

REPUBLIC OF KOREA

# Transformation of the Water Sector (1960–2012)

MAY 2016



This note has been prepared by the Korean Water and Wastewater Works Association (KWWA). The note summarizes information about the developments in the Korean water and wastewater sector between the period 1960 and 2012. The copyright on this document is from KWWA.

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## FOREWORD

The Republic of Korea's (Korea's) successful water sector development mirrors the country's remarkable economic progress. Over a period of 50 years agricultural, industrial, and municipal demands have been safely met, and the impact from drought and flooding has been mitigated. While the population doubled from 25 million (1961) to 50 million (2012), water supply connection rates rose from 17 percent to 98 percent, and sewerage connection and treatment rates rose from about 2 percent to about 90 percent.

The successful transformation of the water sector rests on three seminal decisions. First, the country made water sector development an integral part of the transformation of the economy. Second, the country adopted not only ambitious water sector targets but also developed and applied the laws, strengthened institutions and provided financial to translate goals into results on the ground. Third, the government instituted rigorous monitoring and reporting of resources and results to hold institutions accountable on progress made in the sector.

The transformation is not yet complete. There is over-capacity in water supply and wastewater systems. Operating economies of scale are lagging, and the government is now consolidating the 164 local operating authorities into 10 integrated management divisions along watershed boundaries. Financial subsidies are present but they could be substantially reduced through reforms of pricing and subsidy policies to shift more of costs to users. The next decade will likely be devoted to meeting these challenges

in order to provide equitable, efficient and sustainable water services for the entire economy and the population.

The aim of the note is to tell the story about Korea's reforms in the water sector and to learn the lessons that might benefit other countries in the development of their water and sanitation services.

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# ABBREVIATIONS AND ACRONYMS

<b>ADB</b>	Asian Development Bank
<b>BOD</b>	Biochemical Oxygen Demand
<b>BTL</b>	Build Transfer and Lease
<b>BTO</b>	Build Transfer and Operate
<b>GDP</b>	Gross Domestic Product
<b>IBRD</b>	International Bank for Reconstruction and Development
<b>IDA</b>	International Development Association
<b>km</b>	Kilometer
<b>K-water</b>	Korea Water Resources Corporation
<b>KECO</b>	Korea Environment Corporation
<b>KWWA</b>	Korea Water and Wastewater Works Association
<b>m<sup>3</sup></b>	Cubic meter
<b>MOE</b>	Ministry of Environment
<b>MOLIT</b>	Ministry of Land, Infrastructure and Transport
<b>NGO</b>	Non-Governmental Organizations
<b>NRW</b>	Non-Revenue Water
<b>US\$</b>	United States Dollar





# EXECUTIVE SUMMARY

This note provides an overview of Korea's water sector over the 50 years since the early 1960s. The note tracks how Korea transformed its water and sanitation sector to provide quality services for its citizens. The accomplishments are remarkable in how the country was able to quickly develop the water sector. The political economy of the water sector and the institutional and financial measures taken by the country are summarized in this note. In addition, the note identifies the lessons learned which could be useful for other countries that are making plans to improve the water sector.

## CONTEXT FOR SECTOR DEVELOPMENT

**Improving the water sector has been a national priority for many years.** Ever since the 1960s, the development of the water sector was linked with the economic growth of the country. Policies were developed, institutions were put in place, and funding was made available for the development of the water sector. This allowed the country to meet the increased industrial and domestic water needs, reduce risks to public health, and improve the environment. Successive governments maintained the development of the water sector as a national priority and integrated activities with other related sectors, creating broad support to sustain the momentum to make improvements.

**Policies were developed and implemented effectively.** A systematic approach was taken for the development of the sector through appropriate policies that were goal-oriented. For

instance, the River Law and the Water Cleansing Law (both from 1961) helped to optimize the use of surface water and set the base to clean rivers. Similarly, the Water Supply and Waterworks Install Law (1961) and the Sewerage Law (1966) created the basis to increase water and wastewater services to the population. A notable feature of the policy environment was that every law was accompanied by Presidential Decrees that laid out specific functions for various agencies to implement the policies.

**The institutional arrangements were clear.** The presence of effective institutions—both at the central and local levels—has been a cornerstone for the development of the water sector. Primarily there were two ministries—the Ministry of Land, Infrastructure, and Transport (MOLIT) and the Ministry of Environment (MOE)—and their associated public enterprises that were accountable for the development of the sector. These two ministries played complementary roles in managing the water resources and developing infrastructure for the delivery of services. MOLIT was responsible for the management of water resources. Korea Water Resources Corporation (K-water) is a public corporation that is under MOLIT and it carried out bulk water projects to meet industrial and domestic demand. At the same time, MOE established a national waterworks program to develop the infrastructure needed for service delivery. Korea Environment Corporation (KECO), a corporation under MOE, was established to implement projects on pollution prevention and environmental improvements. In addition, the local governments also played an important role in contracting the works and ensuring that service standards were met. The local governments are required to prepare Water Supply and Wastewater Plans in line with the national plans. Once the local plans are approved by the MOE, it is the responsibility of the local governments to invest, operate, and maintain the water and wastewater assets.

## SECTOR PERFORMANCE

**The increase in water coverage was remarkable.** In 1962, the piped water coverage was around 18 percent. However, through continuous efforts of the successive governments, the piped water

coverage reached around 98 percent in 2012. Currently, 164 local government units provide piped water to the population with the remaining population drawing their water from private waterworks and wells; 18 of these local governments have outsourced the operations of their water supply works to the public corporation K-water. Over time, the total water usage increased from 5 billion cubic meters (m<sup>3</sup>) in 1965 to 33 billion m<sup>3</sup> in 2007 while the population roughly doubled. In this period, domestic piped water consumption increased by about 37 times due to an increase in population and piped water coverage. The increase in water usage was also made possible by the increased storage capacity due to the construction of dams.

**Increase in wastewater collection and treatment reduced pollution.** In 1987, about 30 percent of the population was connected to the sewers while by 2012, the connection percentage had increased to 91 percent. This rapid increase in the sewer connection rate and the treatment of the collected wastewater helped to reduce pollution in water bodies, especially around large cities. In the 1980s, the water quality deteriorated with industrialization, population growth, and urbanization due to discharges of untreated wastewater into the water bodies. River water quality in many places was not adequate and to address this issue, the Government took a number of policy measures including those that were outlined in the Comprehensive Plan for Four Rivers Water Management (1998) and Comprehensive Plan for Clean Water Supply (1989). River water quality also improved in this period through an integrated river basin management approach where inputs from users across the river basin were sought for better management of water and pollution reduction and due to increasing regulatory requirements to reduce pollution. Wastewater is treated by the two national public corporations (K-water or KECO), private companies, and municipal entities.

**The sector is well monitored leading to informed policy decisions.** While the two ministries (MOLIT and MOE) establish and implement policies, the Korea Water and Wastewater Works Association (KWWA) plays an important role in benchmarking

performance and enhancing the skills of staff working in the sector. The KWWA was established in 2002 in accordance with the Water Act and it collects data from service providers that helps to monitor sector development. KWWA also promotes the training of water professionals and disseminates information related to water and wastewater. Utilities submit self-reported data to the KWWA which carries out a benchmarking analysis for the sector that helps to monitor progress made and develop appropriate policies to make sectoral improvements. Some of the parameters that have been recorded include an improvement in staff productivity in utilities. While in 1994 there were 3.1 employees in utilities per 1000 connections, in 2012 this number reduced to around 1.8. In addition, tracking of non-revenue water (NRW) showed the progress made in the sector. The overall NRW is estimated to be around 16.0 percent (in 2012) with a wide variation across utilities. In Seoul the NRW is estimated to be around 5 percent.

**Promoting green growth through water and wastewater services.** The government plans to make water and wastewater treatment plants more efficient. A goal has been established that by 2030 wastewater treatment plants will reduce their electricity consumption from the grid by 50 percent through projects involving the use of biogas, photovoltaic power, wind power, small hydro power, and the promotion of high-efficiency equipment. In addition, the government is planning to use sludge from wastewater operations for energy generation, which will also reduce carbon emissions. In the past, the sludge from the wastewater treatment plant was discharged to the sea. However, as the regulations on sludge disposal to the sea are now more stringent, various sludge disposal methods through recycling and resource recovery are currently being developed. Furthermore, about 546 wastewater treatment plants reuse wastewater (about 12 percent of the total wastewater generated in the country) reducing the need to produce water.

**Increased role of the private sector in wastewater services.** The government is promoting the role of the private sector to increase efficiency and competitiveness in the construction and

operation of wastewater works. Between 1998 and 2008, a total of around US\$800 million private capital financed the construction of 100 wastewater treatment plants. The private sector is also involved in operating wastewater treatment plants. At the end of 2012, about 58 percent of the wastewater treatment plants were transferred to the private sector. Studies show that operating costs for the privately operated sewerage system are about 25 percent lower compared to public operations. Given these benefits of operational efficiency, longer-term contracts with the private sector are being considered such as the Build Transfer and Operate (BTO) and Build Transfer and Lease (BTL) schemes.

**Focus is now on achieving economies of scale in operations.**

While the increase in service coverage and improvement in service quality is remarkable, there has been an issue of building infrastructure with excess capacity. The focus in the past was to increase the capacity as soon as possible and there was less emphasis on carrying out investments that would be economic in nature. Overlaps in geographical jurisdictions between the sector institutions and over-optimistic demand, resulted in excessive investment in waterworks. For instance, the percentage utilization of the water infrastructure dropped from near 90 percent (in 1975) to 50 percent (in 2010). Water production cost on a unit basis is around US\$1.3 per m<sup>3</sup> in the counties while it is around US\$0.6 per m<sup>3</sup> in large cities. Similarly, the unit cost of wastewater treated in small cities (population around 50,000) is much higher compared to cities that have large population (1 million or more). The government is now making efforts to optimize the use of assets through the creation of regional companies that would make operational decisions on economic use of assets reducing the unit cost of operating a water or a wastewater system.

## FINANCIAL ASPECTS

**Adequate and explicit subsidies have facilitated development of the sector.** Development of the water and wastewater sector is a priority in the country, and adequate public resources have been made available in a timely manner to support the increasing costs. Given the large positive externalities of better health

outcomes and the environment, the country has a policy of providing subsidies. In the water sector, between 2000 and 2012, these subsidies ranged from 9.5 to 13.4 percent of the total cost. Similarly, for the wastewater sector during the same period, the subsidies ranged from 55 to 72 percent. The subsidy rates depend on the type of investment and the size of the local government and these policies are explicit, which helps support operations as well as the planning process for investments. Financial support from the central government and provincial governments can only be used for capital costs, while the subsidy from a city can be used for both investment and operating costs. Central government subsidies require investment costs to be co-financed by central government, local government and city governments. When tariff revenue is below operating and maintenance costs, an operating subsidy can be obtained. This type of explicit policy on subsidies helps to secure the rest of the financing through tariffs which in turn has contributed towards the development of the sector and the provision of services in a sustainable manner.

**Service and tariffs are regulated through existing legislation.** A national water regulator is not in place but services are regulated through existing legislation on water supply and wastewater management. These services are monitored by the MOE while the Ministry of Local Administration monitors annually the financial performance of utilities. User tariffs are set by the local governments within the parameters fixed by the Ministry of Local Administration and it takes into account the clear policies on investment grants provided to the sector. It is estimated that the water and wastewater bills represent less than 2 percent of the household income for households that are in the lowest income decile, indicating that the tariff levels are affordable to those in lower income groups. Subsidies that are present in the sector make tariffs affordable at the household level and they are expected to continue, so that the population does not face hardships in receiving quality services.

**Cost recovery is higher in larger cities.** All users of urban water and industrial water pay tariffs. In most cases, the water tariffs

are around US\$0.7 per m<sup>3</sup>. However, the tariffs in counties and rural areas are lower while they are higher in the large cities where affordability is also higher. The water tariff is assumed to pay for most of the combined capital and operating costs and is calculated on the basis of metered consumption. Water tariffs are divided into a bulk water charge for supplies from K-water to local governments and a distribution charge across the water network. The MOLIT decides on the bulk water tariff on the basis of inputs from K-water while the city councils in local governments decide on the distribution tariff. The wastewater tariffs are around US\$0.4 per m<sup>3</sup> in most cases and similar to the water sector, the level of subsidies required (in percentage terms) is lower for larger cities compared to smaller cities. For wastewater, the cost recovery is high in towns that have population greater than 250,000 people compared to towns with lower level of population. This illustrates the need to carefully plan wastewater systems and seek low-cost options, especially for small towns to lower the need for subsidies.

## LESSONS LEARNED

Fifty years of transformation of the Korea water sector teaches four lessons of universal validity:

- ***Political will to develop the sector was strong and continuous.*** By focusing on integrating water issues with overall economic development and through addressing water issues that come up in other sectors (health, environment, urban development), successive governments in Korea provided broad support to develop the sector. Successful coordination was facilitated by the preparation of successive five-year development plans from 1961 onwards and by the political continuity of policies and priorities. The political commitment to improve the water sector was accompanied by continuous revisions to the legal and regulatory framework, which were necessary to keep pace with the changing conditions and to meet the dynamic demand for water services. Priorities were unchanged but laws and regulations were often fine-tuned to meet sector needs.

- ***Institutional arrangements were clear and adjustments were made as necessary.*** Accountability was clear and unambiguous and a few agencies (MOE, MOLIT, KECO, K-water) were assigned the responsibility of developing the sector. These agencies had the sectoral expertise to make the necessary improvements and were adequately supported by high government officials. Over the years, adjustments were made to make sectoral improvements. For instance, a shift is now imminent in the water supply and wastewater utility sector where growing excess capacity and loss of economies of scale signal the need to consolidate the local government utilities to achieve more efficient services.
- ***Sector development was possible due to adequate and explicit subsidies.*** The development of the sector would not have been possible without clear policies on subsidies and user charges. Given the larger benefits to society arising from quality water and wastewater services, successive governments made a policy choice to support the development of the sector through subsidies. The use of subsidies was explicit which helped in the planning process for investments and to support operations. As the development of the water and wastewater sector was a priority in the country, adequate public resources were made available in a timely manner to support the increasing costs. While the subsidies in the wastewater sector were higher, subsidies were also provided to the water sector, especially to ensure quality services to small communities. User charges have also steadily increased over time to meet costs to improve the financial sustainability of the sector. Going forward, as the country focuses on making utilities run more efficiently through consolidation of utilities to achieve economies of scale, the need for subsidies will decline, while the ability to pay higher tariffs will increase with growing affluence of the population, further strengthening the financial sustainability of the sector.



- ***Comprehensive sector information was readily available to set and adjust policies.*** An interesting feature of the Korean water sector was that the technical and financial information was readily available that helped policy makers to continuously monitor progress. The presence of the sectoral agencies with adequate institutional capacity allowed monitoring and benchmarking of the sector. This helped the country to increase coverage and develop appropriate laws and regulations to meet sector targets.

## CHAPTER 1

# SECTOR DEVELOPMENT

### INTRODUCTION

Water sector development in Korea is a national priority and has always been seen as an integral part of the economic development of the country. The country's economic growth, which has taken place in the context of an urbanizing environment, would not have happened without the substantial effort to regulate water resources, to invest in the water infrastructure to meet industrial and municipal demand, and to improve public health. In turn, the wealth created by the country's economic growth supported a steady progress in the water supply and wastewater sector.

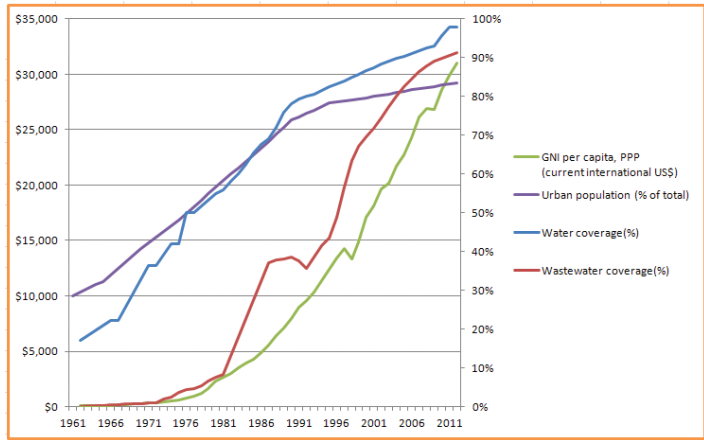
About 98 percent of the population of about 50 million people is now connected to public water supplies and collection and treatment of wastewater is around 90 percent. The impressive progress made in increasing service coverage over the years is shown in Figure 1.

### THE POLITICAL ECONOMY OF THE WATER SECTOR

The economic transformation of the country began in the early 1960s and was implemented through the execution of successive five-year economic development plans. In this period, policy makers formulated and implemented economic policies that stressed import substitution and export-led development. Capital was allocated via the government-controlled financial sector in support of the export-driven development.

FIGURE 1

Korean growth of per capita Gross Domestic Product (GDP) and of its urban water and wastewater services



Source: "Revision of a Study on the Vision 2050 of Wastewater Policy," Korean Ministry of Environment, 2012.

While the economy grew, resources were made available for the water sector. In addition, successive governments focused on integrating water issues with overall economic development and through addressing water issues that come up in other sectors (health, environment, urban development). By taking this approach there was broad support to develop the sector through:

- *Development and application of laws and regulations to meet the targets.* Initially, sector targets were set based on which laws, decrees, regulations were created. The River Law and the Wastewater Cleansing Law, both from 1961, established the principles for optimizing the value of the surface waters in support of economic development and, significantly, public health. The parallel Water Supply and Waterworks Install Law was also promulgated in 1961 and was followed

by a Sewerage Law from 1966. The Housing Fund Law from 1967 initiated a wholesale reform of residences that had as a cornerstone adequate sanitation, including sewerage. The New Village Development in 1970 extended this drive to the modernization of all villages. These laws were preceded by a 1949 Education Law that linked sanitation improvements to a curriculum of hygiene and sanitation education. The Laws were accompanied by Presidential Decrees that interpreted each Law for the executive branch of the government, and by Ministerial Decrees that further specified the duties and tasks of implementation; and

- *Implementation of policies in an effective manner by ensuring that adequate human and financial resources were in place and through monitoring outcomes and making changes as necessary.* The progress made was well documented and site visits were often made by high political authorities signaling the importance of developing the sector. The constant feed-back through the monitoring also prompted frequent adjustments of laws, decrees and regulations in order to reflect the implementation experience gained.

Growing public awareness of the importance of wastewater treatment also increased due to the 1986 Asian Games and the 1988 Olympic Games that Korea hosted. Similarly, an accidental spill of phenol into the Nakdong River also focused attention on implementing measures to prevent spills that would pollute water bodies.

In the initial stages of sector development there was also a need to control the flooding through the construction of multi-purpose dams that would also provide agriculture, industry, and municipalities with a stable supply of raw water. Over time, the water usage increased from 5 billion m<sup>3</sup> in 1965 to 33 billion m<sup>3</sup> in 2007 while the population roughly doubled. The increase in water usage was made possible by the increased storage capacity due to the construction of dams. Also, during the same period, water domestic piped water consumption increased by about 37 times (between 1965 and 2007) due to an increase in population and piped water coverage (Table 1).

**TABLE 1**Water usage by category (units: billion m<sup>3</sup> per year)

Division	1965	1980	1990	1994	1998	2003	2007
Total usage	5.1 (100%)	15.3 (100%)	24.9 (100%)	30.1 (100%)	33.1 (100%)	33.7 (100%)	33.3 (100%)
Households	0.2 (4%)	1.9 (12%)	4.2 (17%)	6.2 (21%)	7.3 (22%)	7.6 (23%)	7.5 (23%)
Industry	0.4 (8%)	0.7 (5%)	2.4 (10%)	2.6 (8%)	2.9 (9%)	2.6 (8%)	2.1 (6%)
Agriculture	4.5 (88%)	10.2 (67%)	14.7 (59%)	14.9 (50%)	15.8 (48%)	16.0 (47%)	15.9 (48%)
Water Reservoirs	—	2.5 (16%)	3.6 (14%)	6.4 (21%)	7.1 (21%)	7.5 (22%)	7.8 (23%)

Source: Long-term General Plan for Water Resources, Korea Ministry of Land, Transport and Maritime Affairs, 2011.

## HISTORICAL HIGHLIGHTS

### Post-Independence Period (1946–1960) and Economic Growth Period (1961–1990)

The first modern water supply infrastructure was built in 1908 in Seoul. By 1962, the connection rate was around 18 percent. Successive governments put in place a series of long-term economic development plans (from 1962–1990) that recognized that water is essential for the socioeconomic development. To overcome the shortage of water and intermittent supply, in 1965, the first 20-year national long-term general water resource plan was adopted which was subsequently updated periodically to adequately manage water demand.

Water supply and wastewater investments from 1960–75 were partly funded by international development aid. Initially, the United States was the primary donor country to Korea but later other countries, such as Japan and Germany, financed projects including those related to the development of water resources. The International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), and Asian Development Bank (ADB) also provided

assistance in this period. The participation of foreign companies during the project preparation and implementation phases promoted the transfer of technology and creation of a pool of skilled technical staff in the water sector of Korea.

By 1976 most projects financed through foreign development grants had been completed and large scale projects were thereafter mainly financed through domestic resources. One such example is the construction of regional waterworks to supply 1.2 million m<sup>3</sup> of water on a daily basis to the four major cities—Seoul, Seongnam, Bucheon, and Incheon. The project aimed to increase the water security to the capital area through a relocation of the water intake due to inadequate water quality in the Han River. The Ministry of Construction took the leadership role in overseeing the works and making arrangements for the financing. In 1979, the Industrial Base Development Corporation, a precursor to the current K-water, was established and it was the agency that implemented the various works in the capital area. The project was carried out in six stages and it increased the water supply coverage in 23 local government areas in the capital area, including Incheon where the water coverage increased from 70 to 98 percent due to the project. Through the efforts of the government, water supply coverage through house connections increased to 78 percent in 1989.

### Consolidation Period (1991–2010)

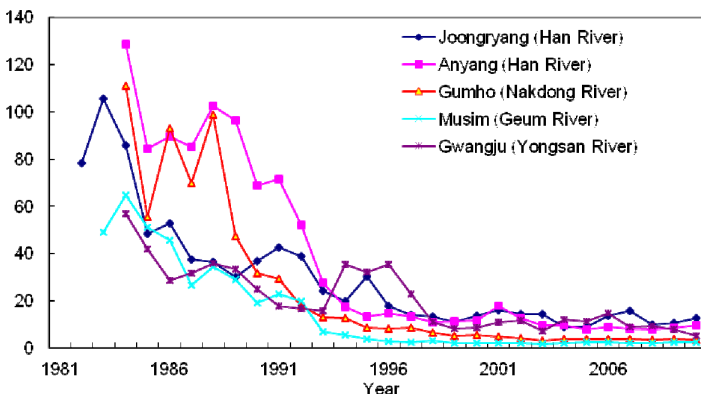
In the 1980s, the water quality deteriorated with industrialization, population growth, and urbanization due to discharges of untreated wastewater into the water bodies—leading to non-compliance with water quality standards in many instances. Recognizing the problems from poor river water quality the government has established the consecutive national programs including the Comprehensive Plan for Clean Water Supply in 1989, the Water Quality Improvement Plan in 1994, the Comprehensive Plan for Four Rivers Water Management in 1998, the Comprehensive Plan for Tap Water Quality Improvement in 2005, and the Basic Plan for Water Environment Management in 2006. These programs have markedly improved water quality.

The chart below (Figure 2) shows how the Biochemical Oxygen Demand (BOD) concentration for the Four Major Rivers (Han River, Nakdong River, Geum River, and Yeongsan River) decreased over time due to measures taken by the government. River water quality also improved in this period through an integrated river basin management approach where inputs from users across the river basin were sought for better management of water and pollution reduction. Additional details of the Four River Water Management are provided in Annex 1.

The river water quality also improved due to increasing regulatory requirements to reduce pollution. The Pollution Prevention Act (1964) introduced effluent standards that could be achieved through primary treatment. Following the construction of an activated sludge wastewater plant in Seoul in 1976 the national standards were tightened for secondary treatment. Subsequently, the standards were revised to take into account nitrogen and phosphate removal in the late 1990s. Thereafter it was revised again to remove toxins. As the effluent standards were being made more stringent, the government also provided resources for the development of the sewerage network and wastewater

## FIGURE 2

The 30-yr history of water quality at urban streams of the Four Major Rivers



Source: Korean Ministry of Environment, White Paper of Environment, 2011.

**BOX 1****Korea's Effective Policies Controlled Intestinal Parasites**

In 1971 an extraordinary 84 percent of the general population tested positive for helminthes (intestinal worms). Yet, by 1995 the country had managed to reduce infection rates to only 2 percent. Korea's success offers lessons for other countries in policy formulation and its implementation.

In the 1960s the Korean Government declared its intentions to control intestinal parasites. To this end it then created the Korea Association for Parasite Eradication with the authority to control intestinal parasites. National and bilateral financing from Japan provided the necessary funding to implement the Parasitic Diseases Prevention Law that stipulated that all students in primary and middle level schools must be tested every six months and, if found infected with intestinal parasites, treated. Parasitologists were trained to support the campaign that focused on school children and promoted hygienic practices. The campaign produced dramatic decreases in the percentage of fecal samples that tested positive for helminths. The positive rates dropped from 84 percent in 1971 to 63 percent in 1976, 41 percent in 1981, 13 percent in 1986, 4 percent in 1992 and to 2 percent in 1997. The extraordinary drop in infection rates was also helped by the government's launch of the New Village ("saemol") movement that modified sanitation habits through expanded indoor plumbing and sewerage, better housing and electricity supplies, road construction, and use of chemical fertilizer to replace the previous use of nightsoil that had been an agent of infection.

*Source:* "A successful experience of soil-transmitted helminth control in the Republic of Korea" by ST Hong, JY Chai, S Huh, HJ Rim and SH Lee, Korean Journal of Parasitology, September 2006.

treatment plants. In 1987, about 30 percent of the population was connected to the sewers while in 2010, the connection percentage increased to 90 percent (in 1997 it was 60 percent; and in 2007 it was 87 percent). This led to more wastewater being collected and treated, reducing the pollution in water bodies. Also, over about 25 years from the early 1970s to the mid-1990s, the prevalence of intestinal parasites declined noticeably (Box 1).

### Effective Institutional Arrangements

The continuous presence of effective institutions both at the central and local levels has been a cornerstone for the development of the sector. There are two ministries (MOLIT and



MOE) and their associated public companies (K-water and KECO) that are responsible for the development of the sector along with local governments and their utilities. The institutional structure is outlined below.

The MOLIT is responsible for planning and managing water resources. Every 10 years the ministry establishes National Long-term Water Resource Plans. The MOLIT also manages the water resources through the construction of dams and other infrastructure. On the other hand, the MOE establishes a national waterworks plan which includes the construction of water and wastewater infrastructure. Infrastructure investments can be financed and implemented only if they are contained within a waterworks local government maintenance plan, approved by the MOE. The MOE also has regional administrative agencies to manage the basins of the four major river systems.

The complementary roles played by MOLIT and MOE resulted in a coordinated action to improve services. The timely availability of water resources is indicated in the National Long-term Water Resource Plan (prepared by MOLIT) and the delivery of services is indicated through the National General Water and Wastewater Plan (prepared by the MOE). There are two corporations under the MOLIT and MOE that also play a key role for the sector development.

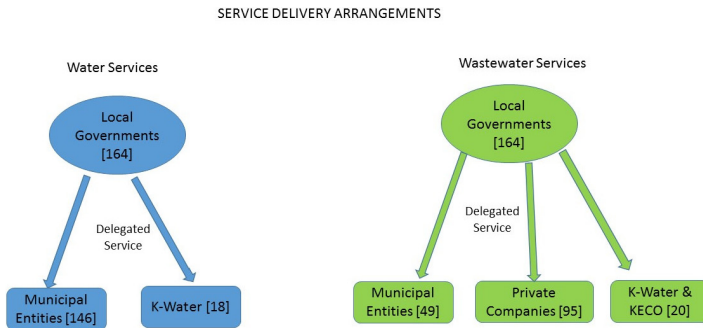
- ***Korea Water Resources Corporation (K-water)***. K-water is a public corporation established as part of MOLIT with the purpose of developing water resources infrastructure to supply bulk water for domestic and industrial purposes to local governments. K-water is in charge of the construction and operation of multipurpose dams, estuary weirs, and canals and of the construction and management of regional waterworks. K-water supplies about 50 percent of national water demand as a wholesaler and also operates wastewater treatment plants as requested by local governments.
- ***Korea Environment Corporation (KECO)***. KECO is part of MOE and it designs and implements projects related to environmental pollution prevention, environmental

improvement, and resource recycling. It monitors environmental pollution, provides technical support to the building and operation of basic environmental facilities, and coordinates the response to climate change.

Local governments are required to establish their own plans for every 10 years to complement the national plans and they develop local Water Supply and Wastewater Plans. Once these plans are approved by the MOE, the local governments are responsible for investing, operating and maintaining all water supply and wastewater systems within their jurisdictions. They may do so themselves or delegate the task to public or private corporations (Figure 3). For water, 18 out of 164 local governments have outsourced the operations of their water supply works to the public corporation K-water; the remaining 146 local governments use municipal water departments to provide water services. Similarly, local governments have elected to outsource the operations and maintenance of their wastewater works to the two public corporations (K-water or KECO; total of 20), private companies (95 of them), or to local public operators (49 of them).

**FIGURE 3**

Delegation arrangements for service delivery



Figures in brackets indicate the number of arrangements

There is no national regulator but the MOE monitors annually the quality of water supply and wastewater services, while the Ministry of Local Administration monitors annually the financial performance. User tariffs are set by the local governments within the parameters fixed by the Ministry of Local Administration. However, the KWWA plays an important role in benchmarking performance and enhancing the skills of staff working in the sector. The KWWA was established in 2002 in accordance with the Water Act and it collects data from service providers that helps to monitor sector development. KWWA promotes the training of water professionals, and disseminates information related to water and wastewater. Utilities also submit self-reported data to the KWWA which carries out a benchmarking analysis for the sector to monitor progress and develop appropriate policies to make sectoral improvements.

## CHAPTER 2

# SECTOR PERFORMANCE

Korea has been successful in increasing the coverage of water and sanitation services as shown in Table 2. Details of this achievement are summarized below.

**TABLE 2**

Performance indicators of water supply and wastewater services

Indicator	1961	1980	2000	2012
Household water supply coverage (%)	17	55	87.1	98.1
Household sewerage coverage (%)	2	8.3	70.5	91.6

*Source:* Statistics of Waterworks & Sewerage, Korean Ministry of Environment, 2013.

## WATERWORKS DEVELOPMENT

The history of waterworks in Korea began in the early 1900s, when the first modern water treatment plant was built in Seoul. Over five decades since the 1960s, the water supply coverage has increased from about 20 percent to nearly universal coverage through continuous efforts to expand waterworks. In 2012, about 98 percent of the population received piped water through services provided by local governments. The remaining population draws their water from private waterworks and wells. In 2012, the total tap water produced was 6,029 million m<sup>3</sup> of which 5,063 million m<sup>3</sup> were sold. The total non-revenue water was around 16.0 percent (in 2012) of which about 10.4 percent was due

to physical leakages. It is a priority of the government to reduce these leakages by rehabilitating old infrastructure as seen through the reduction in physical leakages (Table 3). Expenditures for physical loss reduction will continue in the future to further reduce the non-revenue water.

A comprehensive plan is in place to improve tap water quality. Tap water quality standards were first established in 1963 and remained unchanged until the 1980s. In the 1980s, with industrial development, rivers were being polluted and downstream water quality was deteriorating and it was necessary to reinforce the drinking water quality standards. The Ministry of the Environment established a general plan to improve tap water quality, including measures to improve hygienic management of water treatment plants across the country. Important elements of this general plan are outlined below:

- **Water quality testing and public information.** The revised Water Supply and Waterworks Installation Act obligates water service providers to publish a tap water quality report every year and publish it on the internet. This report must include the source of the water and pollution information, drinking water quality standard test results, telephone numbers of the water treatment plant and water related department, and the names of the relevant officials. Furthermore, each local government should organize a tap water quality evaluation committee, consisting of citizens and experts to ensure that water quality meet required standards.
- **Increase technical capacity.** A national certification system was introduced to improve the expertise of water treatment plant operators and which requires plants to employ a certain number of certified water treatment operators according to the plant's size.

As of the end of 2012, the percentage of the population that had sewerage connections was 91.6 percent (Table 4). The number of public sewage treatment plants with a capacity of 500 m<sup>3</sup> per day or more and that were operational across the nation was 546, with total capacity of 25,297,451 m<sup>3</sup> per day. The number of plants with a capacity of less than 500 m<sup>3</sup> per day was 3,067 with a total

**TABLE 3**  
Development of water supply system

Division	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total supply (million m <sup>3</sup> )	5,791	5,696	5,723	5,909	6,002	5,749	5,747	5,804	5,760	5,910	6,021	6,029
Accounted volume (million m <sup>3</sup> )	4,367	4,395	4,489	4,633	4,761	4,601	4,659	4,744	4,759	4,920	5,025	5,063
Accounted rate (%)	75.4	77.2	78.4	78.4	79.	80.0	81.1	81.7	82.6	83.2	83.5	84.0
Leaked volume (million m <sup>3</sup> )	804	700	781	839	845	819	734	709	658	638	629	626
Leakage rate (%)	13.9	12.3	13.6	14.2	14.1	14.2	12.8	12.2	11.4	10.8	10.4	10.4

Source: Statistics of Waterworks, Korean Ministry of the Environment, 2013.

**TABLE 4**  
Development of sewerage system

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Population with sewerage connections (1,000 persons)	36,760	38,449	39,924	41,157	42,450	43,569	44,631	45,264	46,358	47,034	47,538
Percentage of the population covered (%)	75.8	78.8	81.4	83.5	85.5	87.1	88.6	89.4	90.1	90.9	91.6
No. of facilities (capacity > 500 m <sup>3</sup> /day)	207	242	268	294	344	357	403	438	470	505	546
Capacity (1,000 m <sup>3</sup> /day)	20,233	20,954	21,618	22,568	23,273	23,946	24,568	24,925	25,118	25,228	25,297
Treated volume (1,000m <sup>3</sup> /day)	17,051	17,842	18,290	18,262	18,336	18,404	18,452	18,590	18,739	19,521	19,901

Source: Statistics of Sewerage, Korean Ministry of the Environment, 2013.

capacity of 231,231 m<sup>3</sup> per day. The operation of these treatment plants and the associated sewerage network was essential in improving the water quality in many places. The improvement was possible due to the careful planning by central and local government authorities and the availability of human and financial resources for effective implementation of policies.

There has also been a steady increase in the connection of drains (combined and separated) to collect and transfer the wastewater to the treatment plants. Table 5 shows how between 2002 and 2012, the total length of sewer pipes increased by about 62.5 percent. In the past, construction of wastewater treatment plants was carried out prior to the development of the wastewater networks. Consequently, the actual quantity of the wastewater flowing to a plant was not known, often leading to over-design and non-efficient use of resources. Learning from this experience, efforts were put in place to build the sewerage network to maximize the collection of wastewater from households. In addition, storm drains were installed to collect and dispose of rain water to prevent flooding. The separation of the rain water from the wastewater allows for greater flood control by right-sizing the drains and higher concentrations of wastewater to reach the wastewater treatment plants to improve operational efficiency.

Innovations in wastewater treatment are also increasing with time. As of the end of 2012, 546 of the public sewage treatment plants across the nation were reusing treated water, amounting to about 12 percent of the annual average influent sewage per year. The sludge generated in the wastewater treatment plants is also being increasingly treated to avoid environmental concerns (it is estimated that in 2012, about 3.6 million tons of sludge was generated). In the past, the sludge from the wastewater treatment plant was discharged to the sea. However, as the regulations on discharging sludge to the sea are now stricter, various sludge disposal methods through recycling and resource recovery are currently being developed.

Apart from the steady improvements made in increasing coverage, the country was also able to achieve efficiency improvements

**TABLE 5**  
Development of sewer system (in km)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total sewers	75,859	78,606	82,215	85,755	91,098	96,280	102,079	107,843	113,494	118,329	123,309
Combined system	45,680	46,167	47,255	48,257	48,966	49,636	49,460	49,386	47,976	47,510	45,683
Separated system	30,179	32,438	34,959	37,498	42,132	46,643	52,618	58,457	65,519	70,820	77,627
Wastewater	15,441	16,968	18,532	20,488	23,603	26,532	30,239	33,584	38,068	41,739	45,094
Storm water	14,738	15,471	16,427	17,010	18,530	20,111	22,379	24,873	27,450	29,080	32,533

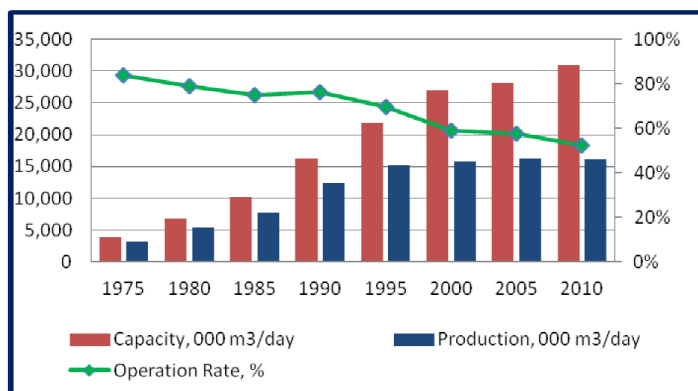
Source: Statistics of Sewerage, Korean Ministry of the Environment, 2013.



in many areas of the sector. Some of these achievements are summarized below:

- 100 percent of the domestic consumption is metered, allowing for monitoring of the system;
- The NRW water is estimated to be around 16.0 percent (in 2012) on average. However, there is a wide variation in the NRW—in smaller cities the number can be as high as 40 percent while it is lower in larger cities; in Seoul the NRW is estimated to be around 5 percent;
- Staff productivity has also improved over time. It used to 3.1 employees per 1,000 connections (in 1994) and this was around 1.8 (in 2012); and
- Although the service levels are high, it is estimated that water and wastewater bills represent less than 2 percent of the household income for household that are in the lowest income decile. This is possible due to the subsidies that were present in the sector in the past (reducing the debt service coverage in the tariffs) and due to the rising income levels in the country.

While the increase in service coverage and improvement in service quality is remarkable, there has been an issue of building infrastructure with excess capacity. The focus in the past was to increase the capacity as soon as possible and there was less emphasis on carrying out investments that would be economic in nature. Overlaps in geographical jurisdictions between the sector institutions and over-optimistic demand projections resulted in excessive investment in waterworks. The percentage utilization of the infrastructure dropped from near 90 percent (in 1975) to 50 percent (in 2010) (Figure 4). The government recognizes this problem and is making efforts to optimize the existing capacity through the formation of regional companies that would use the assets that are already in place.

**FIGURE 4**Water capacity *versus* production

Source: Statistics of Waterworks, Korea Ministry of the Environment, 2012.

# FINANCIAL ASPECTS

Key financial aspects of the water and wastewater sector are summarized below. A notable financial policy has been the explicit use of subsidies which has contributed towards the development of the sector. While adequate and explicit subsidies were provided in a timely manner, user charges also increased making the sector financially viable. Going forward, as the country focuses on making utilities run more efficiently through consolidation of utilities to achieve economies of scale, the need for subsidies will decline, while the ability to pay higher tariffs will increase with growing affluence of the population, further strengthening the financial sustainability of the sector.

### FINANCIAL POLICIES ON WATER

Water sector financial policies in Korea do not necessarily require users to pay for the full costs of service. Given the large external benefits of quality water supply and sanitation services, subsidies are provided to complement the user fees. Subsidy rates depend on the type of investment and the size of the local government (Table 6). Subsidies from the central government and provincial governments can only be used for capital costs, while the subsidy from a city can be used for both investment and operating costs. Central government subsidies require investment costs to be co-financed by local and city governments so that there is more ownership of the investments. When tariff revenue is below operating and maintenance costs, an operating subsidy can be obtained. This type of explicit policy on subsidies helps to secure

**TABLE 6**

Government subsidy rate for water supply projects

Project Type/Location	Nature of Investments	Subsidy for Investments (percent)
Farms and fisheries region	New construction or expansion	80
Small and medium town and rural	New construction or expansion	50
Village	New construction or expansion	100
Urban and multi-city	Water intake, bulk water	50
	Water network	50
	Water treatment plant	100

Source: Korean Ministry of Environment, 2013.

the rest of the financing which in turn has contributed towards the development of the sector.

## WATER SUPPLY FINANCES

The consolidated data on uses and sources of funds of all the water utilities (period ranging from 2000 to 2012) show that tariff operating revenues exceed operating expenditures by a comfortable margin (Table 7). Also, to allow cost recovery of all expenditures, including investment and operating costs, there has been a steady level of subsidies provided. This subsidy amounts to about 9.5 to 13.4 percent of the total (investment plus operations) costs. At the same time, efforts were made to reduce the debt of the sector. Steady debt service payments reduced the overall debt of the sector from about US\$3.4 billion (2000) to around US\$905 million (2012).

## PRICING OF WATER

All users of urban water and industrial water pay tariffs. The water tariff is assumed to pay for most of the combined capital and operating costs and is calculated on the basis of metered

**TABLE 7**  
Water supply—consolidated sources and uses of funds (in US\$ millions)

Division	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Total sources</b>	<b>3,435</b>	<b>3,620</b>	<b>4,110</b>	<b>4,310</b>	<b>5,190</b>	<b>5,343</b>	<b>5,901</b>	<b>6,195</b>	<b>4,693</b>	<b>5,623</b>	<b>5,345</b>	<b>5,386</b>	<b>6,313</b>
Operating Revenue	2,811	2,964	3,437	3,663	4,462	4,656	5,212	5,487	4,044	4,884	4,537	4,479	5,349
Subsidies (% of total revenues)	328 (9.5)	404 (11.2)	439 (10.7)	458 (10.6)	518 (10.0)	509 (9.5)	586 (9.9)	613 (9.9)	572 (12.2)	615 (10.9)	629 (11.8)	722 (13.4)	816 (12.9)
Bonds	296	251	234	189	210	178	103	95	77	123	178	185	149
<b>Total uses</b>	<b>3,435</b>	<b>3,620</b>	<b>4,110</b>	<b>4,310</b>	<b>5,190</b>	<b>5,343</b>	<b>5,901</b>	<b>6,195</b>	<b>4,693</b>	<b>5,623</b>	<b>5,345</b>	<b>5,386</b>	<b>6,313</b>
Capital expenditure	1,085	1,167	1,165	1,141	1,510	1,606	1,476	1,594	1,369	1,921	1,819	1,706	1,989
Operating expenditure	1,048	1,125	1,372	1,563	2,007	2,219	2,331	2,447	1,787	2,191	2,177	2,304	2,576
Principal and interest	453	490	615	516	579	449	522	407	267	276	235	231	279
Ongoing works	849	838	958	1,091	1,094	1,068	1,572	1,746	1,269	1,236	1,113	1,146	1,470

Source: Statistics of waterworks, Korean Ministry of the Environment, 2013. Figures are rounded and converted from Korean Won into US dollars.

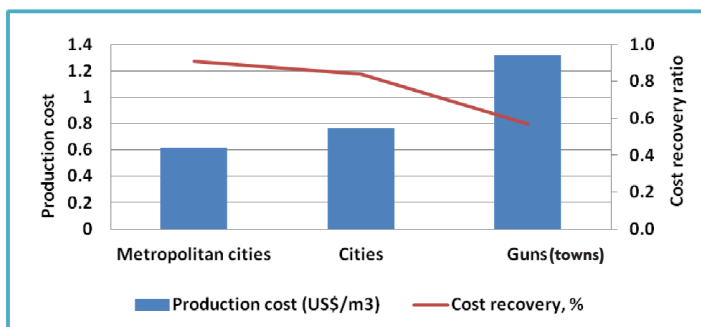
consumption. Water tariffs are divided into a bulk water charge for supplies from K-water to local governments and a distribution charge across the water network. MOLIT decides on the bulk water tariff on the basis of inputs from K-water while the City councils in local governments decide on the water distribution tariff.

In most cases, the water tariffs are around US\$0.7 per m<sup>3</sup>. However, the tariffs in counties and rural areas are lower while they are higher in the large cities where affordability is also higher. In smaller cities the unit cost of production is higher compared to larger cities due to economies of scale. As a result the subsidies provided by the government are mainly for the smaller cities where tariffs do not recover costs. On the other hand, the tariffs in the large cities are adequate to recover costs and subsidies are not needed. Figure 5 demonstrates how water production costs benefit from economies of scale, with costs decreasing as city size increases. For example, water production costs are about US\$1.3 per m<sup>3</sup> for counties (*Gun*), reducing to slightly less than US\$0.80 per m<sup>3</sup> for cities and about US\$0.60 per m<sup>3</sup> for metropolitan cities.

The ongoing effort to create institutional economies of scale is a good example of changing institutional arrangements. The Korean water industry is overly decentralized: there are 164 local government administrative districts and many modest projects are carried out in small and medium-sized cities and counties. The high degree of decentralization has limited institutional development and reduced operational efficiency. Furthermore, the unit cost of water production is high in smaller areas. Recognizing these difficulties, measures are being taken to consolidate the water service areas by reducing the number of service areas from 164 down to 39 (for 32 cities and counties, and 7 metropolitan areas) by the year 2020 and to 10 by the year 2030. This integration will accelerate water transfers between regions

**FIGURE 5**

Water production cost and cost recovery ratio by city size (2012)



Source: Korea Water and Wastewater Works Association, 2013.

to address water shortages and improve efficient use of the resources.

## FINANCIAL POLICIES ON WASTEWATER

Improving wastewater services has been a priority of the government for a long time. Given the large positive externalities involved due to improvements in the environment and health outcomes, the policy of the government has been to provide financial support for the development of the sector. The policies are clear on the levels of subsidies that are provided for various aspects of wastewater management and the subsidies range from 10 to 70 percent of the investment costs, depending on the type of investment and the size of a city. In percentage terms, more investment subsidies are provided to the smaller cities compared to the Metro areas (Table 8).

The consolidated data on local government sources and uses of funds (Table 9) indicate a number of trends that could guide

**TABLE 8**

Government subsidy rate for wastewater projects

Project Type	Investment Location		
	Small City/Town	Medium	Metro City
Private sewage treatment facilities		50%	
Sewer projects	70%	50%	30%
Sewage treatment plants	70%	50%	10%
Sewage sludge treatment plants	70%	50%	30%
Reuse of treated water projects	70%	50%	30%

Source: Korean Ministry of Environment, 2013.

reforms of financial and tariff policies in the wastewater sector. The total subsidies in the sector (covering the construction and operation of wastewater treatment plants and sewerage systems) varied from 55 to 72 percent of the total cost where most of the national and local subsidies were provided for investment support. The user charges have increased about 3.8 times (US\$789 million in 2000 to US\$2,989 million in 2012) to pay for the increased cost of wastewater management, reducing the level of subsidies (in percentage terms) towards the end of the period, as shown in the table. These user charges are based on wastewater tariffs and environmental fees that are around US\$0.4 per m<sup>3</sup> in most cases.

There are substantial economies of scale in total wastewater. For systems with less than 50,000 design population, the total cost per m<sup>3</sup> of wastewater treated is 4.8 times the cost in areas with a design population above 1 million (Figure 6). The cost recovery is also high in towns that have population greater than 250,000 people compared to towns with lower level of population. These numbers illustrate the need to carefully plan wastewater systems and seek low cost options, especially for small towns to lower the need for subsidies.



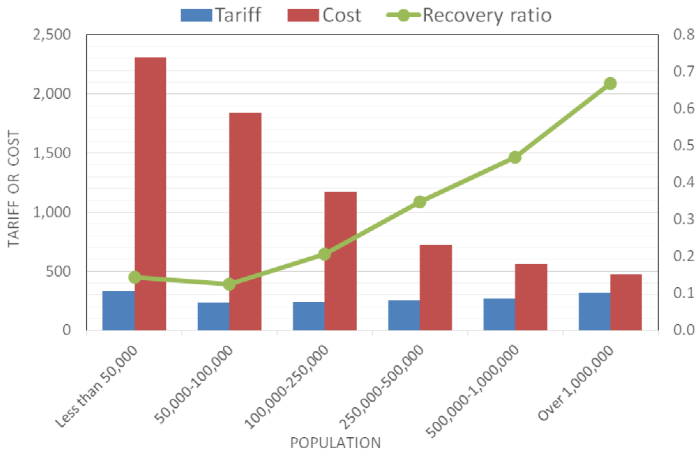
**TABLE 9**  
Wastewater—consolidated sources and uses of funds (in US\$ millions)

Division	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Total sources</b>	<b>2,453</b>	<b>2,407</b>	<b>3,215</b>	<b>3,393</b>	<b>4,135</b>	<b>4,647</b>	<b>5,237</b>	<b>5,295</b>	<b>4,289</b>	<b>5,460</b>	<b>5,652</b>	<b>5,620</b>	<b>6,623</b>
National subsidy	733	822	1,085	1,040	992	1,345	1,512	1,435	1,091	1,540	1,607	1,681	1,730
Local subsidy	932	918	1,179	1,323	1,788	1,613	1,811	1,843	1,530	1,948	1,754	1,520	1,903
Wastewater charge	789	666	952	1,030	1,355	1,689	1,913	2,017	1,386	1,659	1,407	1,369	1,675
Other charges	—	—	—	—	—	—	—	—	282	314	883	1,050	1,314
Subsidy (%)	68	72	70	70	67	64	63	62	61	64	59	57	55
<b>Total uses</b>	<b>2,453</b>	<b>2,407</b>	<b>3,215</b>	<b>3,393</b>	<b>4,135</b>	<b>4,647</b>	<b>5,237</b>	<b>5,295</b>	<b>4,289</b>	<b>5,460</b>	<b>5,652</b>	<b>5,620</b>	<b>6,623</b>
Construction expenditure	1,686	1,608	2,148	2,201	2,480	2,722	2,768	2,565	2,069	2,800	2,978	2,635	2,989
Maintenance Expenditure	229	221	297	325	403	457	523	565	672	759	540	621	626
Operating Expenditure	272	274	366	404	555	662	820	886	702	851	1,014	1,113	1,439
Overhead, Etc	108	95	110	98	186	187	360	399	174	264	344	326	427
Ongoing works	159	207	295	365	511	618	766	880	672	785	823	904	1,141

Source: Statistics of Sewerage, Korean Ministry of Environment, 2013. Figures are rounded and converted from Korean Won into US dollars.

**FIGURE 6**

Economies of scale in the wastewater sector



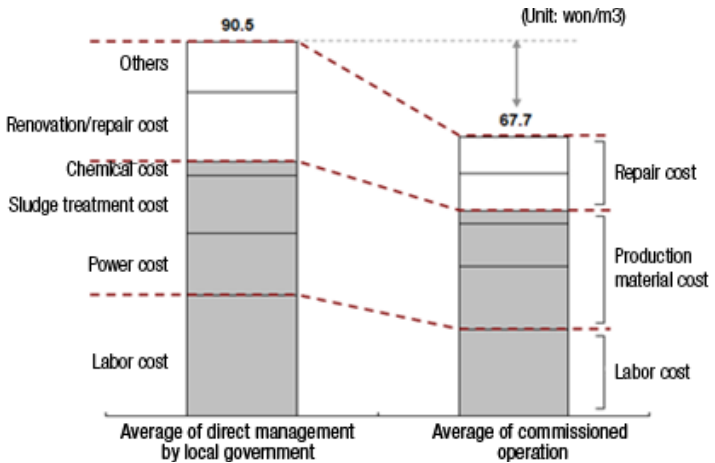
Source: Korea Water and Wastewater Association, 2011.

## ROLE OF THE PRIVATE SECTOR IN WASTEWATER SERVICES

The government is promoting the role of the private sector to increase efficiency and competitiveness in the construction and operation of wastewater works. Between 1998 and 2008, a total of around US\$800 million private capital financed the construction of 100 wastewater treatment plants. The private sector is also involved in operating wastewater treatment plants. At the end of 2012, about 58 percent of the wastewater treatment plants were transferred to the private sector. Studies show privately operated sewerage systems have operating costs that are 25 percent lower compared to plants that are run by public authorities (Figure 7). Given these benefits of operational efficiency, longer-term contracts with the private sector are being considered such as BTO and BTL schemes. Private companies can also be required by the public authorities to bring in innovation through reuse of wastewater or through resource recovery from the sludge.

FIGURE 7

Operating cost structure by operation type of wastewater treatment plant



Source: Operation Results Report of Wastewater Treatment Plants, Korean Ministry of the Environment, 2007.

### Promoting green growth through water and wastewater services.

The government plans to make water and wastewater treatment plants more efficient, and a goal has been established that by 2030 wastewater treatment plants will reduce their electricity consumption from the grid by 50 percent through projects involving the use of biogas, photovoltaic power, wind power, small hydro power, and the promotion of high-efficiency equipment. In addition, the government is planning to use sludge from wastewater operations for energy generation, which will also reduce carbon emissions.

## CHAPTER 4

# LESSONS LEARNED

Fifty years of transformation of the Korea water sector teaches four lessons of universal validity:

***Political will to develop the sector was strong and continuous.***

The development of the water sector can be attributed to successive governments that focused on integrating water issues with overall economic development and through addressing water issues that come up in other sectors (health, environment, urban development). By taking this approach there was broad support to develop the sector by linking the water sector to hygiene education, housing development, industrial transformation. Successful coordination is difficult but was facilitated by the preparation of successive five-year development plans from 1961 onwards and by the political continuity of policies and priorities. The national plans for water supply and wastewater services that Korea prepares every ten years define projects, schedules and funding for infrastructure development and guide actions towards the strategic goals. The political commitment to improve the water sector was accompanied by continuous revisions to the legal and regulatory framework, which were necessary to keep pace with the changing conditions and to meet the dynamic demand for water services. Furthermore, adequate financing was provided to address the sector needs. Priorities were unchanged but laws and regulations were often fine-tuned to meet sector needs.

***Institutional arrangements were clear and adjustments were made as necessary.*** Accountability was clear and unambiguous and a few agencies (MOLIT, MOE, K-water, and KECO) were

assigned the responsibility of developing the sector. These agencies had the sectoral expertise to make the necessary improvements and were adequately supported by high level government officials. Over the years, adjustments were made to make sectoral improvements. From 1961 onwards it was the Ministry of Construction that was in charge of building capacity in the water sector but the main responsibility was reassigned to the MOE since the priority shifted towards safeguarding the quality of raw water and country's environment. A similar shift is now imminent in the water supply and wastewater utility sector where growing excess capacity and loss of economies of scale signal the need to consolidate the local government utilities. The consolidation of these smaller utilities into 10 basin-based regional utilities should prompt a review of the governance of the water supply and wastewater utilities, including a greater autonomy on investment and operational decisions leading to more efficient services.

***Sector development was possible due to adequate funding and explicit subsidies.*** The development of the sector would not have been possible without clear policies on user charges and subsidies. The user charges increased steadily for both the water and wastewater sub-sectors along with the national and local government subsidies. While the subsidies in the wastewater sector were higher, there was need to also provide grants for the water sector, especially for service provision to small communities. As the country is now focusing on making utilities run more efficiently through the consolidation of utilities to achieve economies of scale, the need for subsidies will decline. Furthermore, with the growing affluence of the population the ability to pay higher tariffs will increase. This provides the opportunity to review the tariff policy to make the sector less dependent on subsidies. Lower levels of investment subsidies could still be justified given the positive externalities of providing clean water and collecting and treating wastewater. However, to encourage efficiency, the investments could be prioritized to achieve economies of scale or institutional changes such as formation of larger utilities.

*Comprehensive sector information was readily available to set and adjust policies.* An interesting feature of the Korean water sector was that the technical and financial information was readily available that helped policy makers to continuously monitor progress. The presence of sectoral agencies—such as MOLIT, MOE, K-water, KECO and KWWA—with adequate institutional capacity and the rigorous sector monitoring helped the country to increase coverage and develop appropriate laws and regulations to meet sector targets. For example, the KWWA plays an important role in benchmarking performance and enhancing the skills of staff working in the sector. The KWWA was established in 2002 in accordance with the Water Act and it collects data from service providers that helps to monitor sector development. KWWA promotes the training of water professionals in areas of water quality, and disseminates information related to water and wastewater. Diligent monitoring using the available information has led to constructive reforms and efficiency improvements, including the recent development of policies to merge utilities, creating of economies of scale.

# COMPREHENSIVE PLAN FOR FOUR RIVER WATER MANAGEMENT

One of the measures put in place to address water quality issues is the Comprehensive Plan for Four River Water Management, a project initiated in 1998. It is an innovative approach to developing a watershed management system based on partnership, dialogue, and agreement between upstream and downstream water users. This system not only increased opportunities for watershed members to participate, but also established the Water System Management Committees (a decentralized representative decision-making body). Furthermore, a water system management fund was set up to support the watershed management activities.

The major elements of the Comprehensive Plan for Four River Water Management were to first set goals of acceptable water quality levels. To this end, water quality parameters were established for various water bodies such as the Paldang Lake, Mul Geum Lake, Daechegon Lake, and the Juam Lake. Thereafter, plans were outlined to increase the wastewater collection and treatment in the riparian areas of these lakes. A number of large treatment plants in cities were built along with the wastewater collection system. In addition, wastewater from rural areas was also treated, including the waste from farms. It is estimated that between 1998 and 2005 about US\$10.5 billion was spent to build the necessary infrastructure to collect and treat wastewater.

A Water System Management Committee manages the watershed in each of the four rivers. These committees were established to efficiently manage the watersheds that span across multiple local

governments. The committees are a public corporation with the Vice Minister of the Environment as Chair. Other key members include vice mayors and governors of cities and provinces and officials from public water corporations. The committees review the following matters: (a) pollutant reduction plans to improve water quality; (b) billing and collecting water use charges; (c) management of funds; (d) land purchases; and (e) planning of water monitoring activities and information campaigns. Key activities of the committees include the management of:

- **Total water pollution load reduction system**—this aims to achieve target water quality standards by taking a comprehensive approach of reducing total pollution in a river basin. The sources of various pollution in a river basin are identified followed by priority actions to improve water quality. Co-operative arrangements among basin communities are emphasized in achieving the environmental objective of improving water quality in rivers.
- **Riparian buffer zone system**—certain areas along the river banks are managed carefully, especially the environmentally protected zones where activities that generate pollution are limited or wastewater generated from the area is treated. In some cases, the government purchases land close to rivers to regulate the use of the land and limit pollution. This land is typically converted to forest land, reducing the non-point and point sources of pollution.
- **Water use charge system**—water user charges are applied to raise funds to finance activities that reduce pollution, including the purchase of land by the public authorities. The water use charge is determined by the Water System Management Committee and is around US\$0.20 per m<sup>3</sup>. It is estimated that about US\$700 million is generated through user charges in the Four Rivers in recent years and these funds have greatly contributed towards the development of infrastructure needed to reduce pollution.
- **Information exchange**—to raise awareness on environmental issues, the funds raised are used to monitor progress and carry



out environmental awareness through information campaigns and educational programs that highlight the need to conserve water and improve its quality. Often, local non-government organizations (NGOs) are involved in disseminating the information and seeking feedback from residents in water catchment area to improve on the watershed management plans.

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