The Diversification of Financial Resources for Sustainable and Effective Investment on Water Infrastructure

By

KIM, Sunhwa

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC MANAGEMENT

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Committee in charge:

Professor Lee, Jinsoo, Supervisor

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Executive summary

The “red tap water” incident in Incheon in May 2019 caused a huge social stir over the importance of water infrastructure. This is not a problem confined to Incheon, but a common issue that corresponds to most large cities with high rates of deteriorated water pipes. While citizens' expectations for water services have increased due to the improvement of living standards, the water related finance policy, which has been aimed at expanding the supply of water infrastructure, has lacked the resources and plans for reinvestment on aging facilities. Local governments, which are unable to recover costs due to the difficulty of raising tariffs, are excessively dependent on state subsidies for reinvestment, which makes it difficult to finance. Therefore, this study examines ways to diversify water infrastructure reinvestment resources and propose financing plans according to each project's characteristics.

The key agenda to consider under the current low growth, high fiscal spending policy situation seems to be financial accountability and sustainability. In terms of financial accountability using local bonds to finance water supply reinvestment is a desirable alternative to state subsidies received from higher governments. Local bonds have not yet been issued much, and the progress of projects becomes transparent in coordination process with the local parliament, attracting significant budget savings. For sewerage sector, it is appropriate to raise funds through private investment, including existing BTLs. However, in order for these measures to be activated, it was suggested that local water supply and sewage projects should be excluded from the gross cap of local bonds, and government empowerment on local level would be necessary to increase private investment.

The establishment and use of public revolving fund are considered as a way to increase the sustainability of financing reinvestment on water infrastructure. The U.S. State Revolving Fund case study examines the operational structure, process, assistance criteria, financial structure and support measures, and discusses the feasibility of domestic application and success requirements in Korea.

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I. Introduction

The “red tap water” incident in Incheon in May 2019 caused a significant social issue. As red water of unknown origin came out of the water taps, residents suffered great inconveniences because they could not wash dishes or take showers on time. Schools stopped feeding, and restaurants had to shut down. Citizens went to other regions to do laundry and took a shower with bottled water since they were worried about skin diseases. As the city of Incheon missed a golden time crucial for resolving the case, the scale and duration of the damage became severe, and citizens' anger reached its extreme. According to the city of Incheon, about 261,000 households and 635,000 people were damaged by this incident, and it took 67 days for the city to overcome the situation. It is known that more than 20,000 citizens reported complaints.

The Incheon Metropolitan Government has come up with a plan to compensate for the three-month exemption of water and sewage charges, the cost of purchasing bottled water, medical expenses, and water quality inspection cost. However, citizens filed a class-action lawsuit against the city in October 2019. They were demanding the resignation of the city mayor. Furthermore, it did not take too long to confirm that the “red tap water" problem, which resulted from the deteriorated water pipes, was not just a problem for Incheon City. Public anxiety over drinking water is growing as there have been a series of reports of red tap water outbreaks in Seoul and Ansan. Experts claim that the replacement of old water pipes is essential for the fundamental solution for this situation (Kim, 2019).

Water infrastructure has been intensively installed since the 1980s and is in line with the history of Korea's economic development. Korea achieved 99.1% of water supply and 93.6 % of

sewage supply rate (MOE, 2019a; MOE, 2019b), which can be considered as a success. However, as the aging of water and sewage facilities rapidly progresses, investment in renovation is required.

Indeed, the problem of old water pipes in Korea is serious. According to the 2017 Waterworks Statistics released by the Ministry of Environment, the ratio of deteriorated water pipes, which were installed more than 21 years ago, is 67,676km out of the total 209,034km, accounting for 32.4% of the entire length. In particular, the proportion of deteriorated facilities is higher in densely populated metropolitan areas, including Seoul. Deteriorated waterworks account for 54.8% in Seoul and 56.8% in Daegu, with the average for seven metropolitan cities reaching 46.6 %. On the other hand, if you look at the status of the replacement and improvement of the water pipes, only 0.6 % of the total water pipes were replaced, and 0.9 % were upgraded in 2017 (MOE, 2019a)

Since Korea's water policies have focused on expanding supply, there are structural, financial, and organizational problems such as lack of re-investment resources and plans for aging facilities, lack of adequate policy promotion and financial support system (Moon, 2014). Moreover, the nation's water business has not been able to recover costs through charges. The cost recovery rate is 80.5% for water supply and 45.9% for sewage. For example, the national average water rate stood at 723.3 won/㎥, which is 80.5 % of the production cost of 898.2 won/㎥ in 2017, and the situation is worse in sewage sector (MOE, 2019a).

Local governments should raise tariffs to secure funds to replace their aging water infrastructure, but this is difficult due to tax resistance from citizens. Therefore, local governments are passive in reinvesting in water infrastructure and heavily rely on state subsidies. Of the total water revenue, the ratio of state financial support accounts for 12.5 % of waterworks and 44.9 % of sewage in 2015. (MOE, 2017)

As seen in the case of Incheon, the water infrastructure has become deteriorated, and citizens' expectation for water service is high due to improved living standards in Korea. Although the need for reinvestment is very high, the financial structure of the industry is weak and the relevant criteria are insufficient (Moon, 2014). Local governments, which have difficulty in raising charges and recovering costs, rely heavily on state subsidy, making it very difficult to reinvest. Therefore, the resources and structure for reinvestment, which can no longer be delayed, should be diversified in ways other than the national finance, and diversification measures appropriate for local governments' financial situation should be proposed.

There have been many studies that argued for the legitimacy of the fare increase to secure the soundness of the financial structure for the water infrastructure business. However, little research to date has focused on necessity and plan for diversification of financial resources in Korea's water infrastructure business. Therefore, in order to meet the need for reinvestment in the water infrastructure and to enhance its sustainability and effectiveness, this study seeks to present measures to establish and diversify a sustainable financial system for water infrastructure business in Korea.

This study is composed of five sections. The first part discusses background, current status and problems of water infrastructure in Korea. The second section examines deteriorated water infrastructure, financial structure of business and need to diversify financial resources in detail through literature review. In the third section, estimation of reinvestment cost of water supply and sewerage sector will be presented respectively. The fourth section analyzes financing methods of water infrastructure reinvestment including overseas case study, and the fifth section will propose policy implications.

II. Literature Review

Korea's water infrastructure has been intensively established since the 1980s and has played an essential role in the history of Korea's economic development. Therefore, it has achieved quantitative success in a short period, along with economic growth. But there are some obvious limitations in terms of qualitative development

1. Deteriorated Water Infrastructure and Needs for Reinvestment

According to Lee et al. (2019), Korea's water infrastructure was built in the 1980s without any mid- to long-term management plan during the high growth period, and since then, the damage to property and life because of the aging of facilities has increased. Moon et al. (2017b) emphasize the need to reinvest in existing facilities due to the impact of climate and social changes, in addition to the rapid aging of the water infrastructure. In particular, the authors note that damages such as the flooding of houses and vehicles, total control of roads, and the occurrence of ground erosion in urban centers caused by ruptured water pipes have had a massive impact on people's lives and national economy.

Ryu et al. (2018) argue that local governments, especially those in metropolitan cities, need intensive management of aged facilities as the water infrastructure is aging faster than other local governments. In other words, the deteriorated facilities are increasing in more densely populated areas, which is a dark side of our rapidly industrialized society (Kim, 2019), and it is another challenge we have to solve.

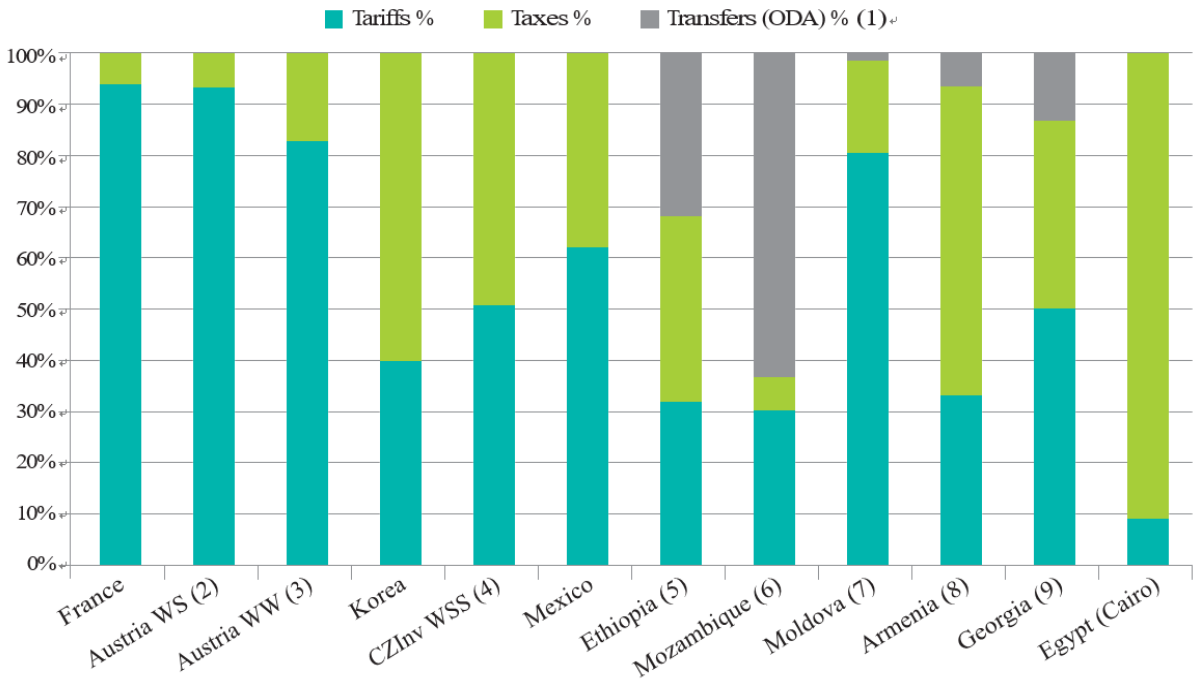
In developed countries, after 30 to 40 years of construction, maintenance costs of water infrastructure have become a significant burden on national finances, reaching 40% of the total

construction budget (Moon et al., 2014). In the case of domestic water and sewage sector, since deteriorated facilities in water treatment plant, intake point, and sewage treatment plant account for more than half of the total capacity, significant maintenance costs are expected to be spent, and the demand for reinvestment will also increase in the future.

2. Financial Structure of Water Infrastructure Business

The low water and sewage tariff levels in Korea can be seen through international comparisons. According to the OECD (2009a), France and Austria have more than 90% of their water and sewage revenues from tariff basis, compared to 40% in Korea, which is similar to 30% of Mozambique. This means that the national burden, for central as well as local government, is high in Korea's water and sewage budget. The OECD analysis (2009b) recommends that the state-burdened resources should be temporary and limited in financial structures of water business. In other words, increasing the proportion of tariff and reducing the portion of national financial burden are necessary to protect sustainable water resources.

Figure 1. 3T financial burden structure of each country



Source: OECD (2009a)

On the other hand, the water business has accumulated a deficit due to the low tariff compared to overall production cost. Moon et al. (2017a) examine waterworks and sewage statistics to identify yearly declines in tariff revenues and increases in national subsidies, which prevent timely reinvestment of old facilities and could lead to a vicious cycle. The author states that the current rate level is not sufficient to cover the regular maintenance cost and principal payments, resulting in local governments with expenses exceeding their incomes.

Although many prior studies have mentioned the importance of raising tariffs, it is a challenging task to achieve. The EU report, which recently introduced the process of restructuring water and sewage rates in European countries, also analyzed that the proposed pricing standards did not have a direct impact on the restructuring of each member country (EEA, 2013). In the case

of the recent rate reforms, in the Netherlands, Spain and Ireland, the reason for the success was due to the financial downturn caused by the economic crisis (EEA, 2013). This shows how powerless the principles and the criteria based on theories are in practice.

Kim et al. (2015) explains the political and economic characteristics of rate increases and adds that most countries face difficulties not because they do not know the need or direction of rate increase but because they can not do. This is because the restructuring of the tariff is due not only to the rationality of the system itself, but also to the various effects of political structure, political-economic interdependence, and social institutional regulation (Kim, 2015). As such, the rate hike can be seen not only in technical content but also in various socio-economic and political situations. The level of water and sewage charges is determined through the process of politics as a result of the agreement between the basic principles of cost estimation and the various suppliers and consumers (Cho, 2018).

3. Need for Diversification of Financial Resources

Kim (2015) and Lim (2016) stress the importance of injecting external funds by expanding local bonds and private investment. Kim (2015) believes that while the burden of national treasury to promote water welfare for vulnerable regions and classes is inevitable, the expansion of state subsidies should be limited by international standards. The author pays attention to the case of Gimhae City, which issued a municipal bond, and drastically replaced the water supply pipes, and mentions it as a possible alternative. However, it is difficult to expand new debt in the sewage and water supply due to the limited size of issuance for local bonds by sector (Moon et al., 2014). Also, political decision-making and parliamentary passage are difficult issues because of concerns over

the burden on residents. There seems to be a lack of concrete alternatives to the causes that make it challenging to implement in practice.

Lee et al. (2019) analyze the policies for resolving aging infrastructure of major overseas countries and stress the importance of active participation of private investment. However, since private investment also needs to secure business feasibility based on rate increases (Cho, 201), it is necessary to analyze how much rate raise can be handled in the region and how much financial support is available from what resources. Lee (2017) focuses on the importance of diversifying sources of funding and drawing joint investments with various stakeholders.

Although studies differ on how to implement diversification, there is some consensus about the need for a change in resources. Nevertheless, specific methods proposal and case studies seem more necessary.

Taken together, the water infrastructure needs to be reinvested as the deterioration of facilities is rapidly progressing. However, it is not easy to raise financial resources due to the low tariffs, high state subsidies and various political issues. Therefore, this study intends to diversify the resources for reinvesting in water infrastructure and propose specific measures to suit the financial status of each local government.

III. Necessity of Securing Reinvestment Resources for Water Infrastructure

While domestic waterworks and sewage infrastructure facilities have continued to grow in quantity due to the expansion of infrastructure facilities through economic growth in the 1960s, aging is underway without investment and replacement for new facilities. Facilities such as water

purification facilities, intake facilities, and sewage treatment facilities with more than 20 years of service account for more than half of the total capacity.

As a result, the financial challenge of water and sewerage sectors is changing from funding for expanding the supply of water and sewerage infrastructure to funding for facility reinvestment. There is a need to consider ways to finance future facility reinvestments as they are expected to require enormous financial resources

1. Estimation of Reinvestment Cost of Water Supply Facilities

In order to estimate the cost of reinvestment demand for water and sewage facilities, the Ministry of Environment checked the degree of deterioration of water and sewage infrastructure facilities and measured the cost by identifying the demand for reinvestment in 2013. At this time, the demand for reinvestment of water supply facilities was estimated based on the renovation project plan for old facilities. In the case of water treatment plant, reinvestment plan was presented according to priority by classifying A ~ F class based on water purification method, year of installation, and water quality standard exceeded.

Measuring mid-term costs from now until 2020 and long-term costs from 2020 to 2030, it was estimated that the cost of reinvestment for deteriorated water treatment plants and pipelines was approximately 12.642 trillion won.

2. Estimation of Reinvestment Cost of Sewerage Facilities

For sewerage facilities, there is not enough data on the cost calculation of the re-investment demand. The years of facility opening and operation status are presented in the statistics for

sewerage treatment plant, but it is difficult to determine the aging degree of the individual sewerage pipelines.

Moon et al. (2014) measured the cost of reinvestment for sewerage reflecting the sewage statistics and survey results of each municipality. In the case of sewage treatment plants, the costs were measured for facilities that had been installed for 30 years, and for sewage pipes that had been installed for 20 years.

As a result of the cost measurement, it is estimated that the pipelines will cost 31.85 trillion won by 2030 and 50.58 trillion won by 2040. The treatment plants are estimated to cost 1.45 trillion won between 2014 and 2020, 2.30 trillion won by 2030, and 2.73 trillion won by 2040. Considering 16.91 trillion won of reinvestment expenses for pipelines and 2.29 trillion won for treatments facilities by 2030, it is estimated that financial resources worth 19.21 trillion won will be needed by 2030. By 2040, a total of 53.304 trillion won will be needed, with 50.58 trillion won for pipelines and 2.72 trillion won for treatment plants.

Table 1. Estimation of Reinvestment Cost for Water Infrastructure

unit: 100 million won

		2014~2020	2021~2030	2031~2040	total
Water supply	treatment facilities	9,661	47,961	-	57,622
	pipelines	16,064	52,736	-	68,800
Sewage	treatment facilities	14,459	8,522	4,318	27,298
	pipelines	38,571	130,524	336,643	505,738
total		78,755	239,743	340,961	659,458

Source: MOE (2013); Moon et al. (2014)

The reinvestment cost for the water and sewage sectors is estimated to be 31.85 trillion won by 2030 and 65.95 trillion won by 2040, which is expected to require an enormous amount of funding. There is a need to present various measures to secure financial resources for reinvestment demand.

IV. Analysis on the Financing Methods of Water Infrastructure Reinvestment

As Korea's water and sewage facilities have been focused on quantitative growth, investment in existing facilities has not been made sufficiently, and the demand for reinvestment is gradually increasing. As mentioned above, the reinvestment of water and sewage is estimated to be immense, amounting to about 64 trillion won from by 2050.

However, there is currently no strategic fiscal plan for reinvesting water infrastructure facilities,

indicating a financial gap. Therefore, this section presents a reasonable procurement plan for reinvesting in water facilities. First, the funding methods within the existing system are to be proposed and then feasibility of the overseas case, revolving fund, is to be analyzed.

1. Local Bond

Local bonds are bonds issued by local public organizations (e.g., metropolitan and provincial governments and local governments such as cities and counties) according to their financial needs under the Local Finance Act, which mainly provides the necessary expenses for public projects such as education, transportation, water service, or refinancing of issued bonds (Moon et al., 2014).

As shown in Table 2, the most ideal forms for financing public expenditure are I and IV, which conforms to the 'Benefits-Received Principle'. (Jeon, 2007). In other words, ordinary expenditures should be financed as 'tax' so the current generation bears both benefit and burden, while capital expenditures should be financed with 'local bonds' as both benefit and burden lead to future generations.

Table 2. Financial Use and Financing Method

		Financial use	
		Ordinary expenditure	Capital expenditure
Financing method	tax	I. benefit: current generation burden: current generation	II. benefit: current and future generation burden: current generation
	local bond	III. benefit: current generation	IV. benefit: current and future

		burden: current and future generation	burden: generation current and future generation

source: Jeon (2007)

Currently, ‘local bond’ that can be used by local governments to secure financial resource can be seen as a desirable alternative in terms of financial soundness. First of all, local governments have not yet had a high level of debt burden, and the requirements and financial management of local bonds (e.g., annual debt repayment plans) have been thoroughly carried out by higher governments, and the annual financial burden and business progress have become more transparent in the course of parliamentary passage.

In fact, the procurement of local bonds to finance the water supply project has been carried out by some municipalities. For example, in 1984, Jeonju City issued local bond to finance the expansion of water supply. In addition, a number of local governments have already utilized such as Jinju City in 1986, Masan City in 1995, Jeongeup City in 1995, and Gimhae City in 2011. (Kim et al. 2013).

Especially noteworthy was the Gimhae City, which used local bond to replace old water pipes. According to the City, it invested about 21.5 billion won, replacing 217km of old pipes by 2013, and settled the problems of old water pipes through smooth operation of local bonds such as injecting a total of 82.4 billion won to expand water supply and water facilities, and repaying 75.3 billion won by 2012.

This way of using local bonds is also a desirable alternative to state subsidies from higher governments in terms of financial accountability. Because local bonds have the advantage of

reporting the debt plan to the local government council so the project are naturally exposed and adjusted in the process of obtaining approval, and most of all, the fiscal responsibility lies with the local residents, which leads to a greater incentive for savings compared to state subsidies. This is contrary to the cases where some local governments have used state subsidies to implement facilities improvement projects, but their performance did not meet the standards.

Local bonds have advantages in terms of fairness in cross-generational burden, fiscal adjustment between years and supplementing the central government's fiscal policy. In terms of national finance, developing new tax sources and improving local financial adjustment systems are ultimately necessary, but there is a need to utilize local bonds in that they can respond effectively when demand for resources temporarily increases.

However, local bonds are difficult to use due the nation's fiscal structure, which is currently heavily dependent on state subsidy. Excessive use of local bonds can undermine local fiscal soundness, putting an excessive burden on future generations. In particular, there is the possibility of impeding sound financial management, such as difficulty paying off debts or increasing the state budget in the process of paying interest. Difficulty in passing through parliament for fear of increasing burdens on residents is what makes it difficult to actually execute.

Indeed, the 2017 water supply statistics show that bond-related income amounted to 27.2 billion won, which is only 0.32% of the total water supply revenue of 8.4317 trillion won. It is difficult to expect local governments to use local bonds in the current situation, which is a structure that cannot be enforced even with a system.

Moreover, the size of local bonds is substantially limited by sectors, making it difficult to expand new debt in water service sectors. The use of local bonds is based on the “gross cap”, this aims to

manage debt as a gross unit in terms of financial soundness. Local bonds are effectively filtered out of the parliamentary budget process, limiting their use once again to the cap in the central government's financial management stage. In case of water projects, it is also possible to provide preferential funding by excluding them from the total limit (Kim et al. 2015).

2. Private Investment

Alternatives for utilizing private investment also need to be considered more actively. The PPP (Public-Private Partnership) portion of network public services in major countries is forecasted to reach about 30 percent in 2016, according to the international organization's outlook. In order to secure fiscal soundness while maintaining a certain level of water supply service, flexible use of external resources should be available. Therefore, private investment is also a viable alternative to the replacement of old pipes, and the BTL method in the sewage field is already well underway.

As of January 2018, 9 types of private investment projects (BTOs) in the sewage sector consisted of 5 sewage treatment plants, 2 sewer pipelines, 1 village sewerage, and 1 sewage reuse. Of the total project cost of about 499.1 billion won, state subsidy accounted for about 40.7% at about 202.3 billion won, and private investment accounted for about 59.3% at about 295.9 billion won. (MOE, 2018)

In the case of BTL projects, 5.536 trillion won was spent from 2005 to 2013 and 60.1 billion won for each unit project based on 92 projects under the agreement. The annual injection of private funds into the sewage sector is estimated to cost an average 644.7 billion won. (National Assembly Budget Office, 2013)

Table 3. Current Status of Private Investment in Water Supply and Sewerage Sector

unit: 100 million won

Category		BTO	BTL	Total
Sewage	Total Cost (period)	2.959 (Y2011~2020)	55,365 (Y2005~2013)	60,356
	Project Unit Cost	329	601	1,156
	Annual Cost	296	6,151	6,447

Source: MOE, 2018; National Assembly Budget Office, 2013

Until now, projects to improve existing facilities in water sector have been limited due to the limited scope and method of implementation, and lack of evaluation methods for project feasibility. However, most of the supply and demand for water supply and sewage facilities has been met. Therefore, it is necessary to focus on reinvestment to improve the aging of existing facilities rather than expansion.

First of all, it is necessary to actively review BTL-type private investment in the sewerage pipeline replacement project and examine concrete ways to realize it. There is a financial risk issue of uncertainty in demand, which can be said to be a problem with private investment, which is not expected to be a big burden in water sectors. This is because the uncertainty in demand is very low due to the nature of water services. Unlike other SOC projects, such as roads or railways, where the ‘demand’ is uncertain, the ‘population’ based water service projects are almost accurate

However, there is a negative view as local governments recognize BTL cost as a ‘debts’ when the past state subsidies are converted into BTL. However, in the long run, the level of water service will improve, so assessing capital expenditures based on short-term financial performance is hasty.

Moreover, it is more appropriate in terms of accountability to be held as the 'liability' of local governments, rather than to support SOC in a particular region as part of the tax paid by the whole nation. Nevertheless, the fact that the BTL part is included in local debt, which acts as a debt pressure for local governments, needs to be improved in terms of easing practical obstacles and encouraging their use.

In the future, the BTL project will be highlighted as a project for improving the performance of old public facilities as well as new construction projects. However, it is necessary to clearly establish the concept and procedures of private investment for remodeling or performance improvement of old facilities.

Although uncertainty in demand for water and sewerage is less than that of other projects, securing business feasibility based on raising tariff is the key to promote private investment. Without a rate hike, local governments cannot break the vicious circle of having to subsidize for the deficit on operating expenses again. Therefore, raising tariff is essential to the success of private investment in water supply and sewage projects.

Private investment in the water supply sector has been rarely made for a variety of reasons. Attracting private capital to waterworks is likely to cause misunderstandings such as privatization and rate hikes in the domestic sentiment, and there is a risk that the driving force for private investment will be lost by causing conflicts in the region when it is combined with the shift of existing personnel's to the private sector.

In fact, the cities of Daejeon, Anyang and Chungju, which have reviewed or are planning to review the eligibility of private investment projects for water purification plants to the PIMAC, are more concerned with the opposition of local civic groups and local councils than the lack of

financial resources. The case study of KIPF et al. (2016) states that misunderstandings and distrust of privatization and rate hikes are the biggest obstacles to the promotion of private investment.

At present, the law on private investment is practically the authority of the central government. As a certain percentage of national subsidy is invested, the central government's business control is necessary. However, in the case of water supply and sewerage sectors with relatively low business risks, it is necessary for local governments to play a leading role and allow flexible operations on private investment

3. Revolving Fund

This section examines the feasibility of using the 'Revolving Fund' system among those that are not currently applied in Korea but are likely to be able to finance reinvestment if the existing system is unable to cover the funding.

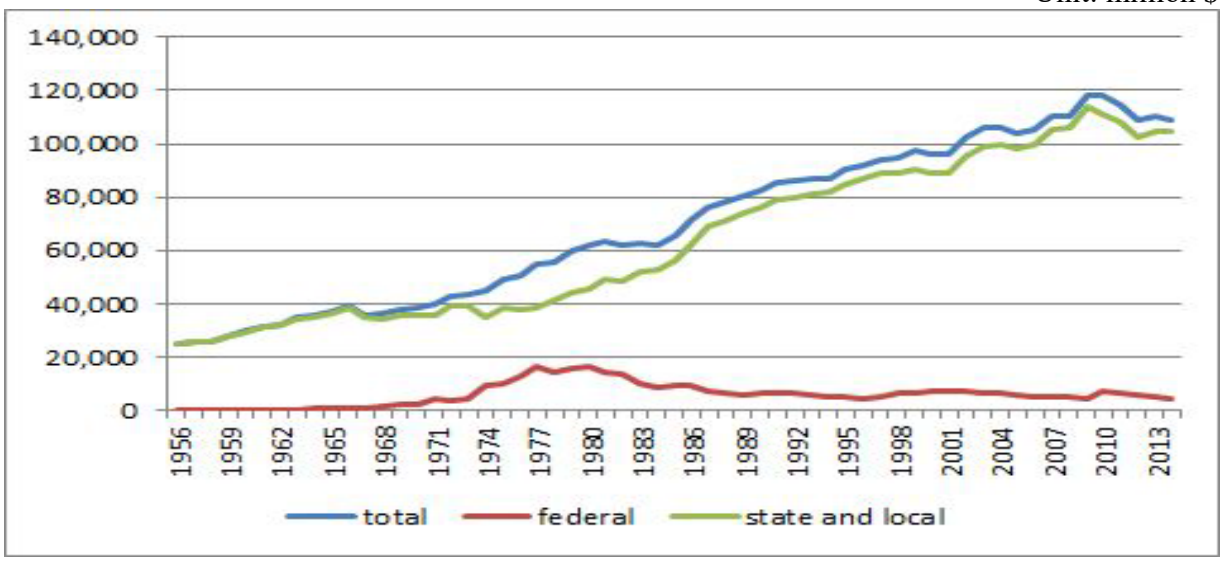
Since the 1960s, Korea has been pushing for policies focusing on expanding the spread of water infrastructure, so policies, fiscal systems that promote efficient operation management of infrastructure and rational investment are somewhat lacking. On the other hand, many advanced countries, including the United States, Canada and Australia, have long been conducting continuous research and attempts on the financial support system to secure funding for water infrastructure.

The U.S. State Revolving Fund (SRF) is a successful example of a well-established partnership between central and federal governments that provides financial support for a variety of water infrastructure projects (Moon et al. 2017).

Funding for US water infrastructure is mainly provided by state and local governments with water tariff and local bonds, but federal subsidies through the SRF are also being provided at the same time. In the United States, the total investment is increasing, but the share of the federal government is decreasing. The federal government's share of investment has increased since the late 1960s, hitting a record high in the late 1970s and early 1980s, and has declined after the 1980s. The federal government accounted for 30.5 percent of the total size of the government in 1977, compared with 4.0 percent as of 2014.

Figure 2. Total investment in U.S. water infrastructure

Unit: million $

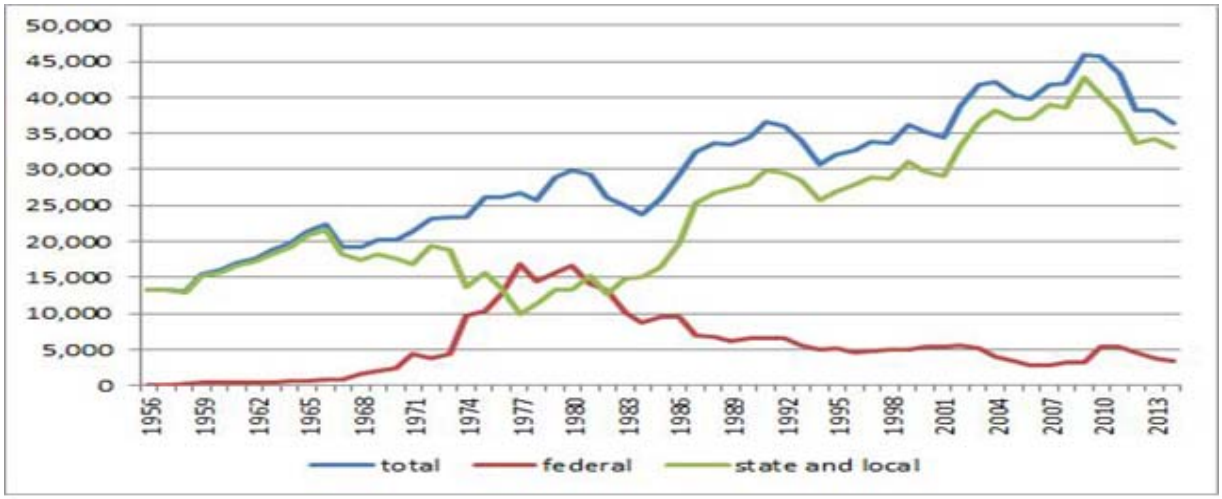


Source: CBO, 2015

In the case of capital investment, the proportion of federal government was higher than that of state and local governments in the late 1970s and early 1980s, but has steadily declined since, with the proportion of federal government investments coming to 9.4% as of 2014, compared with 62.8% in 1977.

Figure 3. Capital investment in U.S. water infrastructure

Unit: million $



Source: CBO, 2015

3.1. Concepts and Classifications of SRF

SRF is a federally funded financing method for US water infrastructure projects that enables low-cost loans to improve and replace existing water facilities.

The revolving fund is a type fund for the continuous operation of the organization. Funds generated from the organization's account are supplemented by repaying the funds even if they are loaned to assistance recipient. Therefore, it is mainly used to support government and non-profit projects because it has the advantage of being operated continuously without additional input if operated efficiently.

The Environmental Protection Agency (EPA) estimates that more than $680 billion is needed to repair and replace water and wastewater infrastructure nationwide over the next 20 years. Under the Clean Water Act and Safe Drinking Water Act, the federal government contributes some

funding to states through EPA's SRF programs. States use this funding to make low or noninterest loans to communities to repair or replace water infrastructure. These loans are repaid with interest, and these funds are then used for future loans (Jones, 2016).

Funds are also called Capitalization Grants, as each state must match at least 20% of the necessary funds. SRFs are divided into DWSRF (Drinking Water State Revolving Fund) and CWSRF (Clean Water State Revolving Fund).

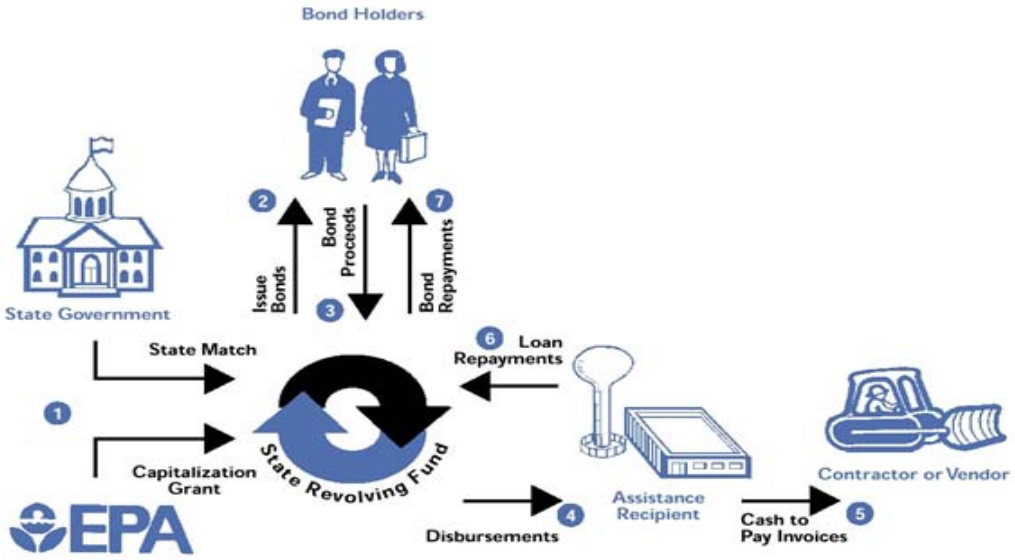
The Drinking Water State Revolving Fund (DWSRF) was established in 1996 by revising the Safe Drinking Water Act to ensure public drinking water quality through the improvement of water supply infrastructure

The Clean Water State Revolving Fund (CWSRF) is a revolving fund for clean water and was established in 1987 to protect surface water, wastewater treatment and management of non-point pollutants. The 51 CWSRFs provide more than $100 billion in funding for about 36,000 projects and are considered the most successful environmental finance programs to date (Curley, 2016).

3.2. Operating Structure of SRF

The operating structure of the SRF system can be represented as shown in <Figure 0>. Through funding from central and state governments or bond holders, SRF raises and provides funds on preferential terms to selected contractors or suppliers in accordance with the purpose and procedures of the project. The contractor or supplier will repay the funds at the preferential interest rate during the repayment period, and the fund redeem back to the bond holders.

Figure 4. Operating Structure of SRF



Source: EPA

According to EPA, thanks to the funds' revolving nature, the federal investment can result in the construction of up to four times as many projects over a 20-year period as a one-time grant. In addition, to the extent that a state uses fund in its SRF to secure bonds and then lends proceeds from the bonds for SRF-eligible activities, loan size is increased. This financing technique, called leveraging, is used by 28 states and provides funding that exceeds the contribution from federal capitalization grants. (Copeland et al., 2016)

3.3. Interest Rate and Process

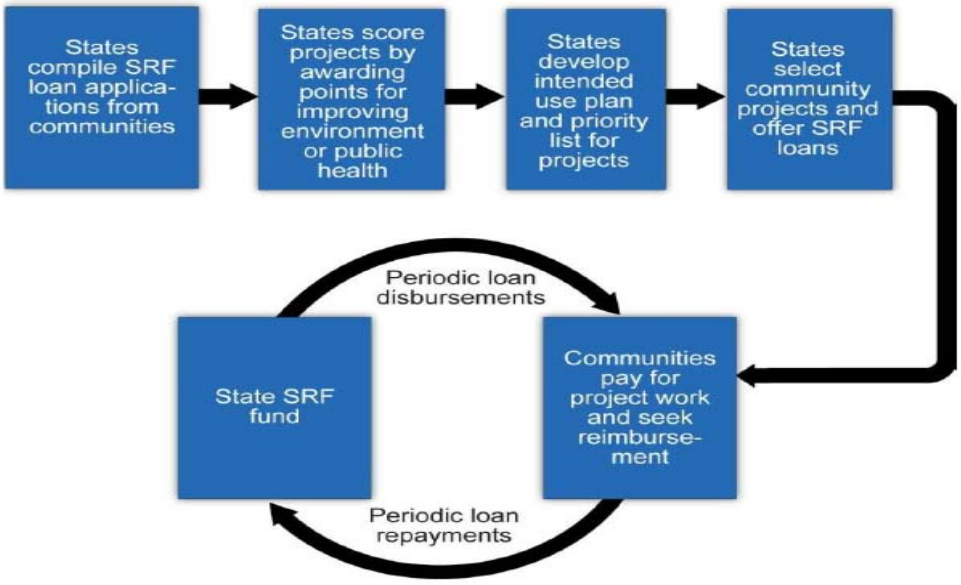
The SRFs are applied differently from state to state, and they appear differently in how they apply for subsidies and loan interest, but the basic flow is unified.

The DWSRF, a water supply sector, generally provides loans at interest rates of 2%, 3% and 4%, but 0% interest rate for at least $ 600,000 in the case of a disadvantage due to facility damage. If the facility is severely damaged, the repayment period can be extended by 10 years.

In the sewage sector, loans are provided at an interest rate of 3% in general, and interest rates are reduced to 1 to 2% in vulnerable areas. Under the SRF system, interest rates are significantly lower than those offered by the market economy, and the resulting cost savings are significant.

In order to promote SRF effectively, each state has provided a list of priorities for water and sewage projects to encourage them to receive priority assistance. Assistance based on the priority list has lower interest rates than other projects, and various loan terms, such as repayment period, are favorable, which may increase the effectiveness of the SRF project in terms of both state governments and contractors. Figure 0 shows a typical project application and payment process.

Figure 5. Project application and Payment Process in general SRF

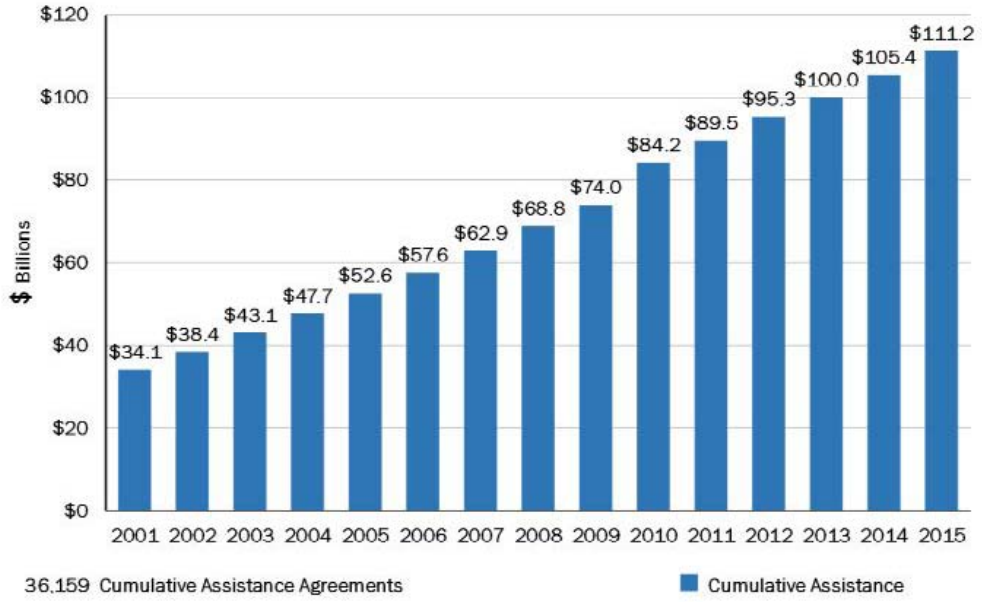


Source: Jones (2016)

3.4. Financial Structure and Assistance Types

According to EPA (2016a), during FY2015, the CWSRF provided $5.8 billion in assistance to eligible projects and over its lifetime, the program has provided $111 billion through over 36,000 assistance agreements. Cumulative assistance will continue to grow with Congressional appropriations, state matching funds, interest earnings, and loan repayments (EPA, 2016a).

Figure 6. Cumulative Assistance Scale



Source: EPA, 2016a

The DWSRF provided loans a total of $ 27.9 billion to 11,400 projects in local governments from 1997 to 2014, with cumulative federal investments totaling $ 17.3 billion, or about 62% of the total. (EPA, 2016b)

The types of assistance of DWSRF vary widely from loans, purchasing debt or refinance, guarantee SRF Revenue debt, providing loan guarantees, and additional subsidization.

EPA (2010a, 2010b) found that the types of assistance were shown in the order of water treatment, 42.8% water transmission and distribution, storage, water supply, etc.in water supply sector. For sewerage sector, there are 96.2% of sewage treatment, 0.2% non-point pollution source, and other projects.

3.5. Domestic Application and Success Requirements

The fact that the SRF is operating to replace and improve the existing water infrastructure has significant implications for the reinvestment for aging facilities in the domestic water and sewage sector.

The revolving fund system for water and sewerage projects requires a large amount of funding and operation over a long period of time, as shown in the previous sections. In order to operate the system, fund raising should be made first, and policy decision-making is necessary as it requires years of state financial input. Indeed, the SRF in the U.S. was also funded through more than a decade of state financial resources

Up until now, the state financial support for water and sewerage facilities has centered on the expansion of new facilities, but the current demand for investment in additional new facilities has significantly decreased, with the rate of water and sewage supply being 99.1% and 93.6% respectively. On the other hand, facilities that were initially invested and aged are not systematically managed from a long-term perspective and are not reinvested due to the difficulty

of financing. Therefore, the reinvestment assistance of small and medium-sized cities with poor financial resources should be converted to the reinvestment fund in the future. An in-depth approach is required as the reinvestment fund system requires a large amount of funding and operation over a long period of time.

To operate the SRF in the U.S., the fund was raised over more than 10 years and the loan repayment period is 20 to 30 years, so considerable amount of fund raising is necessary. Taken into these factors, it is clear that significant funding raising is needed for initial capital procurement and business operation, and a sophisticated operating system is vital to maintain the system for a long time in Korea. Successful establishment of the fund requires critical decision making among stakeholders in the water and sewerage sectors.

While domestic use is possible by supplementing the SRF's assistance standards, priority lists, and implementation guidelines, consideration should be given to the financing measures to reflect local specificities in Korea. In addition, it is necessary to revise standards and guidelines when applying in Korea and use them to meet the actual domestic conditions

V. Policy Implications and Recommendations

The nation`s water supply and sewerage business, which have been aimed at expanding the supply of water infrastructure, are in urgent need of investment as the cost of related disability is already high due to the aging of infrastructure facilities. As a result, state subsidy for deteriorated facilities was continued to increase. However, as huge financial resources for reinvestment is expected in the future, it is difficult to meet the increasing cost of reinvestment without preserving

financial sustainability. Therefore, financial resources for water infrastructure reinvestment need to be diversified in a way that ensures the sustainability of business other than state subsidy.

First, financing of reinvestment for water supply needs to increase financial accountability by utilizing local bonds. The use of local bonds is a more desirable alternative than government subsidies from higher governments in terms of financial accountability and project management. This is because the level of local bonds is not high yet, the local residents are responsible for the budget reduction compared to the state subsidies, and the annual financial burden and business progress become more transparent during the parliamentary passage process. The actual approval of local bonds in local council, however, is a very difficult task in reality, and the use of local bonds is once again limited by the central government's gross ceiling. Therefore, regulations on the use of local bond in water supply and sewerage projects need to be eased by excluding them from the total limit when preferential funding is required.

Second, in the case of sewage sector, long-term investment like sewer pipelines needs to be financed by private investment, including the existing BTLs. Water supply and sewage projects have a significantly lower financial risk than other SOCs, such as roads or railways, which has been a fundamental problem of private investment. However, since the law on private investment is actually the central government's authority, there is little scope for local governments to operate flexibly, and it is difficult to secure business feasibility due to low rates. These are acting as stumbling blocks of private investment in Korea. Therefore, in the case of sewage sector, with a significantly lower tariff, it is necessary to seek private investment in parallel with the tariff increase. In water sector, which has relatively low business risks among the central government's

candidates for private investment, it is necessary to ensure flexible operation and empowerment of local governments.

Third, public revolving funds need to be established and used as a way to increase the sustainability of financing water and sewage reinvestment. The SRF is considered to be the most successful environmental finance program to date, with cooperation from the central and federal governments to finance reinvestment in the water supply and sewerage sectors. In order to establish a fund system, policy decision-making is an indispensable prerequisite among stakeholders, as it requires long-term state investment. In addition, there is a need for a sophisticated funding system to manage significant financial resources over the long term and assistance standards and guidelines need to be applied to meet domestic conditions.

In order to secure fiscal soundness while maintaining water services that meet the expectations of the public, flexible use of financial resources should be possible. Under the current policy environment where securing financial resource for infrastructure is not easy compared to welfare resources, a wide range of funding attempts by municipalities is a viable alternative. Rather than relying entirely on state subsidies, it is crucial to establish a policy environment in which local governments can play a leading role by using various financing measures such as local bonds, private investments and the public revolving funds.

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