatives. The O&M responsibility for all irrigable land was given to the irrigation associations, cooperatives, village authorities and municipalities. The financial success of the process is apparent, since O&M expenditure paid by the state sources decreased from 100% (1991) to 16% (2005).[102] Despite the transfer of O&M responsibilities to water users, the interaction among interested stakeholders has intensified. Among those stakeholders, DSI is a major participant providing workshops, seminars, and training programs for the technicians and the secretariats of irrigation associations. In addition to DSI, the efforts of non-governmental organizations collaborating with farmers, municipalities, academia, and other provincial organizations further enhance the opportunity for interaction.

The responsibilities of irrigation associations are listed as follows according to the Law on Irrigation Associations (no. 6172):

- Operation, maintenance, repair, renewal and management of facilities located within the assigned area;
- Collecting participation, water usage costs, and penalty fees;
- Refunding the investment costs of facilities taken over;
- Improving the taken over facilities and developing new projects affecting this facility with the permission of DSİ;
- Deciding upon the crop pattern in the assigned area according to availability of water and in consultation and collaboration with Ministry of Food, Agriculture and Livestock;
- Conducting research, development, and training activities in collaboration with relevant institutions; and
- Pay its own share of operation and maintenance activities of the commonly used facilities with DSİ.

Other than the irrigation associations, there are several environmental NGOs and interest groups. Those who are particularly interested in water management are generally local groups with campaign oriented temporal demands. Amongst the most well-known environmental NGOs with wider area of influence are based either in Istanbul, or Ankara, or have several offices in other cities.

102) *Tollefson et al. 2014. Policy, Science and Society Interaction. Irrigation and Drainage*, 63: 158-175.

The Turkish Foundation for Combating Soil Erosion, for Reforestation and Protection of Natural Habitats (TEMA) was founded in 1992. It promotes conservation of water resources and ecosystems. TEMA develops and coordinates campaigns to support establishment of national policies for the protection of sustainable use of lands and rational management of water resources. It is Turkey's largest NGO, with 450,000 supporters and 100 scientist, and legal advisors working voluntarily.

The Regional Environmental Center (REC) is an independent international organization. It is not-for-profit and has 17 country offices under the REC Central Office. The REC Turkey Country Office (REC Turkey) started to operate in May 2004 in Ankara. It continues to operate from two offices: Central Ankara and Istanbul Project Office. REC Turkey works at environmental problem-solving in Turkey by supporting collaboration between the government, NGOs, the private sector and other environmental stakeholders and by ensuring public participation in the information sharing and environmental decision-making processes. By treating all stakeholders equally, REC Turkey acts as a common platform for the actors concerned.The Nature Conservation Association of Turkey (TTKD) mainly targets the conservation and the regulation for ecosystems, forests, agricultural lands, land and water resources, sea, lakes, rivers, wetland, caverns, with natural resources of the country ecological process and biological diversity via sustainable means. It promotes consciousness over urban areas, environment, and quality issues.

A professional organization that focuses exclusively on water is the Water Engineering Research & Development Center (WERDEC). It organizes an annual International Advanced Course on Water Resources Data Analysis. Applications are invited from engineers, scientists and specialists working in water-related agencies and institutions all over the world. It also conducts tutorial course programs.

IV. Performance of Water planning and Management in Turkey and the Greater Istanbul Municipality

1. Generic Performance

The restoration of the Golden Horn estuary succeeded for many reasons. It was a case of many different government agencies at national, provincial and municipal levels working together for a mutual goal. Various components of the project involved the private sector, community-level organizations and outside donors such as the European Union and United Nations agencies.

Among the factors that contributed to its positive outcomes were:

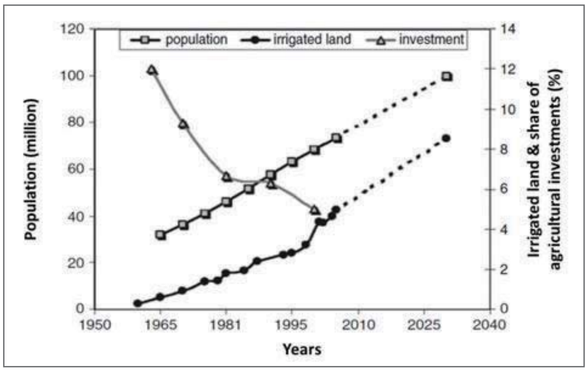
- The restoration project had strong political support from the municipality, the province, and the central government.
- The environmental restoration of the estuary was approached from many different angles that reinforced each other: dredging, wastewater treatment, a seawater tunnel, removal of the old Galata bridge, and green and grey infrastructure for restoring the banks of the estuary.
- Economic revitalization came from commercial and business interests, academic and cultural institutions, and urban real estate developers.
- Social amenities included the preservation of authentic communities, repurposing of buildings for educational and cultural purposes, employment opportunities in the service sector, water recreation facilities, and urban and aesthetic improvements throughout the area.

The negative consequences of the restoration project relate to the displacement of some communities from the Golden Horn area and the removal of the industrial area that had formerly provided jobs to people living in the shantytowns and low-income neighbourhoods. It is also the case that many of the projects were introduced without prior consultation or agreement with the people living in the area. According to the former mayor of Istanbul, however, approval of the project quickly rose to over 90% as the new facilities began appearing one after the other.

2. Economic Performance

Public institutions have always had the lead role in water management, despite the increasing role of the private sector in economic policies, especially since the 1980s. A state-driven economic system was dominant until that time. The State Hydraulic Works (DSI) has been the major actor that is responsible for the construction of irrigation schemes, storage facilities, and dams. These have been the cornerstones of Turkey's developing rural economy in the phase of transformation to industrial economy. The economic liberalization put into place by the 1980s shifted the country to the league of free market economies with export-oriented industrial production.

By the 2000s, the private sector had been incorporated as a main player in the energy sector in order to reduce the government's budget and role in hydroelectric development. However, public investment is still the lead in irrigation investments. DSI initiates the projects and water users associations contribute to the operation and maintenance costs of irrigation facilities. This method allowed for cutting subsidies to agriculture and decreasing the financial burden on state institutions. The WUAs empowered civil society in the agricultural sector. By 2003, the state's share of investment had decreased from 30% to less than 10% of the costs, compared to rates of 1980.[103] Figure 12 shows that,while the projections show a continued increase in population and irrigated area, the government share of investment in irrigation facilities is expected to decrease.



Source: Turkish Statistical Institute

<Figure 12> Projections for Population Growth, Irrigated Areas and Share of Government in Agricultural Investments

Taking the Golden Horn Area restoration project separately, we are confronted with a mixture of public and private actors having an impact on the economic performance of the region over time. The area was formerly an industrial zone, and the ecological rehabilitation project encouraged a flourishing of the service sector. Recreational attractions, museums and universities replaced the industrial facilities along the shore. At the initial stages of the project, a negative social response was expected, especially on the part of people who relied on the industrial facilities for living. Yet, according to the former Mayor of Istanbul Metropolitan Municipality, Bedrettin Dalan, approval for the project had reached 70% within the first year of the project's kick-off and eventually rose to 96% as new facilities were being built one after the other. The urban transformation succeeded in large part because an effort was made to preserve the authenticity of historical and industrial structures, while repurposing them for new functions. For example, an old electricity power plant was turned into an energy museum, an old fez factory became a cultural center, and a cigarette company was transformed into a university campus.[104]

Measuring the social and economic impact of the Golden Horn Restoration Project would be incomplete

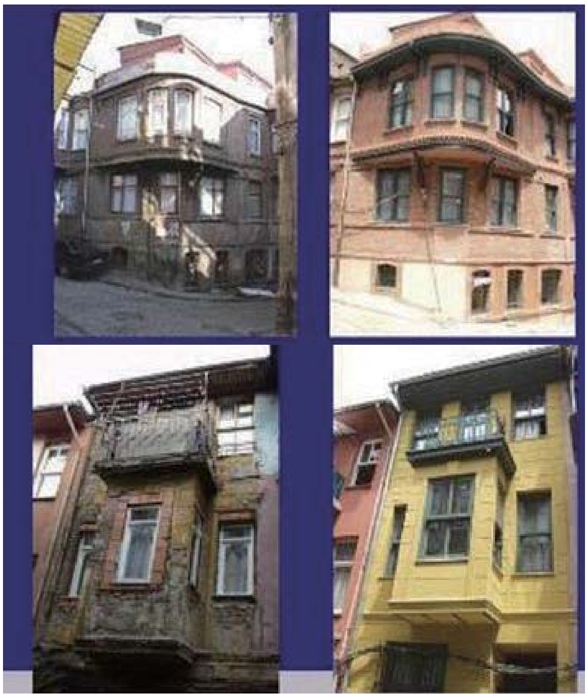
103) Erdogan, N., Aytac, A., Kirbiyik, N., Aytac, H., Unlu, F., Ozgen, G., and Sen, N.F. Added Value in Agricultural Sector Created with Irrigation Systems Developed by DSI. 2. National Irrigation Congress, 16-19 Oct 2003, Aydin, 181-189.

104) Coleman, et al., 2009.

without including other regeneration projects carried on by district municipalities and private actors. It should be noted that the ecological restoration of the Golden Horn has facilitated urban transformation projects with social, economic, and cultural impact. Another important aspect to be pointed out is the diversity of the actors involved in each project, including the Istanbul Metropolitan Municipality, the Fatih District Municipality, the European Union, private enterprise, and local communities. In the Golden Horn ecological restoration project, ISKI and the Metropolitan Municipality were the lead actors, with limited involvement of private sector and civil society.

The urban renewal process with the major economic and social impact was experienced in the Fener-Balat-Ayvansaray neighbourhoods. The transformation in these districts happened as a result of two projects. The first one, 'Fener-Balat Rehabilitation Project' was carried out by the European Union in cooperation with Fatih District Municipality from 1996 to 2008. It was more like a 'rehabilitation' project rather than a 'renewal' attempt, because its primary aim was to restore old texture without changing its authenticity. The second project is the 'Fener-Balat Renewal Project' that brings together Fatih District Municipality and the private sector. This second project has fewer social provisions for the local population, since its primary concern is to bring new people to newly constructed buildings in town.

Fener and Balat are two of the oldest neighbourhoods in the Golden Horn area that hosted wealthy Greek and Jewish communities until the first half of the 20th century. In time, the neighbourhood lost its charm due to transformation of the area into an industrial zone. In 1996, the Habitat II conference paved the way for an urban renewal project in Fener and Balat to accompany the ecological restoration process. The Fener and Balat Rehabilitation Project started in 1997 with a joint intervention by the Fatih District Municipality, UNESCO and the European Union.[105] The project was originally estimated to cost 15.6 million European Currency Units (ECU), of whose one third would be covered by EU and the rest by different Turkish institutions. The Fener-Balat Project comprised four parts: residential restoration (see Picture 5), social rehabilitation, historical revitalization and infrastructure improvements. The most important aspects of the programs were: the active participation of local people in the decision-making process; and precautions to protect local owners, such as prevention ofselling their properties within five years of completion of the restorations.[106] Through the project's lifespan several public outreach meetings were held to inform



Source: http://www.fatih.bel.tr/icerik/1156/fener-balat-semtlerinin-rehabilitasyon-projesi/

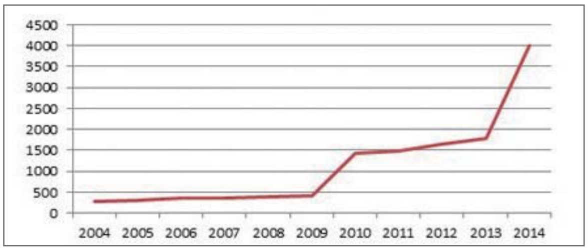
<Picture 5> Rehabilitated Buildings under the Fener-Balat Rehabilitation Project

105) *Bezmez, D. 2009. The Politics of Urban Waterfront Regeneration: The Case of Halic (the Golden Horn), Istanbul. International Journal of Urban and Regional Research*, 123.

106) Şişmanyazıcı, B. et al. 2010 Tarihî Kentsel Alanlarda Toplumsal ve Mekânsal Yeniden Yapılanma. Fener ve Balat Örneği, Mimarlık Dergisi, 352.

the locals about the course of the project and to get their consent for certain steps. The Fener-Balat rehabilitation project ended in 2008. In total, 121 old buildings were renovated. A multifunctional social center has opened that serves for public meetings, occupational courses, infant care programs and after-school study activities. Rehabilitation of historic Balat Bazaar was also realized in consultation with shop-owners.[107] And finally, a solid waste management strategy was developed, and awareness raising meetings were conducted for the local people. Residents were given special solid waste bins and Fatih District Municipality formed a team for collecting solid waste from the residents in the neighbourhood.

The rehabilitation activities supported by the EU attracted the attention of real estate businesses in the region. Since the mid-2000s private enterprise has been gradually engaging in projects with the Fatih Municipality. In time, these public-private partnerships replaced the rehabilitation projects of the late 1990s, and in 2009 the 'Fener-Balat Renewal Project' has been initiated through cooperation between the Fatih Municipality and Çalık Group. As described in Gunay and Dokmeci,[108] "the aim of the project is to create a safer and healthier environment that is integrated with the city, to improve infrastructure, to increase quality of life, to take precautions against earthquake risk, and to improve current patterns of use through tourism-related facilities".



Source: http://www.emlaktasondakika.com/gayrimenkul-degerleme/Bolge%20Raporlari/EyupBalatFenerAyvansaray-Bolgesi-34-yilda-ne-kadar-degisti/45.aspx
Note:Numbers on the vertical axis indicate price in Turkish Lira (TRY)/m^2(US $1.00=TRY 1.9 on 6.5.2014)

<Figure 13> Real Estate Market Value Change in Ayvansaray District of the Golden Horn

The total area of Renewal Project covers almost 280,000 m² and comprises green areas on the shore as well as residential areas with houses and offices.[109] Figure 13 shows the real estate market value increase since 2009. In the zone where the houses and offices are densely located, the prices vary between US $1,000 to 2,000/m^2 for new facilities, and between US $2,500 to 4,000/m^2 for the buildings with historical character. Again, according to Gunay and Dokmeci, the prices of historic buildings are between $162,000 and $650,000; and the rents for restored ones are between $970 and $2600 per apartment flat per month. Only last year, 100 buildings were bought mainly by real-estate companies such as Sener Holding and Riva Foundation.[110] The total estimated cost of the Fener-Balat Renewal Project was $200 million.

In addition to these two urban transformation projects, particular facilities in the region made significant economic progress and had a social impact as well. Rahmi Koç Museum was one of the first private museums in Istanbul. Although it is not easy to make a direct relation, it is interesting to observe the number of private museums that opened between 2000 and 2010. These newly-opened private museums constitute 50% of the total museums in Istanbul. The total revenue of private

107) Fatih District Municipality http://www.fatih.bel.tr/icerik/1156/fener-balat-semtlerinin-rehabilitasyon-projesi/

108) *Gunay, Z. and Dokmeci, V. 2012. Culture Led Regeneration of Istanbul Waterfront: Golden Horn Cultural Valley Project. Cities*, 29.

109) How has Eyup Balat Fener Ayvansaray District Changed within 3-4 Years? [In Turkish]: http://www.emlaktasondakika.com/gayrimenkul-degerleme/Bolge Raporlari/EyupBalatFenerAyvansaray-Bolgesi-34-yilda-ne-kadar-degisti/45.aspx

110) Ibid.

Source: http://www.amplio.com.tr/pdf/amplio_hmgr.pdf

<Picture 6> Vialand Located on the Old Quarry Filled with Dredged Sludge from the Estuary

museums reached US $33 million in 2010, compared to US $5 million in 2000.[111] Another recently finished noticeable project in the region is a huge theme park. The old quarry, where the mud and debris removed from the estuary were transported, was transformed into a gigantic entertainment park (Vialand, see Picture 6). The park and shopping center are constructed on a 600,000m^2 area, and 30 million visitors are expected annually. Vialand will provide employment opportunities for 4,500 people, and approximately 70% of the workforce are expected to be hired from nearby districts.[112]

3. Environmental Performance

In the 1980s, over one million people resided around the estuary, and industrial activity was extremely intense (and also polluting). Hence, almost all of the industries and 5000 shanty homes were expropriated, demolished, and relocated as the initial step of the rehabilitation project. This action enhanced air quality in a short period of time and thereby boosted public health. Beforehand, hazardous concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) were detected in the area as a result of the industrial activities.

Source: http://www.ibb.gov.tr/tr-TR/kurumsal/Birimler/DenizHizmetleriMd/Pages/AnaSayfa.aspx#.U2jCvPl_tpt]
photo by: Murat Ayan

<Picture 7> Sludge dredging in the Golden Horn Estuary

In the next stage of the project, sewage transportation systems were constructedon the north and south of the Golden Horn. Consequently, more residents gained access to sewerage systems, and discharge into the estuary ceased.

111) Bakbasa, C. 2010. Istanbul Cultural Heritage and Cultural Economy Inventory 2010: Museums in Instanbul. Sector Research Report, TC Ministry of Culture and Tourism.

112) Turkey's Biggest Theme Park Vialand Opened On Golden Horn http://www.dailysabah.com/money/2013/05/27/turkeys-biggest-entertainment-park-vialand-opened-on-golden-horn

Following this stage, the accumulated sediment and waste problem in the inner part of the estuary, which caused serious odour problems due to anaerobic degradation, had to be resolved. The sludge was removed by two suction dredgers, six dredging ships and three large pump stations (see Picture 7). More than 5 million m^3 of sludge have been removed and the dredged sludge was transferred into an abandoned rock quarry. Sediment was disposed in an abandoned quarry since concentrations of lead exceeded Turkish landfill standards in 1993. In the end, the odour problem was eradicated, and restoration of ecological life was facilitated.

In 2000, the Old Galata Bridge was removed to improve water quality in the Golden Horn. The bridge floated at the mouth of the estuary on pontoons 4 m deep thatseriously hindered circulation. Additionally, freshwater was released into the estuary from a dam, and a fountain was constructed to supply oxygen into seawater and thereby improve water quality.

The water clarity improved immensely since the 1970s. The total increase in clarity was 85% on the outer estuary by 2005. Dissolved oxygen levels, on the other hand, increased by 80 - 85% since the 1970s. Furthermore, nutrient concentrations (nitrite and inorganic phosphate) declined significantly, and hydrogen sulphide ceased completely. Inner estuary biochemical oxygen demand (BOD) values after rehabilitation have gradually decreased towards the outer estuary; and the BOD values in both areas are below 20mg/L since 2001.

Prior to the rehabilitation project, the only organisms in the hydrogen sulphide-rich estuary were anaerobic. Marine life in the estuary, which was once richwith diverse fish populations and species, was limited to mackerel, sprat and mullet in the 1990s. However, microbiological activity dropped sharply after 2000, and the levels in the outer estuary were low enough to qualify as "safe for fishing" by 2002. The anaerobic conditions in the estuary ceased following sludge dredging and removal of the bridge. The Faecal Coliform levels decreased from 107 FCU/mL to 102 FCU/mL in the inner estuary and to 10 FCU/ml in the outer estuary by 2005. The aquatic biota revived.[113)]

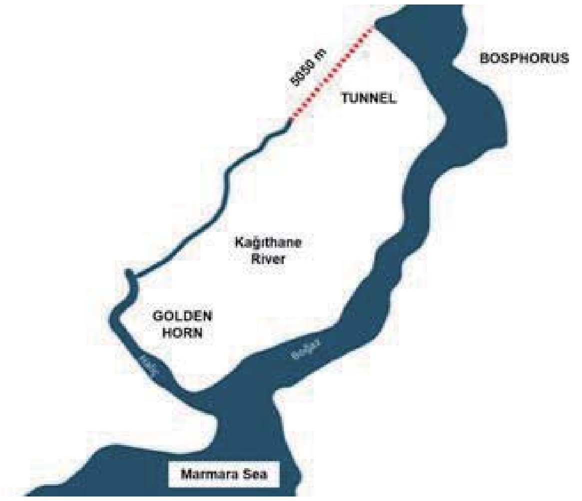
Another ambitious project was finalized in 2012 to pump 260,000 m^3 seawater daily from the Bosporus to Golden Horn (Picture 8). This project further increased the dissolved oxygen levels in the estuary and the Coliform levels dropped below 100 FCU/mL in many parts of the estuary. Moreover, 47 different species of fish and larvae have been observed, as listed in Table 9.[114)]

<Table 9> Fish and Larvae Species Observed in Golden Horn Estuary (1993-2013)

1	Arnoglossus kesleri	24	Mugil (Liza) auratus
2	Atherina sp	25	Mugil cephalus
3	Blennius ocellatus	26	Chelon labrosus
4	Belenius sp	27	Mugil so-iuy
5	Buglasidium luteum	28	Mullus barbatus
6	Callionymus lyra	29	Platichthyes flesus
7	Callionymus maculatus	30	Pomatomus saltator
8	Ctenolabrus rupestris	31	Sarda sadra
9	Dicentrarchus labrax	32	Sardina pilchardus
10	Diplodus annularis	33	Scianea umbra
11	Diplodus sp	34	Scomber japonicus
12	Diplodus vulgaris	35	Scomber scombrus
13	Engraulis encrasicolus	36	Scorpaena porcus
14	Gaidropsarus mediterraneus	37	Serranus hepatus
15	Gobius niger	38	Solea sole
16	Gobius pagenellus	39	Sphyraena sphyraena
17	Gobius sp	40	Spicara maena
18	Gynammodytes cicerelus	41	Sprattus sprattus
19	Hippocampus ramulasus	42	Symphodus tinca
20	Liza saliens	43	Trachurus meditterraneus
21	Merlangius merlangus	44	Trachinus draco
22	Merluccius merluccius	45	Trigla sp
23	Microchirus variegatus	46	Uranuscopus scaber
		47	Syngnathus acus

113) Coleman, H.M. et al. (2009)

114) http://www.iski.gov.tr/Web/haberDetay.aspx?HID=1004186



<Picture 8> Seawater Tunnel Constructed between the Bosporus and the Golden Horn Estuary

4. Social Performance

One of the targets of Golden Horn rehabilitation has been to provide a cultural attraction zone and enhance tourism by reviving the historical urban waterfront. The Master Plan included the renovationof the historic environment, the re-use of former industrial structures and the establishment of museums.

As mentioned in the "Economic Performance" section of this chapter, the rehabilitation of two historic neighborhoods, Fener and Balat (Figure 14) was one of the key aspects of this massive transformation process. The main intention was to raise the living standards of the residents through the provision of a healthier urban environment. The rehabilitation project in these neighbourhoods started in 1997, with a joint intervention by the Fatih Municipality, UNESCO and the European Union. However, the community did not respond willingly to the project, and the project could not be initiated until 2005. Even after 2005, the rehabilitation did not proceed far enough due to shifts in the municipality following the local elections as well as the reluctance of the local community.[115)]

Source: Bezmez, (2009)

<Figure 14> Historic Neighborhoods around Golden Horn Estuary

Although the project was only supported to a certain extent by the local citizens in the beginning, owing to industrial demolition and high unemployment, it certainly gained more acceptance once the industrial zone was transformed into green park areas (Picture 9) and new industries had replaced the old ones.

The transformation of old industrial facilities into cultural and educational centers (e.g. Miniaturk, Rahmi Koc Museum, Kadir Has University etc.) has revived the social and cultural development of the area. At present, the estuary hosts various cultural and social events throughout the year, such as international air races, fairs, water sports competitions, and conferences, attracting large numbers of tourists and citizens. For example, the Feshane Exhibition Center, which was once the Textile Factory, currently receives 2 million visitors annually.

115) Coleman, H.M. et al. (2009)

Source: Amplio Real Estate Investments

<Picture 9> Green Recreational Areas at Golden Horn

Source: Courtesy Amplio Real Estate Investments

<Picture 10> Pierre Loti Hill

Also, the Pierre Loti Hill, the famous café with a view of Golden Horn (Picture 10), receives nearly 400,000 visitors on an annual basis. Taking all of these facts into account, it can be easily concluded that the projec tenabled an environment to bring people from different social backgrounds together.

Furthermore, this newly emerging vibrant social atmosphere provided safer and more attractive neighbourhoods compared to its old times when it was an industrial district. Transportation facilities were stimulated from the estuary mouth towards Eyupin order to meet the increasing demand. Recreational boating and

Source: sabah.com.tr

<Picture 11> Recreational Boating at Haliç

Source: milliyet.com.tr

<Picture 12> Baptism Ceremony on Orthodox Christmas, at Haliç.

rowing activities have been started as well (Picture 11). The news media coverage, such as the highly publicized swim by the mayor and important figures of society in 2003, changed citizens' opinions on the Golden Horn and helped them to view the Golden Horn as a beneficial resource again.

The Golden Horn also hosts a spiritual event every year. The Greek Orthodox Patriarch walks down to the shore of the Golden Horn, blesses the water and throws a cross in the sea in the memory of Jesus Christ's baptism by John the Baptist in the Jordan River. It is believed that whoever catches it first is the lucky person of the year. He receives a special blessing from the Patriarch and a special gift. Although this ritual also takes place in a few other sites around Istanbul, it is the event on the Golden Horn that attracts most attention both by Orthodox Christians and also by Muslims. Since 1992, Patriarch Bartholomeos has been conducting this ceremony as a service to Fener Rum Orthodox Patriarchate (Picture 12).[116]

5. Overall Performance

The Golden Horn project can be regarded as a success story in many senses. Environmental, social, and economic indicators offer a lot to support this claim. Among the factors leading to success is the determined governance of the project by well-coordinated actors from public, private and civil spheres at all phases. The project started with demolition of the industrial zone coordinated by the Istanbul Metropolitan Municipality's decision to take action. Besides the strong managerial component, the project also has well planned financing and monetary resources, which were accomplished by ISKI's ability to collect fees as the main source for project development and implementation. As a long-term project, it required well-coordinated efforts of all the different stakeholders. The academic support in the consultation process was an important component of success. Numerous professors and engineers served as directors for the ISKI staff during the course of the project. In particular, the Marine Sciences Department of Istanbul University had been a dedicated facilitator for ISKI.

116) http://www.hurriyetdailynews.com/looking-for-spiritual-light-on-the-golden-horn-.aspx?pageID=238&nID=10999&NewsCatID=422

V. Lessons Leamed and Conclusion

The urban transformation of Istanbul around the Golden Horn succeeded as a result of many intersecting elements, including strong political support, a variety of measures working together to restore the water quality, and many actors on all levels working in tandem to transform the waterfront from an industrial area to a cultural and educational center. A concerted effort was made to preserve the authenticity of historical and industrial structures, while repurposing them for new functions.

The ecological rehabilitation of the estuary encouraged a flourishing of the service sector. Recreational attractions, museums and universities replaced the industrial facilities along the shore. The ecological restoration of the Golden Horn has facilitated urban transformation projects with social, economic, and cultural impact.

Some of the lessons learned were the following:

A diversity of actors was needed to make the project work.

There was a mixture of public and private actors that had an impact on the economic and social performance of the project over time. Some of the diverse actors involved in the multi-faceted long-term project included: the Istanbul Metropolitan Municipality, the Fatih District Municipality, the European Union, private enterprise and local communities. In the Golden Horn ecological restoration project, ISKI and the Istanbul Metropolitan Municipality were the lead actors, with limited involvement of the private sector and the civil society.

Urban transformation requires the involvement and commitment of communities in keeping the environment clean.

The participation level of stakeholders in the Golden Horn project varied. Local people, private sector, academia, and NGOs have been consulted to varying degrees and were informed properly at different phases of the Project. But, the overall effectiveness of the community-centred institutions remained low. A positive example of community participation comes from the Fener-Balat rehabilitation project, which was completed in 2008. In total, 121 old buildings were renovated, a multifunctional social center was opened that serves for public meetings and educational activities, and the historic Balat Bazaar was renovated in consultation with shop-owners. To ensure long-term sustainability, a solid waste management strategy was developed, and meetings to raise awareness were conducted for the local people. Residents were given special solid waste bins and the Fatih District Municipality formed a team for collecting solid waste from the residents in the neighbourhood.

The project drew on innovative ideas for repurposing and renovation.

Many private businesses and individuals came up with innovative ideas for repurposing and reusing some of the run-down facilities that led to solid economic investments. For example, Rahmi Koç Museum was one of the first private museums in Istanbul. This was followed by a number of other private museums that opened between 2000 and 2010. The total revenue of private museums reached US $33 million in 2010, compared to US $5 million in 2000. The theme park Vialand was built over an old quarry filled with the mud and debris removed by dredging. Other innovative examples include: an electricity power plant that was turned into an energy museum; an old fez factory became a cultural center; and a cigarette company was transformed into a university campus.This type of innovative repurposing preserves the authenticity of the region and saves money on construction.

Residents may not be direct beneficiaries of waterfront facilities.

The Golden Horn project has made a significant contribution to the region through the construction of high-level education institutions, rowing clubs, cultural centers, and museums. Considering that these educational and cultural facilities are open to the public and are not exclusive to inhabitants of the Golden Horn, it should be noted that local residents may not be direct beneficiaries of the renewal process. In fact, many people were displaced from their homes and their jobs when the demolition and renovation of old buildings was carried out. While local residents may be secondary beneficiaries, it is important to include them in the planning process.

Improvements in the Golden Horn's ecosystem and marine environment need to be reinforced with stronger air and water quality regulations.

The project had a positive impact on marine life and biodiversity and resulted in an increase in the fish population. A large increase in number of aquatic species has been observed, and hand-line fishing, which was absent from the region for a long time, is again contributing to the well-being of local residents. Despite improvements in the environment, however, Turkey performs below the OECD average for air and water quality. Therefore, Turkey's strong economic performance needs to be reinforced with focused air and water quality regulations to improve the quality of life.

Political success of the project needs to be combined with social and economic policies.

Because of the social and economic transformation that has taken place around the Golden Horn, the district provides political influence, as it can be promoted both by local and central government politicians. Revival of this once environmentally devastated urban center is a remarkable political success as long as it is combined with fairly implemented social and economic policies.

Improved water saving and reuse technologies can help to meet the future water demand for the city of Istanbul and Turkey.

While Istanbul has made good progress in terms of water supply and treatment, improved water saving and reuse technologies could help meet future water demands for the city. The same measures can be applied to Turkey as a whole. Citizens need to recognize the value of water more. Better technologies for water treatment, storage, transfer, and monitoring are essential to bring about water savings. Citizens, municipalities, farmers, and companies – every actor should pay more attention to produce more with less water. Big cities such as İstanbul should handle leakage problems in an effective way to save every single drop of water.

Better coordination among government and other actors is needed for improved water management, especially at the basin level.

At the institutional level, coordination is needed among public bodies as well as across the private sector, universities, and civil society in order to make more informed decisions. There have not been well-organized water management plans in Turkey in the past, but in the lead up to EU accession, river basin management plans will be implemented in the coming years. Thus, it is expected that a more holistic and inclusive water management system will be developed. The establishment of the Ministry of Forestry and Water Affairs and SUEN strengthens Turkey's attention to water management at the national and international levels and expands its collaboration with global actors. Turkey will have to apply river basin management plans carefully and consider varying conditions of each basin in order to achieve reasonable tradeoffs and meet the particular needs of basins.

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Sources are indicated with each photo.

Interview 1

We have a recent project to increase the oxygen level of the Golden Horn water. Since 2012, we are carrying clean seawater from Bosporus, Sarıyer via great tunnels. The project took three and a half years in total. Thanks to the project, ecologic parameters in the region have improved significantly, which pave the way for richer biodiversity. We have detected 47 different species of fish in the Golden Horn recently.

ISKI put a lot of effort into protecting and sustaining available water resources as well as utilizing new and alternative water resources. We are working on acquiring an additional 700 ha of territory to become lakes filled with drinkable water. Furthermore ISKI is working to supply more water to the increasing population of Istanbul. In just last five years we increased the supply of treated domestic water from 723 million m^3/year (2009) to 909 million m^3/year (2013). This indicates more than 25% increase of supplied clean water in four years. ISKI has also had great success in terms of treated wastewater. Thanks to the advanced wastewater treatment plants built in the last 10 years, the daily amount of treated wastewater increased from 1.37 million m^3/day (2003) to 3.18 million m^3/day (2013). ISKI now aims to reuse 130,000 m^3/day treated wastewater in green areas and industry.

There is no doubt that improved water and sanitation systems make positive contribution to people's lives. Istanbul residents used to have limited access to water back in the early 1990s – only a couple of hours a day. Almost all wastewater was discharged without treatment. Not only the Golden Horn, but also the whole Istanbul is now better off, largely thanks to the efforts of ISKI and the political will to rehabilitate the area. The Golden Horn has become a center of attraction with all recreational and cultural facilities.

Well, recently (after the local elections on March 31, 2014) some of the municipalities have been turned into metropolitan municipalities. Now there are more than 30 metropolitan municipalities. This means that the ISKI model and law will be applied in these districts. This transformation will require lots of effort, but eventually a more holistic and well-operated water management will be achieved. Even the household water demands of distant villages and small towns that are integrated into the metropolitan municipality will be taken care of through new ISKI-type administrations.

Istanbul is making good progress in terms of water supply and treatment. But, improved water saving and reuse technologies can help more in order to meet the future water demand of the city. The same measures can be applied to Turkey in general. We need to recognize the value of water more. Better technologies for water treatment, storage, transfer and monitoring are essential everywhere.

Interview 2

Regarding the Golden Horn area, the Municipality has worked with ISKI for a long time. In terms of task distribution, the Municipality may represent the political will to act and it shared the project development and planning responsibilities with ISKI, which is still active in operation and maintenance of infrastructure such as distribution lines and treatment plants. The most recent involvement of the Municipality with the Golden Horn project has been through the water transfer project from Bosporus to the estuary. In order to increase the amount of oxygen in the estuary, we carry clean seawater through pipes with a size of 2,200 mm. In total the transfer tunnel is 14 km long, and it carries 260,000 m^3 of seawater per day. In total 44 million Turkish lira were invested for this project.

As the Environmental Conservation Department of the Municipality we have specific tasks of monitoring, controlling and developing projects to combat particular environmental problems at the local level. Our area of work primarily includes protection of marine ecosystems and air quality, control of noise pollution and fuel supervision.

These projects improve the water quality in the Golden Horn, which is appreciated by all the people. We try to enable cleaner seas and air, and reduced noise for the citizens in Istanbul. For instance, as the Istanbul Metropolitan Municipality we manage a social facility by the shore of the Golden Horn estuary. It is an affordable place where you can enjoy good food and scenery with your family in a safe and healthy place. It would not have been possible to enjoy anything at all next to the Golden Horn estuary 20 years ago.

There are a lot of things being done as far as I know. Several legislations are in place regarding water quality and treatment. Domestic waters of Istanbul meet the EU standards in terms of water quality. But, at household level many of the buildings possess old storage facilities, so especially the people at middle-income or higher level hesitate to drink from the taps. The EU membership application process triggered many improvements due to the environment chapter that sets tangible goals for improved environmental standards. In this sense local governments have more responsibility compared to previously, because EU regulations pay close attention to involvement of local entities in the decision-making process.

First of all, there is a need for water savings at all levels. Citizens, municipalities, farmers, companies; every actor should pay more attention to produce more with less water. Big cities like İstanbul should handle leakage problems in an effective way to save every single drop of water. At institutional level, coordination is needed among public bodies as well as across the private sector, universities and civil society in order to make for more informed decisions.

Interview 3

In my term of service at ISKI, we used to make pop-up inspection visits to industrial sites that discharge treated wastewater into the inlet. Although we very rarely encountered minor leakages in the discharge systems, we were quite strict with sanctions to make firms meet their environmental protection standards. We applied sanctions ranging from cash penalties to prohibition from production until the necessary steps were taken. I know ISKI still monitors the water quality regularly and checks the activities of the firms located along the shore. Such control activities ensure that the efforts made to clean the Golden Horn are not for nothing, but will keep it clean perpetually.

For now, I can speak on behalf of SUEN. As SUEN we do not have responsibility to take on site action with tangible impact. We are rather authorized to develop projects to study the conditions and needs of river basins in Turkey. Recently we have been working on modelling projects at several river basins. There are also training programs that SUEN organizes for developing countries such as Afghanistan, Azerbaijan, Ghana and Saudi Arabia. The content of these programs varies according to demand, yet mainly includes water treatment techniques and the institutional structure of the Turkish water management system. Other than modelling studies and training programs, SUEN engages with international partners for joint periodic projects. The total outcome of these activities can help increase public awareness and improve decision-making capabilities for stakeholders.

SUEN's activities do not make much socio-economic change at local level. We are authorized to work with academia at local level at most. But, this does not mean that the joint work between SUEN and universities does not deal with local issues. Turkey is adapting basin level management models. The river basin management plans for 25 river basins are ready to be implemented. New administrative units such as basin management commissions are formed with the involvement of local stakeholders. They will enable better linkages between local and central authorities. The establishment of the Ministry of Forestry and Water Affairs is another important milestone that shows Turkey is giving special attention to water management. Of course, there is SUEN established in the same year as the Ministry (2011), which strengthens Turkey's ability to follow up international water agenda and collaborate with global actors.

Improved higher education facilities for water management studies would be better for Turkey. There are already several academic programs focusing on environmental management. We need to expand the number and quality of such institutions in an interdisciplinary way. In this way we can build the capacity of well-trained water experts. Besides higher education, regular citizens should also have more access to information about the condition of water and its services, so that they can contribute better to the decision-making processes.

Interview 4

To my knowledge, there is a recent project for carrying seawater from the Bosporus to the Golden Horn in order to increase the oxygen rate in the inlet. Actually, we can consider this as a continuation of the previous rehabilitation project. They both aim to improve the environmental quality of the region. Of course there has been a large-scale effort on the part of multiple actors to make the region more habitable, not only for humans but also other species as well.

I personally do not carry out such projects. The IWRA works as a forum to bring together academics from different disciplines to discuss water management around the world. In this sense, IWRA helps disseminate knowledge globally via events and publications. Green growth has been on the agenda of the IWRA members for a while. There are many articles and case studies examining the relationship between ecology, society, economy and water management. On the one hand, there are separate projects that increase the social and economic attractiveness of the Golden Horn region, such as universities, convention centers and museums alike. On the other hand, there are comprehensive urban transformation projects with the involvement of global actors like UN HABITAT and the European Union.

In order to make sense of the evaluation of water management in Turkey, one should associate the process with the efforts to join the European Union and globalization. Turkey has been taking European Water Framework Directive (WFD) as a model to make a shift to the IWRM system. Now water resources utilization should take all ecological, social and economic needs into consideration. Turkey is even willing to apply this scientific model at the transboundary level to overcome the water-related problems with its neighbours. Not only European Union, but also other international initiatives have been popular in Turkey. Since the 5th World Water Forum in Istanbul, Turkey has become an influential actor in a region that is at the crossroads of Europe, Asia and Middle East. Turkey is becoming more proactive in terms of contributing to the global water agenda. In legal terms there is a draft water law, which resembles the WFD in many aspects, soon to be implemented. I believe this law will have a positive impact on basin-level water management.

Istanbul obviously will need more cautious measures to meet the increasing water demand, so does Turkey. ISKI has been working hard in many fields including water supply, sanitation and treatment. In recent years Turkish engineers have gained lots of experience in water treatment and distribution. This is important, because we will obviously need to reuse treated wastewater in an increasing manner in the coming years. In many scientific reports it is claimed that Turkey's water potential will be affected by climate change in a complex way. It is expected that some regions will face droughts, while the others will have to mitigate the flood risks. In this sense, Turkey should apply river basin management plans carefully and consider segregated conditions of each basin in order to achieve reasonable tradeoffs and meet the particular needs of basins.

Interview 5

As a community-centered organization working for marine protection, we have no projects particularly for the Golden Horn region. But, TURMEPA has been conducting many projects along the Bosporus shore since 1994. Our projects can be clustered under three titles: training projects, awareness projects and conservation projects. One of TURMEPA's recent projects is the museum for underwater wastes, where we literally exhibit wastes that were found through our marine cleaning activities. We welcome children groups to the exhibition where we inform them about human impact on marine life and what needs to be done to keep the marine environment cleaner. There are some other training projects tailored for children of primary school age and their teachers. Moreover, in 2006 and 2010 we established two marine observation centers at Fethiye and Samsun respectively. Each year we give a TURMEPA Sabri ÜLKER Environment Prize for financing a novel environmental application. There are also four TURMEPA boats that collect solid wastes around various shorelines of Turkey with the help of volunteers. These are a few of TURMEPA's education and conservation projects.

A cleaner environment is one of the primary requirements for human development. TURMEPA's projects aim to increase the environmental awareness and encourage people to take action with their own will. We would not be able to achieve what we have done so far unless we reached people. Cleaner marine ecosystems are quite related to cleaner freshwater resources that are utilized by people and eventually flow back into the sea most of the time. Thus, there is a need for integrated and holistic approaches. Unless we can prevent the pollution at source through preventive action, at both household and industrial level, then we have to put a lot more effort and money to fix our mistakes. When you think about how you can change human behaviour in terms of environmental impact and exploitation of nature, you realize that preventive actions are good both for nature, human society and the economy.

There has been some progress in this field. It is good to have river basin management plans, but these need to be implemented cautiously. Protection of environment should be the primary concern when developing any kind of project. Especially when construction projects are planned close to wetlands and water resources, the activity should not be allowed to start unless the environmental well-being is ensured. Likewise, environmental impact assessment reports should be used more effectively to that end. It is not enough to have detailed rules and regulations. What is essential is to monitor the implementation of these tools properly. Coordination among public bodies should be strengthened for better management of the water resources. There are currently four ministries working on marine related issues, and overlaps occur in legislation as well. These problems require urgent solutions. Moreover, transparency and public involvement is equally important for the enhancement of water management. Universities and non-governmental organizations should participate in water related projects.

Water and Green Growth Project Questionnaire[1)]

(Type A)

Request to Respondents

The Water and Green Growth (WGG) Project is a joint research undertaking by the Ministry of Land, Infrastructure, and Transport of the Republic of Korea (MOLIT), the Korea Water Resources Corporation (K-water), and the World Water Council (WWC). Its aims are to explore the role of water in green growth and enhance green growth policies through a better informed and higher consideration of water resources. The outcome of this research is to be a second edition report of *Water and Green Growththat* builds on the progress of the first edition that was published last year, in 2012.

It is to this second edition that we invite you to contribute by completing this questionnaire. As the focus of this second edition is in-depth case studies, the questions pertain to your water-related case. Thus, your expertise is a crucial part of the research, and your contribution will be fully and gratefully acknowledged in the finished report. Knowing the value of your time and knowledge, we have designed this questionnaire to be as clear and concise as possible. Thank you in advance for your support and cooperation in this important study.

(A) Framework and Definitions

The analytical framework we have chosen in this study involves threeelements: *exogenous factors, water institution*, and the related *performance* or outcomes. The exogenous factors merely describe the broad national, regional, or local level context in which a project or set of policies were implemented. These exogenous factors may influence performance directly but also do so indirectly by influencing the institutional factors that comprise the water institution. The water institution is composed of the more static law and administration institutional factors and the more malleable policy mix institutional factors. The former describe the structure and rules that govern the internal processes within a state, i.e. how state, market, and less formal community and civil society initiatives operate; the latter refer to the policy instruments used by a society to attain performance goals.Institutions and institutional factors may be characterized according to whether they are state-driven, market-oriented, or community-centered. Thus, state-driven, market-oriented, and community-centered institutions each havetheir own law and administration factors and policy mix factors. These influence one another and influence performance.

(B) Notes

1. The questionnaire follows the order suggestedabove in (A) Framework and Definitions. However, rather than having a set of questions on exogenous factors, for which we merely employ publicly available data, the questionnaire begins with a set of questions on basic information about your case.The second set refers to state-driven institutions, the third set to market-orientedinstitutions, the fourth to community-centered institutions, and the fifth and final set to performance.

1) This questionnaire is adapted from Saleth, R.M. and Dinar, A. 2004. *The Institutional Economics of Water*. Cheltenham, UK: Edward Elgar, 329-348. and a water and sanitation evaluation survey drafted internally by K-water.

2. Unless otherwise indicated, each question refers to the time of the case in question.

3. Please answer every question. If a question does not provide an answer that fits your situation or does not provide enough space for your answer, feel free to use the blank space next to the question to provide your answer.

4. For questions that require you to tick your answer, you may tick more than one answer unless otherwise stated.

5. For questions requiring a response on a scale of 0 to 10, 10 should be understood as meaning greatest, strongest, most favorable, most influence, most effective, etc. 1 should be understood as meaning least, weakest, least favorable, least influence, least effective, etc. 0 should be understood as meaning having no significance, having no influence, not effective, etc.

For some questions in the 'Performance' part requiring responses on a scale of 1 to 9, 9 should be understood as most positive; 5 should be understood as having no impact; 1 should be understood as most negative.

6. We gratefully acknowledge work that has served as models and inspirations for our questionnaire. In particular, we owe a great debt to The Institutional Economics of Water (2000) by R. Maria Saleth and Ariel Dinar for the World Bank and to a water and sanitation evaluation survey drafted internally by K-water.

Background Information	
1. Respondent's Name	
2. Specialization (circle all that apply)	Government official / Water expert / Economist / Engineer / Legal expert / Student / Other: ______________
3. Affiliation	
4. Address	______________ ______________ ______________ e-mail: ______________ phone: ______________ fax: ______________
5. Any other relevant information	

I. Project Overview

Project overview		
1. Official Project Name		
2. Period	~	
3. Main Purpose of the Project/Case		
4. Type of Project/Case (*tick all that apply*)	☐ Water resources development ☐ Sanitation ☐ Waterfront development ☐ Urban water ☐ Ecosystem restoration	☐ Water supply ☐ Hydropower/tidal power ☐ Flood control project ☐ Ecosystem services ☐ Other: ________________
5. Total Cost	______________________ in ________ (year) US $. *(*Please give your response in US$ at the exchange rate at the time of the project.)*	
6. Source of Funds *(please fill in the blank)*		

Source of Funds	Public ____%	+ private ____%	+ other ____%	= 100%
Internal funds	%	%	%	
Loans	%	%	%	
Subsidies	%	%	%	
ODA (loans)	%	%	%	
(grants)	%	%	%	
Others (specify) ______________	%	%	%	

Ⅱ. State-driven Institutions

A. Law and Administration

a. Legal Treatment of Water Resources [L1]		
1. Legal Treatment of Different Water Sources *(tick all that apply)* [L1]	a) Surface and groundwater are treated alike	tick
	b) They are treated differently	
	c) Laws discriminate between water development and use by public and private parties	
	d) Law distinguishes water development and use across sectors such as irrigation, household, and industrial uses	
	e) There is differential priority and treatment of consumptive and nonconsumptive uses	
2. Legal Linkages between Water and Water-Related Resources.Are there any legal linkages? *(tick all that apply)*	a) Between land and groundwater	
	b) Between land and surface water	
	c) Between forest and environment and water	

b. Balance in Government Layers [SI1]		
1. Regarding the case in question, indicate your judgment on the relative role and influence of government branches *(0 to 10).*	a) Central or federal government	
	b) State or regional government	
	c) Local government	
	d) Statutory bodies and authorities	
2. Is there an exclusive department for water? *(Please circle)*		
2.1. If not, indicate the influence of departments in the case *(0 to 10).* [SI3]	a) Water resources/irrigation department	
	b) Agricultural department	
	c) Environment and forestry department	
	d) Urban and local administrative department	
	e) Legal department	
	f) Other, e.g. economic affairs, finance *(specify)*: ____________________	
3. How well coordinated is the water administration?*(0 to 10)* [SI3]		
4. If there is no exclusive department for water sector or specialized agencies for different subsectors, how much does this hinder better water administration in the case in question?*(0 to 10)*		

c. Organizational Basis and Structure of Water Administration [SI2][A1/A2]		
1. How is the water administration organized? *(Tick all that apply)* [SI2] [A1]	a) On administrative division (geographical basis)	
	b) On hydro-geological regions	
	c) River basins	
	d) Other *(specify)*: ________________	
2. In the case in question, is functional specialization within the water administration balanced? [SI3] [A2]*(Please circle)*		Yes No
2.1. If no, what are the gaps in the existing administrative set-up? *(Please list them with their priority ranking)*	______________________ ______________________ ______________________ ______________________	

B. Policy

a. Well-Organized Plans [SP1]	
1. Are there or have there been well-organized plans related to water management (e.g. national economic development plan) in your country? *(Please circle)*	Yes No
1.1. If yes, how well was the case aligned with the plans? *(0 to 10)*	

b. Financial Support [Subsidies and/or ODA] [SP2]		
1. Has the case received financial support such as subsidies or ODA?*(Please circle)*		Y/N
1.1. If yes, how effectively did the financial support affect the case in question? *(0 to 10)*		
1.2. If yes, pleasedescribe the impacts of the financial support as specifically as possible.	______________________ ______________________ ______________________ ______________________	

c. Taxes and Levies [SP3]		
1. Was the case in question subject to taxes, levies, or tax deductions? *(Please circle)*		Yes No
1.1. How effectively did they affect the case? *(0 to 10)*		
1.2. If yes, please specify the name of the tax(es), levies, or tax deductions and please describe the impacts of the taxes, levies or tax deductions as specifically as possible.	______________________ ______________________ ______________________ ______________________	

d. Regulations		
1. Were there specific regulations directly affecting the case in question? *(Please circle)*		Yes No
2. Did the case begin as a result of regulation or regulatory standards? *(Please circle)*		Yes No
2.1. If yes, how much did the regulation contribute to the start of the case? *(1 to 10)*		
3. How effectively did these regulations affect the implementation of the case? *(0 to 10)*		
4. If yes, please describe the impacts of the regulations as specifically as possible.	______________________________ ______________________________ ______________________________	

e. Technology/R&D Policies [SP4][A7]		
1. Were any specific green technologies or innovative technologies deployed in the case in question? *(please circle)*		Yes No
2. Please check technologies deployed in the case and indicate how extensively the technology components were used in the case. *(tick all that apply)* [A7]		Use
	a) Research and experimental information	tick
	b) Modern accounting and auditing techniques	
	c) Information system technologies (e.g. GIS, etc.)	
	d) Wireless communication	
	e) Water measuring technology	
	f) Computerized dynamic regulation of canal and water delivery networks	
	g) Recycling technologies	
	h) Drip systems	
	i) Sprinkler systems	
	j) Water-saving methods	
	k) Drought-resistant crops and farming practices	
	l) Water quality and sanitation	
	m) Any other *(specify)*: ______________________	
3. Did the case utilize or develop new or cutting edge technologies? *(circle)*		Utilize/ Develop/ Both/ Neither/

C. Overall Effectiveness of the State-driven Institutions

a. Overall Effectiveness of the State-driven Institutions	
1. How effective has the state-driven institution been in the case in question? *(0 to 10)*	

Ⅲ. Market-oriented Institution

A. Law and Administration

a. Water Rights [MI1][L2]		
1. Does water law allow private water rights? *(Please circle)*		Y/N
1.1. If yes, is it in the form of *(tick all that apply)*	a) Individual rights	
	b) Group and collective rights	
	c) Other forms *(specify)*: ____________________	
1.2. If yes, how strongly did water rights influence the case in question? *(0 to 10)*		
1.3. If no, what are the constraints? *(Tick all that apply)*	a) Public control is needed for equity	
	b) Administering private rights is socially difficult	
	c) Gaps in water control institutions and technologies	
	d) Other *(specify)*: ______________________	
2. Basis for general rights in water *(tick all that apply)* [L2]	a) None or not clear	
	b) Legally guaranteed open access	
	c) Common or state property	
	d) Riparian system	
	e) Appropriative system	
	f) Correlative system (equal or proportional sharing)	
	g) Other *(specify)*: _____________________	

b. Scope for Private Participation [MI2][L7]

1. Do the legal provisions allow private sector participation in the following sectors *(tick all that apply)* and how extensive is private participation in the following sectors? *(0 to 10)*		Legal basis	Extensiveness
	a) Irrigation	tick	0~10
	b) Water supply and sanitation for households		
	c) Water supply and sanitation for industrial & commercial sites		
	d) River management and flood control		
	e) Others *(specify)*:____________________		

2. For the case in question, do the legal provisions allow private sector participation in the following steps (tick all that apply) and how extensive is private sector participation in the case in question?*(0 to 10)*		Legal basis	Extensiveness
	a) Planning	tick	0~10
	b) Engineering and construction		
	c) Operation and Maintenance		
	d) Investment		
	e) Others *(specify)*: ____________________		

B. Policy

a. Cost Recovery[MP1][P2]

1. Water pricing is based on *(please tick)* [MP1] [P2]

	Irrigation	Household use urban/rural	Industrial & Commercial use
a) Full cost recovery			
b) Partial recovery			
- specific rate (%)	%	%	%
c) Full subsidy			

2. In the case in question, how fully are the costs covered by the price or the charge?	%

b. Private Sector Promotion Policies [MP2][P4]

1. In your opinion, how well are users disposed toward private sector involvement in the case? *(tick one)*	a) Favorable overall	
	b) Favorable in particular sector	
	c) Not favorable	
	d) Indifferent	
	e) Opposed	

c. Project Selection Criteria [MP3][[P1]

1. Please indicate the criteria used in project selection. *(Tick all that apply)* [MP3] [P1]

	Irrigation project	Urban project	Multipurpose scheme
a) Financial factors (b/c, IRR, etc.)	tick	tick	tick
b) Equity factors			
c) Ecological factors			
d) Any other*(specify)*: ____________			

2. Please indicate your judgment as to the percentage (or proportion) of the case using each criterion. *(please fill in the blank)*	a) Financial factors (b/c, IRR, etc.)	
	b) Equity factors	
	c) Ecological factors	
	d) Any other*(specify)*: ____________	

C. Overall Effectiveness of the Market-oriented Institutions

a. Overall effectiveness of the Market-oriented Institutions

1. How effective has the market-oriented institution been in the case in question? *(0 to 10)*	

Ⅳ. Community-centered Institution

A. Laws and Administration

a. Conflict Resolution and Coordination[CP3][L3]		
1. Are the conflict-resolution mechanisms explicitly specified in law? *(Please circle)*		Y/N/not clear
2. Indicate the kinds of conflict resolution or coordination mechanisms that are in place regarding the case in question. *(Tick all that apply)*	a) Administratively/bureaucratically rooted system (Water Resource Dept., Irrigation Dept., etc.)	
	i. Local administration/govt.	
	ii. National Water Council	
	b) Relatively more decentralized system	
	i. River boards	
	ii. Basin organizations	
	iii. Other, e.g. water user associations (WUAs) *(specify)*: ________________________	
	c) Tribunals	
	d) Judicial/legislative/constitutional	
	e) Other*(specify)*:__________________________	
3. What are the legally specified mechanisms for transboundary conflicts (interstate and international)? *(Tick all that apply)*	a) River boards	
	b) Basin organizations	
	c) Tribunals	
	d) Other *(specify)*: ___________________	
4. In your opinion, how effective are the legal provisions for conflict resolution and coordination mechanisms related to the case in question? *(0 to 10)* [L3]	a) Local level (among users)	
	b) National level (among regions and sectors)	
	c) International level (among nations)	

b. Accountability [CI1][L4/A5]		
1. Are there explicit legal provisions for ensuring the accountability of officials, water suppliers, and users in the case in question? [CI1] *(Please circle)*		Yes No
2. In your opinion, how effective are the accountability provisions? *(0 to 10)* [CI1] [L4]	a) For officials	
	b) For water suppliers	
	c) For users	
3. Regarding the case in question, do the accountability provisions vary by *(tick one or more)*: [CI1]	a) Use categories (agriculture, household, and industry)	
	b) User groups (local govt., private companies, associations, etc.)	
	c) None	

4. In the case in question, in what way are the legal provisions of accountability administratively (or organizationally) translated and how effective are they in practice? [CI1][A5]

	(tick)	*(0 to 10 scale)*
a) Within formal water administration		
i. Administrative supervision	tick	0~10
ii. Financial auditing(public accounts committees)		
iii. Work auditing		
iv. Grievance cells		
v. Monitoring procedure for sectoral and regional water allocation		
vi. Interministerial committees		
vii. Other *(specify)*:____________________		
b) Outside formal water administration		
i. Local user groups		
ii. NGOs		
iii. Local administration(government)		
iv. Other, e.g. statutory bodies *(specify)*:____________________		

c. Adequacy and Relevance of Information [CI2][A6]		
1. Are water data which are a basis for water-related decision making adequately collected, managed and publicized? *(Please circle)*		Yes No
1.1. Please state the name of the agency in charge of water data management	______________________________ ______________________________ ______________________________ ______________________________	
2. How much are the data open to the public? *(0 to 10)*		
3. How adequate and reliable are the data for the case in question? *(0 to 10)* [A6]	a) Planning	
	b) Implementation	
	c) Performance evaluation	
	d) Coordination and conflict resolution	
	e) Research	
4. Tick the ways in which data are available.	a) Website	
	b) Print materials	
	c) Upon request	
	d) Company reports	
	e) External audit	
	f) Government order	

d. Integrated Approach [CI3][L5]	
1. Does the case in question represent an integrated water resources management (IWRM) approach? *(Please circle)*	Yes No
1.1. If yes, to what degree would you say the case in question accords with IWRM principles? *(0 to 10)* [L5]	

B. Policy

a. Decentralization		
1. Do state policies favor decentralization in the case in question? *(Please circle)*		Y/N
1.1. If yes, how favorable are these policies in each step of the case *(0 to 10)*?	a) Planning	
	b) Construction & implementation	
	c) Management & operation	

b. Stakeholder Participation [CP1][P5]

1. Rank the stakeholders of the project according to the degree of their interest (Write "n/a" for those that do not apply) and tick *the stages* of the top project in which the three stakeholders participated.

	Rank	Non-participation*	Consultation**	Decision making***
a) Central governmen	1~7	tick	Tick	tick
b) Regional government				
c) Local government				
d) NGO				
e) Residents/community				
f) Firms				
g) Other *(specify)*: ________________				

*Stakeholders are informed only
** Stakeholders' opinions are collected or they participate for material incentives
*** Stakeholders participate in important decision making

2. How favorable are the stakeholder participation policies to the case? *(0 to 10)*		
3. How effective is the participation of stakeholders in the decision making in the case? *(0 to 10)* [P5]	a) Central government	
	b) Regional government	
	c) Local government	
	d) NGO	
	e) Residents/community	
	f) Firms	
	g) Other *(specify)*: ____________________	
4. How effective were the following methods for promoting stakeholders' participation in the case? *(0 to 10)*	a) Through education	
	b) Through communication with stakeholders	
	c) Raising public awareness	
	d) Providing decision making power	
	e) Other *(specify)*:	
5. If there are (were) informal or formal organizations for stakeholder participation please list their names and functions.	____________________ ____________________ ____________________ ____________________	

C. Overall Effectiveness of the Community-centered Institutions

a. Overall Effectiveness of the Community-centered Institutions

1. How effective has the community- and civil society-centered institution been in the case in question? *(0 to 10)*	

V. Performance

A. Generic Performance

a. Effectiveness	
1. To what degree did the case in question achieve what was intended? *(0 to 10)* [GP1]	
2. What factors contributed to the successes of the case in question?[GP1]	
3. What factors caused unexpected results in the case's implementation? [GP1]	

b. Efficiency		
1. How efficient has the project administration system been? *(0 to 10)*		
2. How timely was the implementation of the case? [GP2]	a) How timely was the implementation of the case? *(0 to 10)*	
	b) Did the case finish within the planned timeframe? *(please circle)*	Yes / No
	c) If not, how much longer did it take than planned? *(months)* *(please fill in the blank)*	
3. How appropriate were the input costs of the case? *(0 to 10)* [GP3] [GP1]		
4. How transparently has the case been conducted? *(0 to 10)*		

B. Outcome (Overall Effectiveness, Sustainability, and Success) of the case [GP1]

a. Performance										
		(+)			No impact(5)					(-)
1. Economic performance *(please circle)* [EP]	a) Increasing gross regional domestic product (GRDP) brought by the case	9	8	7	6	5	4	3	2	1
	b) Creating jobs in the local economy thanks to the case	9	8	7	6	5	4	3	2	1
	c) Local development to national standards caused by the case	9	8	7	6	5	4	3	2	1
	d) Technological performance and technological advancement	9	8	7	6	5	4	3	2	1

a. Performance										
		(+)		No impact(5)						(-)
2. Societal performance (please circle) [SP]	a) Improvement of people's health by the case	9	8	7	6	5	4	3	2	1
	b) Improvement in quality of life by the case	9	8	7	6	5	4	3	2	1
	c) Increased citizen participation in decision making in or by the case	9	8	7	6	5	4	3	2	1
	d) Increased gender equality in or by the case	9	8	7	6	5	4	3	2	1
3. Environmental performance (please circle) [ENP]	a) Improvement in water quality by the case	9	8	7	6	5	4	3	2	1
	b) Maintaining or restoring biodiversity by the case	9	8	7	6	5	4	3	2	1
	c) Improvement in disaster safety by the case	9	8	7	6	5	4	3	2	1
	d) Increased environmental awareness by the case	9	8	7	6	5	4	3	2	1
4. Overall performance (generic, economic, social, and environmental performance) of the case. (please circle) [OP]		9	8	7	6	5	4	3	2	1

Note * 9 should be understood as the most positive
* 5 should be understood as having no impact
* 1 should be understood as the most negative

C. Institutional Effectiveness

a. Institutional Effectiveness	
1. Please describe the progressiveness of water institutions based on the following factors such as effectiveness, flexibility, adaptability, technological applications, innovation, openness to change, etc. [IP]	______________________________ ______________________________ ______________________________ ______________________________ ______________________________ ______________________________

Variables

Water law variables

[L1] LTRWSA = Legal treatment of water sources, a dummy variable with a value of 1 if all sources are treated alike, but 0 otherwise

[L2] LPRSRF = Format of surface water rights having a value range of 0–7 with 0for no rights; 1 for unclear, unauthorized, or scattered rights; 2 forcommon or state property; 3 for multiple rights; 4 for a ripariansystem; 5 for an appropriative system; 6 for a correlative (proportionalsharing) system; and 7 for a license or permit system

[L3] LCRMEE = Effectiveness of conflict-resolution mechanisms7 captured interms of judgmental perception and expressed on a 0–10 scale

[L4] LACPRE = Overall effectiveness of accountability provisions8 evaluated interms of judgmental perception and expressed on a 0–10 scale

[L5] LINTRE = Overall ability of water law to provide a legal framework for anintegrated treatment of water from various sources evaluated interms of judgmental perception and expressed on a 0–10 scale

[L6] LOECEN = Extent of a centralization tendency within water law evaluated interms of judgmental perception and expressed on a 0–10 scale

[L7] LOEPRV = Legal scope for private sector participation in the water sectorevaluated in terms of judgmental perception and expressed on a0–10 scale

[L8] LOEFWL = Overall effectiveness of water law9 evaluated in terms of judgmentalperception and expressed on a 0–10 scale.

Water policy variables

[P1] PPSCRI = Project-selection criteria having a value range of 0–6 with 0 forno response, 1 for political dictates, 2 for equity factors, 3 forecological factors, 4 for benefit–cost ratio, 5 for internal rate ofreturn, and 6 for multiple criteria

[P2] PCOREC = Cost-recovery status with 0 for non-response, 1 for full subsidy,2 for partial recovery, and 3 for full cost recovery

[P3] PIRSWE = Effectiveness of interregional and intersectoral water transfersevaluated in terms of judgmental perception and expressed on a0–10 scale

[P4] PGPIPP = Impact of private sector promotion policy evaluated in terms ofjudgmental perception and expressed on a 0–10 scale

[P5] PGPIUP= Impact of the policy for promoting users' participation evaluatedin terms of judgmental perception and expressed on a 0–10 scale

[P6] POPAWE = Extent of the influence of other policies10 on water policy evaluatedin terms of judgmental perception and expressed on a0–10 scale

[P7] POELWL = Extent of the linkages between water law and water policy evaluatedin terms of judgmental perception and expressed on a0–10 scale

[P8] POEFWP = Overall effectiveness of water policy11 evaluated in terms ofjudgmental perception and expressed on a 0–10 scale.

Water administration variables

[A1] AORGBA = Spatial organization of water administration taking a value of 0for non-response; 1 if organized in terms of administrative divisions;2 for the hybrid basis, that is, in terms of both geographicdivisions and hydro-geological regions; 3 for broad hydro-geologicalregions; and 4 for river basins

[A2] ABALFS = Balance in functional specialization, a dummy with a value of 1if balanced and 0 otherwise

[A3] AIBDWP = Existence of an independent body for water pricing, a dummywith a value of 1 for existence and 0 otherwise

[A4] ASBUDC = Seriousness of budget constraint facing the water administrationevaluated in terms of judgmental perception and expressed on a0–10 scale

[A5] AACCME = Effectiveness of the accountability arrangements12 evaluated interms of judgmental perception and expressed on a 0–10 scale

[A6] AARINF = Adequacy and relevance of the information base evaluated interms of judgmental perception and expressed on a 0–10 scale
[A7] AEXTST = Extent of science and technology application13 in water administrationevaluated in terms of judgmental perception andexpressed on a 0–10 scale
[A8] AOEFWA = Overall operational ability of the water administration evaluatedin terms of judgmental perception and expressed on a 0–10scale.

Performance variables

[O1] WSPPHY = Physical performance14 of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale
[O2] WSPFIN = Financial performance15 of the water sector evaluated in termsof judgmental perception and expressed on a 0–10 scale
[O3] WSPECO = Economic performance of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale
[O4] WSPEQU = Equity performance of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale
[O5] WSPOEV = Overall performance of the water sector obtained by averagingWSPPHY, WSPFIN, WSPECO, and WSPEQU
[O6] WIPOEV = Progressiveness or overall adaptive capacity of the water institutiontaken as a whole evaluated in terms of judgmentalperception and expressed on a 0–10 scale.

Exogenous Variables

[E1] GNPPPC = Purchasing power parity-based GNP per capita in US dollars
[E2] POPDEN = Population density in people per km2
[E3] DCUPOP = Decadal change in urban population as a percentage
[E4] FWATWC = Freshwater withdrawal per capita per year in cum
[E5] PWATAG = Agricultural share in total water withdrawal as a percentage
[E6] ALANDC = Arable land per capita in hectares (ha)
[E7] FPIIND = Food production index
[E8] EXPEDU = Public expenditure on education as a percentage of GNP
[E9] GININD = Gini index
[E10] NCNATW = Share of natural capital in total wealth as a percentage
[E11] ENVRRI = Environmental Regulatory Regime Index in score
[E12] ININCR = Institutional Investors' Credit Rating index.

WSPOEV = f1[LTRWSA, LPRSRF, LCRMEE, LACPRE,LINTRE, LOECEN, LOEPRV, PPSCRI,PCOREC, PIRSWE, PGPIPP, PGPIUP,POPAWE, POELWL, AORGBA, ABALFS,AIBDWP, ASBUDC, AACCME, AARINF,AEXTST]

O5= f1 [L1, L2, L3, L4, L5, L6, L7, P1, P2, P3, P4, P5, P6, P7, A1, A2, A3, A4, A5, A6, A7]

Overall performance = f1[Legal treatment of water sources, surface water rights, Effectiveness of conflict-resolution mechanisms, effectiveness of accountability provisions, a legal framework for an integrated treatment of water, a centralization tendency within water law, Legal scope for private sector participation, Project-selection criteria, Cost-recovery status, Effectiveness of interregional and intersectoral water transfers, private sector promotion policy, the policy for promoting users' participation, influence of other policies on water policy, between water law and water policy, Spatial organization of water administration, Balance in functional specialization, independent body for water pricing, budget constraint, Effectiveness of the accountability, Adequacy and relevance of the information base, of science and technology application in water administration]

Water and Green Growth Project Questionnaire[1]

(Type B)

Official project name:

Request to Respondents

The Water and Green Growth (WGG) Project is a joint research undertaking by the Ministry of Land, Infrastructure, and Transport of the Republic of Korea (MOLIT), the Korea Water Resources Corporation (K-water), and the World Water Council (WWC). Its aims are to explore the role of water in green growth and enhance green growth policies through a better informed and higher consideration of water resources. The outcome of this research is to be a second edition report of Water and Green Growththat builds on the progress of the first edition that was published last year, in 2012.

It is to this second edition that we invite you to contribute by completing this questionnaire. As the focus of this second edition is in-depth case studies, the questions pertain to your water-related case. Thus, your expertise is a crucial part of the research, and your contribution will be fully and gratefully acknowledged in the finished report. Knowing the value of your time and knowledge, we have designed this questionnaire to be as clear and concise as possible. Thank you in advance for your support and cooperation in this important study.

(A) Framework and Definitions

The analytical framework we have chosen in this study involves threeelements: exogenous factors, water institution, and the relatedperformance or outcomes. The exogenous factors merely describe the broad national, regional, or local level context in which a project or set of policies were implemented. These exogenous factors may influence performance directly but also do so indirectly by influencing the institutional factors that comprise the water institution. The water institution is composed of the more static law and administration institutional factors and the more malleable policy mix institutional factors. The former describe the structure and rules that govern the internal processes within a state, i.e. how state, market, and less formal community and civil society initiatives operate; the latter refer to the policy instruments used by a society to attain performance goals.Institutions and institutional factors may be characterized according to whether they are state-driven, market-based, or community-centered. Thus, state-driven, market-based, and community-centered institutions each havetheir own law and administration factors and policy mix factors. These influence one another and influence performance.

(B) Notes

1. The questionnaire follows the order suggestedabove in (A) Framework and Definitions. However, instead of a set of questions on exogenous factors, for which we merely employ publicly available data, there is a set of questions on your water-related case. Thus, the first set of questions refers to your water-related case, the second set to state-driven institutions, the third set to market-based

1) This questionnaire is adapted from R. Maria Saleth and Ariel Dinar, *The Institutional Economics of Water*(Cheltenham, UK: Edward Elgar, 2004), 329-348, and a water and sanitation evaluation survey drafted internally by K-water.

institutions, the fourth to community-centered institutions, and the fifth and final set to performance.

2. Unless otherwise indicated, each question refers to the time of the case in question.

3. Please answer every question. If a question does not provide an answer that fits your situation or does not provide enough space for your answer, feel free to use the blank space next to the question to provide your answer.

4. For questions that require you to tick your answer, you may tick more than one answer unless otherwise stated.

5. For questions requiring a response on a scale of 0 to 10, 10 should be understood as meaning greatest, strongest, most favorable, most influence, most effective, etc.; 1 should be understood as meaning least, weakest, least favorable, least influence, least effective, etc; 0 should be understood as meaning having no significance, having no influence, not effective, etc.

For some questions in the 'Performance' part requiring responses on a scale of 1 to 9, 9 should be understood as most positive; 5 should be understood as having no impact; 1 should be understood as most negative.

6. We gratefully acknowledge work that has served as models and inspirations for our questionnaire. In particular, we owe a great debt to The Institutional Economics of Water (2000) by R. Maria Saleth and Ariel Dinar for the World Bank and to a water and sanitation evaluation survey drafted internally by K-water.

Background Information	
1. Respondent's Name	
2. Specialization (circle all that apply)	Government official / Water expert / Economist / Engineer / Legal expert / Student / Other: ________________
3. Affiliation	
4. Address	________________ ________________ ________________ e-mail: ________________ phone: ________________ fax: ________________
5. Any other relevant information	

Ⅰ. State-driven Institution

A. Law and Administration

a. Legal Treatment of Water Resources [L1]		
1. Legal Treatment of Different Water Sources *(tick all that apply)* [L1]	a) Surface and groundwater are treated alike	tick
	b) They are treated differently	
	c) Laws discriminate between water development and use by public and private parties	
	d) Law distinguishes water development and use across sectors such as irrigation, household, and industrial uses	
	e) There is differential priority and treatment of consumptive and nonconsumptive uses	
2. Legal Linkages between Water and Water-Related Resources. Are there any legal linkages? *(tick all that apply)*	a) Between land and groundwater	
	b) Between land and surface water	
	c) Between forest and environment and water	

b. Balance in Government Layer[SI1]		
1. Regarding the case in question, indicate your judgment on the relative role and influence of government branches *(0 to 10)*.	a) Central or federal government	
	b) State or regional government	
	c) Local government	
	d) Statutory bodies and authorities	
2. Is there an exclusive department for water? (*Please circle)*		Y/N
2.1. If not, indicate the influence of departments in the case *(0 to 10)*. [SI3]	a) Water resources/irrigation department	
	b) Agricultural department	
	c) Environment and forestry department	
	d) Urban and local administrative department	
	e) Legal department	
	f) Other, e.g. economic affairs, finance *(specify)*: ________________	
3. How well coordinated is the water administration?*(0 to 10)* [SI3]		
4. If there is no exclusive department for water sector or specialized agencies for different subsectors, how much does this hinder better water administration in the case in question?*(0 to 10)*		

c. Organizational Basis and Structure of Water Administration [SI2][A1/A2]		
1. How is the water administration organized? *(Tick all that apply)* [SI2] [A1]	a) On administrative division (geographical basis)	
	b) On hydro-geological regions	
	c) River basins	
	d) Other *(specify)*: ________________	
2. In the case in question, is functional specialization within the water administration balanced? [SI3] [A2](*Please circle)*		Y/N

B. Policy

a. Well-Organized Plans [SP1]	
1. Are there or have there been well-organized plans related to water management (e.g. national economic development plan) in your country? (*Please circle)*	Y/N
1.1. If yes, how well was the case aligned with the plans? *(0 to 10)*	

b. Financial Support [Subsidies and/or ODA] [SP2]		
1. Has the case received financial support such as subsidies or ODA?(*Please circle)*		Y/N
1.1. If yes, how effectively did the financial support affect the case in question? *(0 to 10)*		
1.2. If yes, pleasedescribe the impacts of the financial support as specifically as possible.	________________ ________________ ________________ ________________	

c. Taxes and Levies [SP3]		
1. Was the case in question subject to taxes, levies, or tax deductions? (*Please circle)*		Y/N
1.1. How effectively did they affect the case? *(0 to 10)*		
1.2.If yes, please specify the name of the tax(es), levies, or tax deductions and please describ*e the imp*acts of the taxes, levies or tax deductions as specifically as possible.	________________ ________________ ________________ ________________ ________________ ________________	

d. Regulations		
1. Were there specific regulations directly affecting the case in question? (*Please circle*)		Y/N
2. Did the case begin as a result of regulation or regulatory standards? (*Please circle*)		Y/N
2.1. If yes, how much did the regulation contribute to the start of the case? (*1 to 10*)		
3. How effectively did these regulations affect the implementation of the case? *(0 to 10)*		
4. If yes, please describe the impacts of the regulations as specifically as possible.	____________________ ____________________ ____________________	

e. Technology/R&D Policies [SP4][A7]		
1. Were any specific green technologies or innovative technologies deployed inthe case in question? *(pleasecircle)*		Y/N
2. Please checktechnologies deployed in the case and indicate how extensively the technology components were used in the case. *(tick all that apply)* [A7]		Use
	a) Research and experimental information	tick
	b) Modern accounting and auditing techniques	
	c) Information system technologies (e.g. GIS, etc.)	
	d) Wireless communication	
	e) Water measuring technology	
	f) Computerized dynamic regulation of canal and water delivery networks	
	g) Recycling technologies	
	h) Drip systems	
	i) Sprinkler systems	
	j) Water-saving methods	
	k) Drought-resistant crops and farming practices	
	l) Water quality and sanitation	
	m) Any other *(specify)*: ____________________	
3. Did the case utilize or develop new or cutting edge technologies? *(circle)*		Utilize Develop Both Neither

C. Overall Effectiveness of the State-driven Institutions

a. Overall Effectiveness of the State-driven Institutions	
1. How effective has the state-driven institutions been in the case in question? *(0 to 10)*	

Ⅱ. Market-oriented Institution

A. Law and Administration

a. Water Rights [MI1][L2]		
1. Does water law allow private water rights? (*Please circle*)		Y/N
1.1. If yes, is it in the form of *(tick all that apply)*	a) Individual rights	
	b) Group and collective rights	
	c) Other forms *(specify)*: ______________________	
1.2. If yes, how strongly did water rights influencethe case in question? *(0 to 10)*		
1.3. If no, what are the constraints? *(Tick all that apply)*	a) Public control is needed for equity	
	b) Administering private rights is socially difficult	
	c) Gaps in water control institutions and technologies	
	d) Other *(specify)*: _______________________	
2. Basis for general rights in water *(tick all that apply)* [L2]	a) None or not clear	
	b) Legally guaranteed open access	
	c) Common or state property	
	d) Riparian system	
	e) Appropriative system	
	f) Correlative system (equal or proportional sharing)	
	g) Other *(specify)*: ______________________	

b. Scope for Private Participation [MI2][L7]

1. Do the legal provisions allow private sector participation in the following sectors *(tick all that apply)* and how extensive is private participation in the following sectors? *(0 to 10)*

	Legal basis	Extensiveness
a) Irrigation	tick	0~10
b) Water supply and sanitation for households		
c) Water supply and sanitation for industrial & commercial sites		
d) River management and flood control		
e) Others (specify):________________________		

2. For the case in question, do the legal provisions allow private sectorparticipation in the following steps (tick all that apply) and how extensive is private sector participation in the case in question?(0 to 10)		Legal basis	Extensiveness
	a) Planning	tick	0~10
	b) Engineering and construction		
	c)Operation and Maintenance		
	d) Investment		
	e) Others (specify): ____________________		

B. Policy

a. Cost Recovery[MP1][P2]

		Irrigation	Household use urban/rural	Industrial & Commercial use
1. Water pricing is based on *(please tick)* [MP1] [P2]	a) Full cost recovery			
	b) Partial recovery			
	- specific rate (%)	%	%	%
	c) Full subsidy			

2. In the case in question, how fully are the costs covered by the price or the charge?	%

b. Private Sector Promotion Policies [MP2][P4]

1. In your opinion, how well are users disposed toward private sector involvement in the case? (*tick one*)	a) Favorable overall	
	b) Favorable in particular sector	
	c) Not favorable	
	d) Indifferent	
	e) Opposed	

c. Project Selection Criteria [MP3][[P1]

		Irrigation project	Urban project	Multipurpose scheme
1. Please indicate the criteria used in project selection. *(Tick all that apply)* [MP3] [P1]	a) Financial factors (b/c, IRR, etc.)	tick	tick	tick
	b) Equity factors			
	c) Ecological factors			
	d) Any other*(specify)*:____________			

C. Overall Effectiveness of the Market-oriented institution

a. Overall effectiveness of the Market-oriented Institution

1. How effective has the market-oriented institution been in the case in question? *(0 to 10)*	

III. Community-based Institution

A. Laws and Administration

a. Conflict Resolution and Coordination[CP3][L3]		
1. Are the conflict-resolution mechanisms explicitly specified in law?(*Please circle)*		Y/N/not clear
2. Indicate the kinds of conflict resolution or coordination mechanisms that are in place regarding the case in question. *(Tick all that apply)*	a) Administratively/bureaucratically rooted system (Water Resource Dept., Irrigation Dept., etc.)	
	i. Local administration/govt.	
	ii. National Water Council	
	b) Relatively more decentralized system	
	i. River boards	
	ii. Basin organizations	
	iii. Other, e.g. water user associations (WUAs) *(specify)*:______________________	
	c) Tribunals	
	d) Judicial/legislative/constitutional	
	e) Other *(specify)*:_____________________	
3. What are the legally specified mechanisms for transboundary conflicts (interstate and international)? *(Tick all that apply)*	a) River boards	
	b) Basin organizations	
	c) Tribunals	
	d) Other *(specify)*: _________________	
4.In your opinion, how effective are the legal provisions for conflict resolution and coordination mechanisms related to the case in question? *(0 to 10)*[L3]	a) Local level (among users)	
	b) National level (among regions and sectors)	
	c) International level (among nations)	

b. Accountability [CI1][L4/A5]		
1. Are there explicit legal provisions for ensuring the accountability of officials, water suppliers, and users in the case in question? [CI1](*Please circle)*		Y/N
2. In your opinion, how effective are the accountability provisions? (0 *to 10)*[CI1] [L4]	a) For officials	
	b) For water suppliers	
	c) For users	

c. Adequacy and Relevance of Information [CI2][A6]		
1. Are water data which are a basis for water-related decision making adequately collected, managed and publicized?(*Please circle)*		Y/N
2. How much are the data open to the public*? (0 to 10)*		
3. How adequate and reliable are the data for the case in question? *(0 to 10)* [A6]	a) Planning	
	b) Implementation	
	c) Performance evaluation	
	d) Coordination and conflict resolution	
	e) Research	

d. Integrated Approach [CI3][L5]	
1. Does the case in question represent an integrated water resources management (IWRM) approach? (*Please circle)*	Y/N
1.1. If yes, to what degree would you say the case in question accords with IWRM principles? *(0 to 10)* [L5]	

B. Policy

a. Decentralization		
1. Do state policies favor decentralization in the case in question?(*Please circle)*		Y/N
1.1. If yes, how favorable are these policies in each step of the case *(0 to 10)*?	a) Planning	
	b) Construction & implementation	
	c) Management & operation	

b. Stakeholder Participation [CP1][P5]

1. Rank the stakeholders of the project according to the degree of their interest (Write “n/a” for those that do not apply) and tick *the stages* of the project in which the top three stakeholders participated.

	Rank	Non-participation*	Consultation**	Decision making***
a) Central government	1~7	tick	Tick	tick
b) Regional government				
c) Local government				
d) NGO				
e) Residents/community				
f) Firms				
g) Other *(specify)*: ___________				

*Stakeholders are informed only
** Stakeholders’ opinions are collected or they participate for material incentives
*** Stakeholders participate in important decision making

2. How favorable are the stakeholder participation policies to the case? *(0 to 10)*		
3. How effective is the participation of stakeholders in the decision making in the case? *(0 to 10)* [P5]	a) Central government	
	b) Regional government	
	c) Local government	
	d) NGO	
	e) Residents/community	
	f) Firms	
	g) Other *(specify)*: ___________________	
4. How effective were the following methods for promoting stakeholders' participation in the case? *(0 to 10)*	a) Through education	
	b) Through communication with stakeholders	
	c) Raising public awareness	
	d) Providing decision making power	
	e) Other *(specify)*:	

C. Overall Effectiveness of the Community-centered Institutions

a. Overall Effectiveness of the Community-centered Institutions	
1. How effective has the community- and civil society-based institutions been in the case in question? *(0 to 10)*	

Ⅳ. Performance

A. Generic Performance

a. Effectiveness		
1. To what degree did the case in question achieve what was intended? *(0 to 10)* [GP1]		
2. What factors contributed to the successes of the case in question?[GP1]	___________________ ___________________ ___________________	
3. What factors caused unexpected results in the case's implementation? [GP1]	___________________ ___________________ ___________________	

b. Efficiency		
1. How efficient has the project administration system been? *(0 to 10)*		
2. How timely was the implementation of the case? [GP2]	a) How timely was the implementation of the case?*(0 to 10)*	
	b) Did the case finish within the planned timeframe?*(please circle)*	Y/N
	c) If not, how much longer did it take than planned?*(months)(please fill in the blank)*	
3. How appropriate were the input costs of the case? *(0 to 10)* [GP3] [GP1]		
4. How transparently has the case been conducted? *(0 to 10)*		

B. Outcome (Overall Effectiveness, Sustainability, and Success) of the case [GP1]

a. Performance											
		(+)			No impact(5)					(-)
1. Economic performance *(please circle)* [EP]	a) Increasing gross regional domestic product (GRDP) brought by the case	9	8	7	6	5	4	3	2	1
	b) Creating jobs in the local economy thanks to the case	9	8	7	6	5	4	3	2	1
	c) Local development to national standards caused by the case	9	8	7	6	5	4	3	2	1
	d) Technological performance and technological advancement	9	8	7	6	5	4	3	2	1
2. Societal performance *(please circle)* [SP]	a) Improvement of people's health by the case	9	8	7	6	5	4	3	2	1
	b) Improvement in quality of life by the case	9	8	7	6	5	4	3	2	1
	c) Increased citizen participation in decision making in or by the case	9	8	7	6	5	4	3	2	1
	d) Increased gender equality in or by the case	9	8	7	6	5	4	3	2	1
3. Environmental performance *(please circle)* [ENP]	a) Improvement in water quality by the case	9	8	7	6	5	4	3	2	1
	b) Maintaining or restoring biodiversity by the case	9	8	7	6	5	4	3	2	1
	c) Improvement in disaster safety by the case	9	8	7	6	5	4	3	2	1
	d) Increased environmental awareness by the case	9	8	7	6	5	4	3	2	1
4. Overall performance (generic, economic, social, and environmental performance) of the case.*(please circle)* [OP]		9	8	7	6	5	4	3	2	1

Note * 9 should be understood as the most positive
* 5 should be understood as having no impact
* 1 should be understood as the most negative

C. Institutional Effectiveness

a. Institutional effectiveness	
1. Please describe the progressiveness of water institutions based on the following factors such as effectiveness, flexibility, adaptability, technological applications, innovation, openness to change, etc. [IP]	

Variables

Water law variables

[L1] LTRWSA = Legal treatment of water sources, a dummy variable with a value of 1 if all sources are treated alike, but 0 otherwise

[L2] LPRSRF = Format of surface water rights having a value range of 0–7 with 0for no rights; 1 for unclear, unauthorized, or scattered rights; 2 forcommon or state property; 3 for multiple rights; 4 for a ripariansystem; 5 for an appropriative system; 6 for a correlative (proportionalsharing) system; and 7 for a license or permit system

[L3] LCRMEE = Effectiveness of conflict-resolution mechanisms7 captured interms of judgmental perception and expressed on a 0–10 scale

[L4] LACPRE = Overall effectiveness of accountability provisions8 evaluated interms of judgmental perception and expressed on a 0–10 scale

[L5] LINTRE = Overall ability of water law to provide a legal framework for anintegrated treatment of water from various sources evaluated interms of judgmental perception and expressed on a 0–10 scale

[L6] LOECEN = Extent of a centralization tendency within water law evaluated interms of judgmental perception and expressed on a 0–10 scale

[L7] LOEPRV = Legal scope for private sector participation in the water sectorevaluated in terms of judgmental perception and expressed on a0–10 scale

[L8] LOEFWL = Overall effectiveness of water law9 evaluated in terms of judgmentalperception and expressed on a 0–10 scale.

Water policy variables

[P1] PPSCRI = Project-selection criteria having a value range of 0–6 with 0 forno response, 1 for political dictates, 2 for equity factors, 3 forecological factors, 4 for benefit–cost ratio, 5 for internal rate ofreturn, and 6 for multiple criteria

[P2] PCOREC = Cost-recovery status with 0 for non-response, 1 for full subsidy,2 for partial recovery, and 3 for full cost recovery

[P3] PIRSWE = Effectiveness of interregional and intersectoral water transfersevaluated in terms of judgmental perception and expressed on a0–10 scale

[P4] PGPIPP = Impact of private sector promotion policy evaluated in terms ofjudgmental perception and expressed on a 0–10 scale

[P5] PGPIUP= Impact of the policy for promoting users' participation evaluatedin terms of judgmental perception and expressed on a 0–10 scale

[P6] POPAWE = Extent of the influence of other policies10 on water policy evaluatedin terms of judgmental perception and expressed on a0–10 scale

[P7] POELWL = Extent of the linkages between water law and water policy evaluatedin terms of judgmental perception and expressed on a0–10 scale

[P8] POEFWP = Overall effectiveness of water policy11 evaluated in terms ofjudgmental perception and expressed on a 0–10 scale.

Water administration variables

[A1] AORGBA = Spatial organization of water administration taking a value of 0for non-response; 1 if organized in terms of administrative divisions;2 for the hybrid basis, that is, in terms of both geographicdivisions and hydro-geological regions; 3 for broad hydro-geologicalregions; and 4 for river basins

[A2] ABALFS = Balance in functional specialization, a dummy with a value of 1if balanced and 0 otherwise

[A3] AIBDWP = Existence of an independent body for water pricing, a dummywith a value of 1 for existence and 0 otherwise

[A4] ASBUDC = Seriousness of budget constraint facing the water administrationevaluated in terms of judgmental perception and expressed on a0–10 scale

[A5] AACCME = Effectiveness of the accountability arrangements12 evaluated interms of judgmental

perception and expressed on a 0–10 scale

[A6] AARINF = Adequacy and relevance of the information base evaluated interms of judgmental perception and expressed on a 0–10 scale

[A7] AEXTST = Extent of science and technology application13 in water administrationevaluated in terms of judgmental perception andexpressed on a 0–10 scale

[A8] AOEFWA = Overall operational ability of the water administration evaluatedin terms of judgmental perception and expressed on a 0–10scale.

Performance variables

[O1] WSPPHY = Physical performance14 of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale

[O2] WSPFIN = Financial performance15 of the water sector evaluated in termsof judgmental perception and expressed on a 0–10 scale

[O3] WSPECO = Economic performance of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale

[O4] WSPEQU = Equity performance of the water sector evaluated in terms ofjudgmental perception and expressed on a 0–10 scale

[O5] WSPOEV = Overall performance of the water sector obtained by averagingWSPPHY, WSPFIN, WSPECO, and WSPEQU

[O6] WIPOEV = Progressiveness or overall adaptive capacity of the water institutiontaken as a whole evaluated in terms of judgmentalperception and expressed on a 0–10 scale.

Exogenous Variables

[E1] GNPPPC = Purchasing power parity-based GNP per capita in US dollars

[E2] POPDEN = Population density in people per km2

[E3] DCUPOP = Decadal change in urban population as a percentage

[E4] FWATWC = Freshwater withdrawal per capita per year in cum

[E5] PWATAG = Agricultural share in total water withdrawal as a percentage

[E6] ALANDC = Arable land per capita in hectares (ha)

[E7] FPIIND = Food production index

[E8] EXPEDU = Public expenditure on education as a percentage of GNP

[E9] GININD = Gini index

[E10] NCNATW = Share of natural capital in total wealth as a percentage

[E11] ENVRRI = Environmental Regulatory Regime Index in score

[E12] ININCR = Institutional Investors' Credit Rating index.

WSPOEV = f1[LTRWSA, LPRSRF, LCRMEE, LACPRE,LINTRE, LOECEN, LOEPRV, PPSCRI,PCOREC, PIRSWE, PGPIPP, PGPIUP,POPAWE, POELWL, AORGBA, ABALFS,AIBDWP, ASBUDC, AACCME, AARINF,AEXTST]

O5= f1 [L1, L2, L3, L4, L5, L6, L7, P1, P2, P3, P4, P5, P6, P7, A1, A2, A3, A4, A5, A6, A7]

Overall performance = f1[Legal treatment of water sources, surface water rights, Effectiveness of conflict-resolution mechanisms, effectiveness of accountability provisions, a legal framework for an integrated treatment of water, a centralization tendency within water law, Legal scope for private sector participation, Project-selection criteria, Cost-recovery status, Effectiveness of interregional and intersectoral water transfers, private sector promotion policy, the policy for promoting users' participation, influence of other policies on water policy, between water law and water policy, Spatial organization of water administration, Balance in functional specialization, independent body for water pricing, budget constraint, Effectiveness of the accountability, Adequacy and relevance of the information base, of science and technology application in water administration]

Results of Quantitative Analysis on Institution and Policy Effectiveness

Table C-1. Descriptive statistics for institutional and performance variables[1)]

Category	Variables	TYPE	Mean	Std. Dev.	Min	Max
Legal treatment of different water sources	Surface and groundwater are treated alike	dummy	0.296	0.458	0	1
	Laws discriminate between public and private parties	dummy	0.367	0.483	0	1
	Laws discriminate across sectors such as irrigation, household, and industrial uses	dummy	0.836	0.371	0	1
	Priority of consumptive and non-consumptive uses	dummy	0.423	0.495	0	1
Legal linkages between water and water-related resources	Land and ground water	dummy	0.642	0.481	0	1
	Land and surface water	dummy	0.732	0.444	0	1
	Forest, environment and water	dummy	0.698	0.460	0	1
Role of government layers	Central government	scale	5.755	3.058	0	10
	State or regional government	scale	5.931	3.235	0	10
	Local government	scale	5.242	3.298	0	10
	Existence of ministries	dummy	0.633	0.483	0	1
	Coordination of water-related ministries	scale	5.616	2.051	0	10
Authority and structure of water administration	Administrative division	dummy	0.711	0.455	0	1
	Hydro-geological regions	dummy	0.100	0.301	0	1
	River basins	dummy	0.592	0.493	0	1
Well-organized plans	Well-organized plans	dummy	0.811	0.393	0	1
	Effectiveness of well-organized plans	scale	6.236	2.778	0	10
Financial support	Existence of financial support such as subsidies or ODA	dummy	0.511	0.501	0	1
	Effectiveness of financial support plan	scale	7.753	1.840	3	10

1) Questions in ‘performance’ part; economic performance, social performance, environmental performance were requiredto respond on a scale of 1 to 9, 9 should be understood as most positive; 5 should be understood as having no impact; 1 should be understood as most negative. These are recalculated to a scale of -10 to 10, based on 0. The average of each performance is mean value of each component.

Category	Variables	TYPE	Mean	Std. Dev.	Min	Max
Taxes and Levies	Taxes and levies	dummy	0.461	0.500	0	1
	Effectiveness of taxes and levies	scale	4.425	2.652	0	10
Effectiveness of regulations	Regulations	dummy	0.646	0.480	0	1
	Effectiveness of regulations	scale	6.667	3.140	0	10
Technology / R&D policies	Green technology and innovative technology	dummy	0.788	0.410	0	1
	Effectiveness of deployed green technology	scale	2.563	1.082	0	4
Water rights	Allowance of private water rights	dummy	0.529	0.500	0	1
Scope of private participation	Irrigation	dummy	0.618	0.487	0	1
	Household	dummy	0.680	0.468	0	1
	Industry	dummy	0.719	0.451	0	1
	River management and flood control	dummy	0.432	0.497	0	1
	Planning	dummy	0.615	0.488	0	1
	Engineering and construction	dummy	0.772	0.421	0	1
	Operation and maintenance	dummy	0.743	0.438	0	1
	Investment	dummy	0.693	0.463	0	1
Water pricing cost-recovery	Irrigation	dummy	0.129	0.337	0	1
	Household use	dummy	0.210	0.409	0	1
	Industry	dummy	0.301	0.460	0	1
Private sector promotion policies	Scope of participation	scale	7.279	2.973	0	10
Project Selection Criteria	Financial factors	dummy	0.764	0.426	0	1
	Equity factors	dummy	0.520	0.501	0	1
	Ecological factors	dummy	0.736	0.442	0	1
Conflict resolution and coordination	Specified conflict-resolution mechanisms in law	dummy	0.620	0.487	0	1
Accountability	Legal provisions for the accountability of officials, water suppliers, and users	dummy	0.789	0.409	0	1
Adequacy and Relevance of Information	Whether water data is collected and managed	dummy	0.611	0.489	0	1
Integrated approach	Applicability of IWRM	dummy	0.644	0.480	0	1
Decentralization	State policies which favor decentralization	dummy	0.738	0.441	0	1

Category	Variables	TYPE	Mean	Std. Dev.	Min	Max
Stakeholder participation	Preference of stakeholder participation policies	scale	6.875	2.037	1	10
	Effectiveness of central government's decision making	scale	5.697	3.274	0	10
	Effectiveness of regional government's decision making	scale	5.877	3.306	0	10
	Effectiveness of local government's decision making	scale	5.955	3.098	0	10
	Effectiveness of NGO's decision making	scale	4.674	3.257	0	10
	Effectiveness of residents and community	scale	5.044	2.892	0	10
	Effectiveness of firm's decision making	scale	5.025	3.225	0	10
Effectiveness of institutions	Effectiveness of state-driven institutions	scale	6.281	2.687	0	10
	Effectiveness of market-oriented institutions	scale	5.135	2.636	0	10
	Effectiveness of community-centered institutions	scale	5.853	2.509	0	10
Economic Performance	Economic Performance (average)	scale	3.852	2.968	-6.25	10
	Increases in GRDP	scale	3.617	4.145	-10	10
	Job creation in the local economy	scale	3.440	3.748	-7.5	10
	Local development to national standards	scale	4.000	3.979	-10	10
	Technological performance and technological advancement	scale	4.203	3.451	-7.5	10
Social Performance	Social performance (average)	scale	3.824	2.836	-6.875	10
	Improvement of people's health	scale	4.267	4.102	-7.5	10
	Improvement in quality of life	scale	5.568	3.892	-7.5	10
	Increased citizen participation in decisionmaking	scale	3.773	3.617	-10	10
	Increased gender equality	scale	1.561	3.475	-10	10
Environmental performance	Environmental performance (average)	scale	4.946	3.188	-7.5	10
	Improvement in water quality	scale	6.124	3.299	-2.5	10
	Maintaining or restoring biodiversity	scale	5.036	4.003	-10	10
	Improvement in disaster preparedness	scale	2.927	3.886	-10	10
	Increased environmental awareness	scale	5.767	3.593	-7.5	10
	Overall performance (average)	scale	4.173	2.633	-7.5	9.5833

Table C-2. Effects of the Legal and Administrative System

Type	Variable	Coefficient Value	Standard Variables	t-Value	P->|t|
Perception of laws about the water resources	Difference between surface and ground water	-0.044	0.619	-0.070	0.943
	Discrimination between private and public sector	-0.217	0.669	-0.320	0.747
	Distinguish irrigation, household and industrial uses	0.045	0.793	0.060	0.955
	Priority and treatment of consumptive and non-consumptive uses	0.523	0.684	0.760	0.447
Legal linkages between water and water-related resources	Land and ground water	1.611**	0.788	2.050	0.045
	Land and surface water	-1.021	0.750	-1.360	0.178
	Forest, environment and water	0.107	0.767	0.140	0.890
Role of government layers	Central government	-0.041	0.124	-0.330	0.743
	State or regional government	0.273**	0.116	2.360	0.021
	Local government	-0.109	0.097	-1.130	0.263
	Supervisory and regulatory institution	0.016	0.100	0.160	0.873
Coordination mechanism of water-related administration	Existence of exclusive department of water resources	-0.315	0.808	-0.390	0.698
	Coordination of water administration	0.673**	0.178	3.780	0.000
Authority and structure of water administration	Administrative division	0.131	0.772	0.170	0.866
	Hydro-geological regions	-0.723	0.966	-0.750	0.457
	River basins	1.240	0.782	1.590	0.117
	constant term	-0.112	1.860	-0.060	0.952

Table C-3. Effects of policy

Variable	Coefficient Value	Standard Variables	t-Value	P->|t|
Well-organized plans	1.397**	0.547	2.550	0.012
Financial support	0.666	0.427	1.560	0.120
Taxes and levies	-0.862***	0.439	-1.960	0.052
Regulations	1.198**	0.476	2.510	0.013
Green technology and R&D policy	-0.946***	0.527	-1.790	0.075
Constant term	5.129	0.736	6.970	0.000

Table C-4. The effectiveness of market-oriented institutions

Type	Variables	Coefficient Value	Standard Variables	t-Value	P->|t|
Private water rights	Allowed private water rights	0.529	0.448	1.180	0.240
Scope of private participation	Irrigation	-0.549	0.518	-1.060	0.291
	Household	-1.474**	0.647	-2.280	0.024
	Industry	1.332*	0.736	1.810	0.072
	River management and flood control	1.313*	0.505	2.600	0.010
	Planning	0.678	0.543	1.250	0.214
	Engineering and construction	-0.067	0.825	-0.080	0.936
	Operation and maintenance	1.700*	0.870	1.950	0.053
	Investment	0.023	0.654	0.040	0.972
	Constant term	3.125	0.587	5.320	0.000

Table C-5. Effects of policy system

Type	Variables	Coefficient Value	Standard Variables	t-Value	P->|t|
Water pricing cost-recovery	Irrigation	1.747***	0.981	1.780	0.078
	Household use	-0.262	1.017	-0.260	0.798
	Industry	0.081	0.831	0.100	0.922
Private sector promotion policies	Favorable to participation of private sectors	-0.087	0.100	-0.880	0.383
Project Selection Criteria	Financial factors	-2.189*	1.314	-1.670	0.099
	Equity factors	0.206	0.654	0.310	0.754
	Ecological factors	-1.572*	0.795	-1.980	0.051
	Constant term	8.192	1.438	5.700	0.000

Table C-6. Effectiveness of community-centered institutions

	Coefficient Value	Standard Variables	t-Value	P->|t|
Conflict resolution and coordination	0.182	0.496	0.370	0.714
Accountability of officers and water suppliers	0.150	0.606	0.250	0.805
Adequacy and Relevance of Information	0.296	0.431	0.690	0.493
Integrated approach	0.837**	0.417	2.010	0.047
Constant term	4.861	0.541	8.980	0.000

Table C-7. Effects of policy

	Coefficient Value	Standard Variables	t-Value	P->|t|
State policies which favor decentralization	0.603	0.634	0.950	0.345
Preference of stakeholder participation policies	-0.050	0.137	-0.370	0.715
Effectiveness of central government's decision making	-0.046	0.085	-0.540	0.592
Effectiveness of regional government's decision making	0.160**	0.076	2.110	0.038
Effectiveness of local government's decision making	0.065	0.095	0.680	0.499
Effectiveness of NGO's decision making	0.422***	0.085	4.950	0.000
Effectiveness of residents and community	0.169*	0.093	1.820	0.074
Constant term	2.279	1.088	2.090	0.040

Table C-8. The effects of institutions' effectiveness on economic performance

	Coefficient Value	Standard Variables	t-Value	P->|t|
Effectiveness of state-driven institutions	0.256*	0.088	2.930	0.004
Effectiveness of market-oriented institutions	0.239*	0.090	2.650	0.009
Effectiveness of community-centered institutions	-0.131	0.091	-1.440	0.153
constant term	1.842	0.947	1.950	0.054

Table C-9. The Influence of institutions' effectiveness on social performance

	Coefficient Value	Standard Variables	t-Value	P->|t|
Effectiveness of state-driven institution	0.220**	0.087	2.520	0.013
Effectiveness of market-led institution	0.128	0.090	1.420	0.157
Effectiveness of community-led institution	0.193**	0.090	2.130	0.035
constant term	0.791	0.945	0.840	0.404

Table C-10. The Influence of institutions' effectiveness on environmental performance

	Coefficient Value	Standard Variables	t-Value	P->|t|
Effectiveness of state-driven institution	0.201**	0.093	2.170	0.032
Effectiveness of market-led institution	0.208**	0.099	2.110	0.036
Effectiveness of community-led institution	0.068	0.100	0.680	0.500
constant term	2.191	1.029	2.130	0.035

Table C-11. The Influence of institutions' effectiveness on overall performance

	Coefficient Value	Standard Variables	t-Value	P->|t|
Effectiveness of state-driven institution	0.267**	0.075	3.540	0.001
Effectiveness of market-led institution	0.148***	0.078	1.900	0.060
Effectiveness of community-led institution	0.044	0.079	0.560	0.576
constant term	1.569	0.815	1.920	0.056

Results of Quantitative Analysis on Case Specific Performance

The WGG team asked local consultants to collect at least 20 questionnaires for each case study, including at least 1 Type A. Type A was to be completed by the project manager(s) or persons(s) with the most intimate knowledge of the project or case. Type B questionnaires were completed by other stakeholders with a competent knowledge of and legitimate connection to the project.

Measuring performance requiring responses on a scale of 1 to 9, 9 should be understood as most positive; 5 should be understood as no impact; and 1 should be understood as most negative. The questionnaire is referred to the Appendix A.

1. Republic of Korea

Performance		
Economic	GRDP	5.75
	Job creation	6
	Local development	8.75
	average	6.8
Social	Public health	3.25
	Quality of life	8
	Citizen participation	7.75
	Gender equality	3.5
	average	5.6
Environment	Water quality	9
	Biodiversity	8.25
	Disaster safety	4.75
	Environmental awareness	8.75
	Waterfront environment	8
	average	7.4

2. Australia

Performance		
Economic	GRDP	-0.69
	Job creation	-0.39
	Local development	0.83
	Technological advancement	2.92
	average	0.67
Social	Public health	-0.56
	Quality of life	0.53
	Citizen participation	2.50
	Gender equality	-0.26
	average	0.55
Environment	Water quality	1.97
	Biodiversity	3.55
	Disaster safety	-0.39
	Environmental awareness	4.87
	average	2.50

3. Brazil

Performance		
Economic	GRDP	2.08
	Job creation	2.50
	Local development	2.08
	Technological advancement	3.47
	average	2.53
Social	Public health	2.76
	Quality of life	4.08
	Citizen participation	2.37
	Gender equality	0.83
	average	2.51
Environment	Water quality	5.13
	Biodiversity	4.08
	Disaster safety	2.89
	Environmental awareness	5.53
	average	4.41

4. China

Performance		
Economic	GRDP	3.86
	Job creation	3.07
	Local development	4.32
	Technological advancement	5.21
	average	4.11
Social	Public health	5.66
	Quality of life	5.71
	Citizen participation	3.30
	Gender equality	1.67
	average	4.08
Environment	Water quality	6.48
	Biodiversity	1.67
	Disaster safety	0.87
	Environmental awareness	4.27
	average	3.32

5. Ecuador

Performance		
Economic	GRDP	-2.50
	Job creation	1.25
	Local development	0.67
	Technological advancement	1.00
	average	0.10
Social	Public health	2.97
	Quality of life	4.53
	Citizen participation	5.00
	Gender equality	5.31
	average	4.45
Environment	Water quality	6.09
	Biodiversity	6.56
	Disaster safety	3.59
	Environmental awareness	6.72
	average	5.74

6. Egypt

Performance		
Economic	GRDP	8.85
	Job creation	7.31
	Local development	1.54
	Technological advancement	8.65
	average	6.59
Social	Public health	3.85
	Quality of life	7.50
	Citizen participation	1.73
	Gender equality	-0.19
	average	3.22
Environment	Water quality	8.85
	Biodiversity	8.08
	Disaster safety	3.27
	Environmental awareness	5.38
	average	6.39

7. India

Performance		
Economic	GRDP	5.44
	Job creation	3.68
	Local development	4.12
	Technological advancement	4.69
	average	4.48
Social	Public health	4.26
	Quality of life	5.59
	Citizen participation	2.79
	Gender equality	2.79
	average	3.86
Environment	Water quality	5.16
	Biodiversity	3.68
	Disaster safety	3.53
	Environmental awareness	4.41
	average	4.19

8. Nepal

Performance		
Economic	GRDP	6.13
	Job creation	5.88
	Local development	6.13
	Technological advancement	4.63
	average	5.69
Social	Public health	5.88
	Quality of life	5.88
	Citizen participation	4.50
	Gender equality	3.75
	average	5.00
Environment	Water quality	3.50
	Biodiversity	3.00
	Disaster safety	1.13
	Environmental awareness	4.50
	average	3.03

9. Republic of Korea

Performance		
Economic	GRDP	5
	Job creation	0
	Local development	7.5
	Technology advancement	0
		3.125
Social	Public health	10
	Quality of life	10
	Citizen participation	5
	Gender equality	-2.5
		5.625
Environment	Water quality	10
	Biodiversity	10
	Disaster safety	7.5
	Environmental awareness	10
		9.375

10. Spain

Performance		
Economic	GRDP	2.21
	Job creation	1.81
	Local development	0.56
	Technological advancement	2.78
	average	1.84
Social	Public health	2.36
	Quality of life	3.19
	Citizen participation	5.28
	Gender equality	-0.44
	average	2.60
Environment	Water quality	5.79
	Biodiversity	4.08
	Disaster safety	5.39
	Environmental awareness	3.75
	average	4.75

11. Turkey

Performance		
Economic	GRDP	4.26
	Job creation	6.47
	Local development	7.06
	Technological advancement	7.21
	average	6.25
Social	Public health	8.17
	Quality of life	8.68
	Citizen participation	2.97
	Gender equality	0.00
	average	4.95
Environment	Water quality	8.68
	Biodiversity	8.09
	Disaster safety	2.81
	Environmental awareness	7.81
	average	6.85

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