

A Study on the Renewal of the Local Water Usage Fee System in Korea
- Focused on improving the increasing block fee system -

By

MIN, Jee In

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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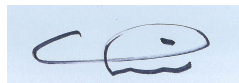
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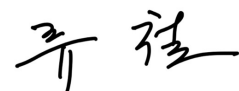
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ABSTRACT

A Study on the Renewal of the Local Water Usage Fee System in Korea

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By

Min, Jee-in

In this report, an improvement plan is proposed for the increasing block water usage fee system for households in consideration of recent socio-demographic changes, that is, the size of the number of members in each household and income level.

I would like to discuss the current status and problems of the household Increasing Block water usage fee system, which is a large part of the current local water usage fee system, and propose measures to improve management efficiency, such as improving the reliability of water usage fees and easing financial burdens of local governments through financial simulations and analyses.

As a result of the scenario analysis conducted in this report, it was found that there is a significant quantitative effect in terms of fee income and fee realization by adjusting the water usage level and unit price by stage. And through the improvement of the system suggested in this report, it is expected that the realization fee will be improved without a water usage fee increase, the fiscal income of local governments will increase, and the water usage fee equality for each household will be secured.

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1. Introduction

Based on the 2020 budget of Korea, the national debt of the central and local governments amounts to 805.2 trillion won which is 39.8 percent of GDP¹.

With the upcoming presidential election and the election of local government heads, and in addition to experiencing the unexpected COVID-19 pandemic, welfare demands in each sector of society are expected to increase and further worsen the soundness of the national fiscal management plan. Along with the recent intensification of climate change related-issues, the demand for water welfare, the most basic of the people's diverse welfare needs, has recently become more prevalent.

Water welfare is usually the basis for water supply indicators and sufficiency, safety and adequacy, accessibility, and appropriate price levels act as the basis for determining the level of water welfare. In particular, the Korea Waterworks Authority stipulates that “waterworks operators should establish a water service charge system based on reasonable cost calculations, make efforts to improve the water supply technology, induce water conservation, and ensure that cost and business continuity are included in the calculations.”

In addition, an increasing block water usage fee system has been implemented to achieve the effect of income redistribution by eliminating waste elements of water use and imposing the costs of providing water supply services proportionally to income.

As per the Local Public Enterprise Act (2), 116 of the 161 provincial waterworks are managed and operated by local public corporations² and they aim to pursue publicness through

¹ 2020 National Salim Budget Overview (Ministry of Strategy and Finance, 2020). The national debt is the sum of debts of the general government (central government, local governments) and does not include debts of public corporations and non-profit financial institutions and potential debts of social security systems such as pensions.

² Local governments with a daily tap water production capacity of 10,000m³ or more (Article 2 of the Enforcement Decree of the Local Public Enterprise Act).

corporate management by properly harmonizing public service outcomes and corporate sustainability.

Public service outcomes refer to continuous and reliable water supply services while corporate sustainability means ensuring adequate profitability for the reproduction of services by incorporating management mind concepts into the provision and funding of services to increase efficiency.

The public principle of quality tap water supply and improvement of public water supply services is aimed at improving water quality and securing a stable water supply, while rationalizing efficient and proper management practices for public organizations, manpower, investment projects and facilities.

Therefore, despite the efforts to secure publicness and public corporation sustainability, there are still many challenges to be addressed. Recently, due to aging infrastructure and public demand, significant investment is required for the modernization of facilities to prepare for the increase in water demand due to the improvement of living standards and to supply water in a more stable and equitable manner.

Given the limited financial capabilities of local public enterprises, general financial support is still needed, but considering budget constraints each local government face, more efforts to improve water supply services and ensure sustainable financing, which is to streamline management, are both required and inevitable.

2. Policy on Water Usage Fees

2.1 The significance of water usage fees in the water supply sector

Article 22 (1) of the Local Public Enterprises Act stipulates that "Local governments may collect water usage fee for investment by local public autonomous enterprises as prescribed by the Ordinance."

Water usage fee imposed by a local public enterprise are the consideration of goods or services provided by a local public enterprise that provides the basis for the operation of an independent profit-making system while also providing the principle of user burden.

Since local tap water consumers do not have any alternative options, the price elasticity of demand is small and the local tap water supplier itself provides exclusive services. Accordingly, if the water usage fee is not properly managed, there is the risk that business operators will act in self-interest and raise the water usage fee to earn exclusive profits.

In general, water usage fee in Korea are controlled according to the needs of the country's economic policy and price stabilization policy, and public regulations are imposed to maintain an appropriate water usage fee level to protect consumers from business operators who take advantage of their monopoly to maximize profits.

In addition, water usage fee in Korea are based on the compensation principle, so business operators are not allowed to pursue excessive profits. In other words, in the water supply business, even if the appropriate profits required to maintain a company's continuity are recognized, water usage fee policies aimed at maximizing profits are not acceptable.

This feature is aimed at determining the desirable price level for water usage, and is necessary not only to protect tap water consumers and ensure that they not only receive quality services at an appropriate price, but also to ensure that appropriate profits for business operators.

2.2 Determination of water usage fees

2.2.1 Determination of the level of water usage fees

2.2.1.1 Criteria for determining the level of water usage fees

According to Article 22 of the Local Public Enterprises Act, there are four criteria for determining fees for services provided by local public enterprises: adequacy of fee, equity between regions, cost compensation, and maintenance of corporate continuity. Appropriateness and equity between regions are in terms of publicness, and cost compensation and maintenance of corporate continuity can be explained as corporateness.

2.2.1.2 Appropriateness of water usage fees

Appropriateness of water usage fees means that service users must be able to receive services worth as much as they pay. This means that local public enterprises should not pursue maximum profits like private enterprises. Therefore, it can be said that the adequacy of water usage fee rates generally means a level at which the independent profit system can be maintained.

2.2.1.3 Equity between regions

Since local public enterprises are selected by each local government as business operators, the level of water usage fees are inevitably different depending on the difference in production costs. However, for balanced development between regions and the soundness of local finances, it is necessary to maintain equity between regions by narrowing the gap in fee as much as possible.

2.2.1.4 Cost compensation principle

Cost compensation presupposes an independent profit-making system for local public

enterprises, so expenses necessary for operation and services must be covered by income from their own projects. In terms of local water supply projects, water usage fees account for most of the operating income, so it is desirable to set the fees at least at a level capable of compensating for such expenses.

2.2.1.5 Maintaining corporate continuity

The water usage fees collected by local public enterprises should not only compensate for operation costs, but also maintain mid- to long-term continuity by securing sound management conditions of the enterprise.

In other words, even if excessive profits are not pursued like private companies, it is difficult to say that the balance on the simple income statement is '0', and appropriate capital costs are needed to continuously respond to demands, service improvements, and facility improvements. For this purpose, the Local Public Enterprises Act stipulates that capital costs are added to operating costs when calculating the water usage fees.

2.3 Charging methods

2.3.1 Types of water usage fee systems according to the charging standards

2.3.1.1 water usage fee system by usage

The water usage fee system classifies water users into various types such as residential, business, and industrial and distributes costs according to the industry, but applies different fee for each use or industry in Korea. The basis for applying differentiated fee depending on the user corresponds with the different burdens and policy considerations because demand elasticity varies depending the user type.

This method has the advantage of meeting the principle of control function and capacity burden for each user type, but it is difficult to classify clearly the various user types, resulting

in complaints from users about the application of differentiated fee for industries, and weak rational fee distribution arguments between industries and uses.

Therefore, problems such as complicated imposition of charges and arbitrary judgment may be involved in the process of policy setting for each industry type have been pointed out.

2.3.1.2 Water usage fee system by usage

The water pipe diameter water usage fee system is a method of determining charges in proportion to the diameter size of the water pipe provided to the user. In other words, water supply facilities are built with consideration of the maximum demand, and the amount of water that can be used by consumers at any given time depends on the current size of the installed meter, so it is a water usage fee system that differentiates usage fees depending on diameter of the meter.

While the water usage fee system by use is based on valueism, the water pipe diameter water usage fee system is based on individual costs and fee are determined based on flow fee, so it has the advantage of maintaining fairness in water usage fee sharing and providing relatively reasonable arguments for water usage fee determination.

2.3.1.3 A single water usage fee system

The single water usage fee system is a system that applies a single fee according to the amount of usage regardless of the user type of water or the size of the water supply pipe installed to each user. This fee system has the advantage of being easy for users to understand.

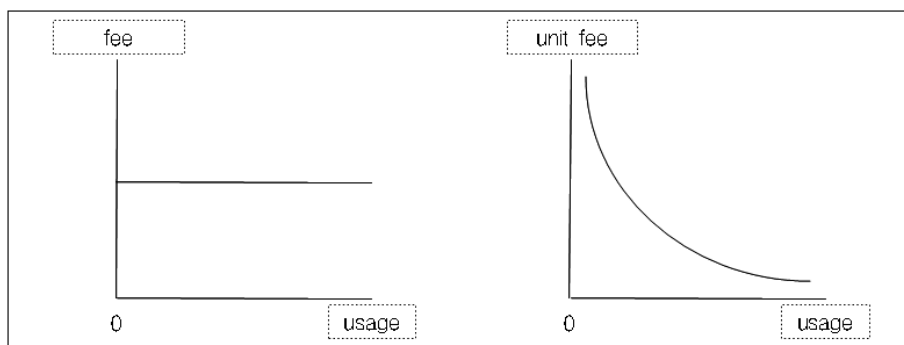
2.3.2 Classification of water usage fee systems according to fee application method

2.3.2.1 Flat fee

The flat fee system is a method of charging water users a certain amount at a predetermined fee regardless of the amount of water used. This method was widely used in developed countries until the 19th century when the quantity was abundant.

This method is convenient to collect fees and has a simple fee system. Although water can be used as much as possible if the consumer pays a certain amount, this method can lead to inefficient use of resources due to wasted water.

Figure 1: Principle of setting the flat fee



2.3.2.2 Two-part fees

The two-part usage fee system is a fee system that charges flat charges up to a certain level of use and applies a certain fee to usage exceeding that level. This system is the most widely applied fee system in reality. The flat fee here is also called the basic fee or the minimum fee, and unlike the flat fee system, the same flat fee is imposed only up to a certain level of water usage.

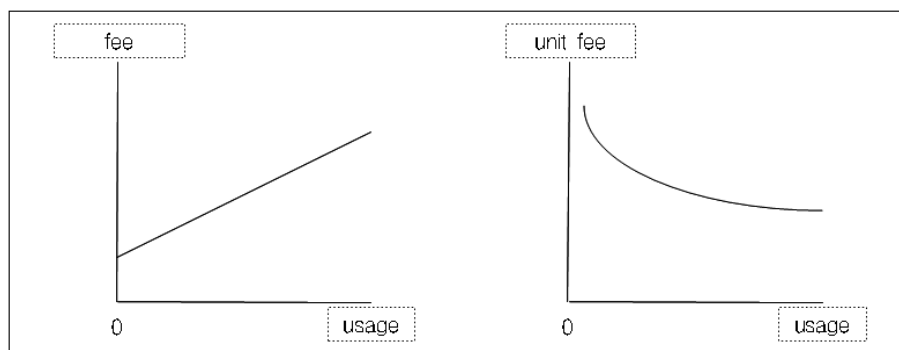
In consideration of the aspect of income redistribution, basic charges may be charged differently depending on the income level or property of users. This has the disadvantage in that fee calculations are more complicated. In this two-part fee system,

the establishment of the basic fee has an economic effect of inducing users to consume water corresponding to the basic fee.

This is because when dividing the basic fee by the basic quantity, it is common to set it much cheaper than the normal water fee (excess charge) used in excess of the basic quantity. Due to the modification of the basic fee system, a very low flat fee may be imposed on the basic quantity essential for life in terms of social welfare to support the low-income class, which is also called the life-line fee system.

In this case, the essential quantity used by the general public is supplied at a price below the cost to support low-income families, and the resulting decrease in income is generally passed on to mass consumers.

Figure 2: Principle of setting the fee for the two-part fee system



2.3.2.3 Uniform fee system

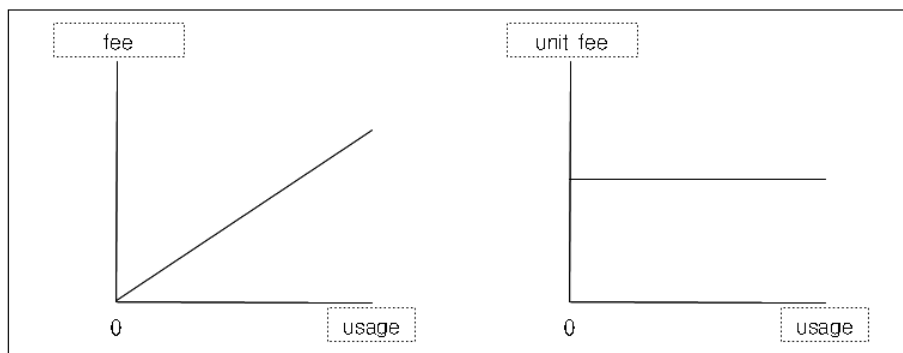
The single fee system is easy to calculate fee and is suitable for equity in burden and it is easy to secure financial resources. However, in terms of income redistribution, the ability of users to bear the costs is not considered at all.

This method has been adopted mostly in developed countries with high income levels. Among the utility bills in Korea, telephone bills, railroad bills, wide-area water usage fee of

the Korea Water Resources Corporation, and city gas bills have been adopted this method.

As for the fee application method, the fee per unit is first determined at the same level as the marginal cost, which theoretically values efficiency and maximizes social utility. In reality, even though the calculation process is simple, this method may have an adverse effect of increasing welfare costs.

Figure 3: Principle of setting the uniform fee system



2.3.2.4 Increasing block fee system

The structure of the increasing block fee system is that as water consumption increases to suppress water use, the fee per unit increases. This method is most widely applied in developing countries.

This fee system is based on the assumption that more income users will consume, and the higher the water consumption, the higher the fee per unit is applied. In terms of social welfare, this method is relatively progressive. The fee functions to induce cross-assistance between income classes by differentiating the application fee according to usage.

In the situation where water resources are insufficient, the application of the increasing block fee system imposes a higher fee per unit on water consumption, so a water saving effect can be expected.

On the other hand, the increasing block fee system has the disadvantage of weakening the function of representing prices if the usage stage is too subdivided. On the other hand, income redistribution and water saving effects cannot be achieved if not divided enough.

In addition, there are no clear standards for calculating the increasing fee, and there is inevitably an arbitrary judgment by the water supply business operator. Thus, complaints are likely to increase significantly if consumers believe the calculation criteria are not fair.

Figure 4: Principle of setting up the increasing block fee system

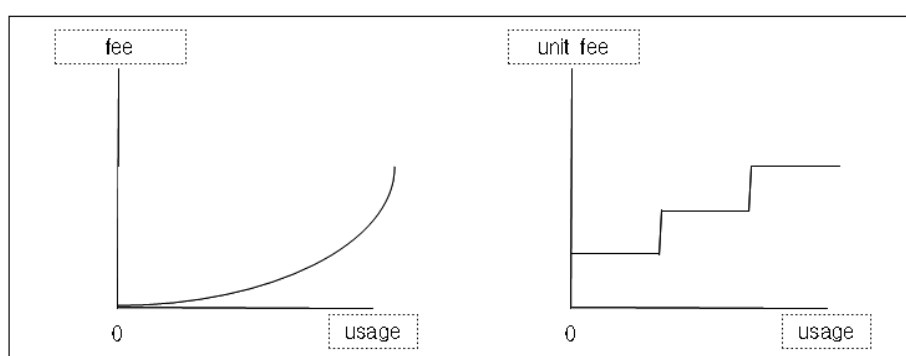


Table 1: Pros and cons of each fee system

Division	Pros	Cons	Note
Flat fee	<ul style="list-style-type: none"> • Fee income is stable • Convenient billing and collection 	<ul style="list-style-type: none"> • Cause water wastage • Unfairness in charge 	<ul style="list-style-type: none"> • Charge a certain amount regardless of consumption • Agricultural Water Charges (Past)
Uniform fee	<ul style="list-style-type: none"> • Fee burden is fair • Convenient billing and collection 	<ul style="list-style-type: none"> • Difficulty in redistribution of income • Instability of fee income 	<ul style="list-style-type: none"> • Telephone, railway bulk water, gas
Increasing block fee	<ul style="list-style-type: none"> • Reduce the burden of low-income families • Expect water saving effect 	<ul style="list-style-type: none"> • Fees are unfair • Disadvantages to users of large amounts of water 	<ul style="list-style-type: none"> • water, electricity
Fee system by use	<ul style="list-style-type: none"> • Differentiation is possible considering the ability to bear charges according to the industry 	<ul style="list-style-type: none"> • The industry classification standard is ambiguous • Standards for charges between industries is difficult to set up 	
Water pipe diameter fee system	<ul style="list-style-type: none"> • The standard for price discrimination is clear 	<ul style="list-style-type: none"> • Too much burden for small users 	

3. Status and Problems of the Domestic Water usage fee System

This report will focus on the problems of the increasing block fee system, especially the increasing block fee system for households

3.1 Status and Problems of the Domestic Water usage fee System

The increasing block fee system generally imposes an under-priced unit fee for consumption from the point of view of social welfare. As a result, cross-subsidies between income classes can be achieved.

The fundamental core of the increasing block fee system can be summarized in two ways. First, how to classify consumption. Second, how to set the price per unit.

3.1.1 Current status of the increasing block fee system for households

3.1.1.1 Water consumption per household and increasing block fee system stage

The monthly consumption of tap water per household is a key factor in the composition of the water fee system. Because the water fee system of most local governments applies the increasing block fee system for each usage stage, setting the usage section is the basis of the fee system. Furthermore, determination of the usage section based on the average monthly usage is the basis of the increasing block fee system. This is because it is easy for policy effects to be achieved.

The calculation of monthly tap water consumption per household can be done by multiplying the number of household members by the water consumption per person per day (ℓpcd). The average number of household members in Korea is 2.55. Furthermore, each person uses 282³ liters of water per day on average. Thus, the average monthly water consumption per

³ Waterworks Statistics 2019 (Ministry of Environment, 2019)

household is approximately 22m³.

As of 2018, if we look at the increasing block fee system stage on for each household use of local waterworks, 43 local governments (26.7%) have set the first-stage use section to 10m³, 113 local governments (70.2%) up to 20m³ and others appeared in 5 governments (3.1%). Meanwhile, Table 2 shows the fee multiple for each use section compared to the first stage.

Table 2: Fee multiplier by stage of use

Division		2 nd Stage	3 rd Stage	비 고
Compared to 1 st Stage fee multiple	average	1.4 times	1.9 times	
	medium	1.4 times	1.9 times	
	maximum	2.3 times	3.4 times	
	minimum	1.0 times	1.0 times	Uniform fee (Daegu, Ansan)

* Source: National Law Information Center, Ministry of Legislation

3.1.2 Changes in the composition of domestic household members

As can be seen in Table 3, the number of households in Korea in 2019 was 20,343,000, an increase of about 41% compared to 14,391,000 in 2000. In particular, the number of single-person households was 6,148,000 households, 2.76 times higher than the 2,224,000 households in 2000, and 5,663,000 households with two people, 2.07 times higher than the 2,731,000 households in 2000.

However, the number of households with four or more members was 5,232,000 households in 2019, 81.1% compared to 6,449,000 households in 2000. Overall, the key factor for the increase in the total number of households is not the increase in the population, but the sharp increase in the number of households with three or less members.

Table 3: Number of Households by Composition of Number of Household Members Nationwide

(Unit: thousand households)

Division		Sum	1 person	2 person	3 person	4 or more
1990		11,355	1,021 (9.0%)	1,566 (13.8%)	2,163 (19.0%)	6,605 (58.2%)
2000		14,391	2,224 (15.6%)	2,731 (19.0%)	2,987 (20.8%)	6,449 (44.8%)
2019		20,343	6,148 (30.2%)	5,663 (27.8%)	3,300 (16.2%)	5,232 (25.8%)
Increase or decrease (multiple)	2019-2000	1.41	2.76	2.07	1.10	0.81
	2019-1990	1.79	6.02	3.62	1.53	0.79

* Source: National Statistics Portal, Statistics Korea (KOSIS)

Looking at the proportion of the population by number of household members shown in Table 4, in 1990, households with four or more members accounted for 75.5% of the total population. 64.0% in the previous year and 47.1% in 2019, showing a sharp decline.

On the other hand, the proportion of the total population of one to two-person households increased from 9.5% in 1990 to 33.8% in 2019, while that of three-person households accounted for 19.1%. In other words, 52.9% of the total population is households with less than three people. As shown in Table 5, the average number of household members per household dropped 31.3% from 3.71 in 1990 to 2.55 in 2019.

Table 4: Population share by size of number of household members

(Unit: thousand households)

Division	Total population	Population and share of household types				
		1 person	2 person	3 person	4 or more	
1990	43,411	1,021 (2.3%)	3,131 (7.2%)	6,490 (15.0%)	32,768 (75.5%)	
2000	46,136	2,224 (4.8%)	5,461 (11.8%)	8,962 (19.4%)	29,488 (64.0%)	
2019	51,779	6,148 (11.9%)	11,326 (21.9%)	9,900 (19.1%)	24,405 (47.1%)	
Increase or decrease (multiple)	2019-2000	1.12	2.76	2.07	1.10	0.83
	2019-1990	1.19	6.02	3.62	1.53	0.74

* Source: National Statistics Portal, Statistics Korea (KOSIS)

Table 5: Average number of household members per household

(Unit: person/household)

Division	1990	2000	2019	Note
Average number of household members	3.71	3.21	2.55	

* Source: National Statistics Portal, Statistics Korea (KOSIS)

This change in household composition shows that policy changes are inevitable depending on the size of the household. In the public utility sector particularly, it is judged that it is urgent to change the water fee policy, which simply applies an increasing block fee system according to water consumption without considering the number of household members.

3.1.3 Income level in relation to the number of household members

The average number of household members in Korea is 2.55 as of 2019, and the average monthly disposable income per household is 3,941,000 won, representing an average income of 1,545,000 won per household member.

Looking at this more specifically for household type, it can be seen from Table 6 that the monthly average disposable income of households with 1 to 3 members is higher than that of households with 4 or more members.

Like the change in the composition of the number of household members, this also shows that it is necessary to improve the current increasing block fee system, in which fee benefits are provided to households with three or less members without considering the difference in income level by number of household members.

Table 6: Disposable income level by number of household members nationwide

(unit : thousand won)

Division	Monthly income	Average Income per Person	Note (Relative to average per person income)
Overall average	3,941	1,545	-
1 person	1,780	1,780	1.15
2 person	3,530	1,765	1.14
3 person	5,786	1,929	1.25
4 person	6,827	1,706	1.10
5 or more	9,445	-	-

* Source: National Statistics Portal, Statistics Korea (KOSIS)

3.2 Problems of the increasing block fee system for home use

The purpose of the introduction of increasing block fee system is to expect water saving and income redistribution effects by imposing a higher fee on consumers who use proportionately more water, but the problem arises that the increasing block fee system, which does not consider the purpose of use, has low effectiveness.

In the case of households that use a lot of water, the effect of the block water usage fee system may occur. However, in the current situation where more than 70% of local governments have set 20m³ as the first-stage use section, local governments estimate that a large number of low-income households will be included in the case of consumers belonging to the first-stage household, and low fee have been imposed for the first-stage household for a relatively long time.

However, as mentioned above, this fee system accounts for 53% of all households. As such, households with one to three members with relatively high incomes are charged a low fee since the first-tier fee is applied to them. On the other hand, despite the relatively low average income per capita, households made up of four or more people are charged high fees.

In other words, the current increasing block fee system is regressive⁴, which is why it can be said that it is directly achieving the opposite of what it was supposed to do when it was originally introduced.

In the current block water usage fee system, when the fee of the first stage is 100, the fee of the third stage is set at an average of 190 (maximum of 340). In addition, each stage should be set in consideration of the household composition and changes in the number of household members and income level by household. As mentioned, the current stage of use does not reflect these characteristics. There is a problem that the standard per ton for each stage is arbitrarily determined regardless of actual usage, and there is no rational basis for setting the weight applied to each stage.

Ultimately, the current domestic local water supply increasing block fee system for households does not reflect the characteristics of household member size and income level due to recent demographic and social changes, so it is designed to provide fee benefits to households with three or less members without any rational reason. Therefore, households with three or less members should be classified as a contributing group rather than a beneficiary of cross-subsidies.

In other words, since the average monthly income per person decreases as the number of household members increases, an increasing block fee system such as water and electricity utilities that charge a higher fee as the amount of usage per household increases is relatively high for households with a large number of members. Thus, it is an unfavorable system.

The basis for the implementation of the increasing block fee system is that a water saving effect is expected by applying a high fee for the large amount of water use. However, I would like to emphasize once again that the current increasing block stage standard has a large

⁴ A phenomenon in which people with lower incomes have a higher tax burden. The value-added tax is a representative tax of regression, and the progressive tax is a representative tax that is not regressive.

difference from the average water consumption per household, so it should not be expected that the water saving effect by the increasing block fee system will occur, and also the income redistribution effect cannot be expected due to the increase in income levels.

3.3 Literature Review

Hyeong-geun Lee (2005) argued in 『A Study on the Improvement of the Water Fee System in Seoul』 that the seasonal fee system should be introduced by reflecting this production cost structure because there are different demands for water depending on the season and thus the production cost of tap water is affected by season.

In addition, instead of abolishing the increasing block fee system in which the unit price is charged differently according to the usage stage, it is proposed to introduce a uniform fee system that charges the same unit price according to the usage, and emphasized the gradual increase in Seoul's water fees.

As a result of analyzing the recent household composition characteristics in 『A Study on Fiscal Burden by Increasing Block Water fee System』, Kwon Hyung-jun et al. (2013) found that the current increasing block fee system shows that the average income of a household with four or more members has the lowest average per capita income compared to households with fewer members. The study pointed out that these large household pay more in water fees and it was recommended that it was necessary to improve the household block fee system.

In this study from 2013, problems with the local water usage fee system were analyzed and several solutions were suggested such as the improvement of the increasing block fee system. However, it is disappointing that these previous studies did not provide a quantitative effect when the claimed policy was implemented.

4. Simulation Analyses and Policy Implications

4.1 Simulation Analysis Tool Design

4.1.1 Analysis sample

The basis for writing this report was the development of a simulation analysis tool for improving the household increasing block fee system.

First, considering that it is physically impossible to analyze all local water supply data nationwide for household tap water consumption and charge data from the middle group (250,000 to 400,000) local governments with the highest proportion of water supply population in local governments was used. Data collected in 2018 for Paju City, Gyeonggi Province, which is a representative local waterworks project operated by the Korea Water Resources Corporation, was used for this study.

Data corresponding to 26,823 households (18.1%) excluding apartments among 148,081 households were analyzed⁵. The usage fee charged to the households analyzed in 2018 was about 2.7 billion KRW, accounting for 19.4% of the total 13.9 billion KRW, similar to 18% of the number of samples, so representativeness is judged to be sufficient.

4.1.2 Analysis tool design

The variables for simulation analysis consisted of ① setting the usage section for each increasing block usage fee stage and ② setting the unit price for each usage section, and analyzed a total of 8 scenarios, as shown in Table 7 below.

According to the scenarios, before and after the fee system was reformed, the increase/decrease in fee revenue of local governments, fee realization, and fee realization

⁵ Excludes consumers who pay the entire bill in installments through multiple households reading a representative meter and those who do not use it

improvement effects can be expressed visually. In addition, since this analysis tool is designed to analyze any scenario as long as there is water usage charge data from local governments in Korea, it is considered to be highly useful for additional research in the future.

Table 7: Boundary: Paju City household increasing block fee system (adjustment of usage stage, unit price adjustment by usage stage)

Stage for increasing block usage fee		Stage 1-1 Block 1: Until 30m ³ /Mon Block 2: Over 30m ³ /Mon				Stage 1-2 Block 1: Until 39m ³ /Mon Block 2: From 40m ³ /Mon			
Fee level by usage stage	Block 1	S 2-1 Average unit fee	S 2-2 Average fee	S 2-3 Average fee	S 2-4 Unit fee without change for 4persons household	S 2-1 Average fee	S 2-2 Average fee	S 2-3 Average fee	S 2-4 Unit fee without change for 5persons household
	Block 2	S 2-1 Production cost	S 2-2 1.9times fee of Block 1	S 2-3 1.4times fee of Block 1	S 2-4 Production cost	S 2-1 Production cost	S 2-2 1.9times fee of Block 1	S 2-3 1.4times fee of Block 1	S 2-4 Production cost
Increase/decrease in fee income									
Increase/decrease in fee income by household		Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6	Exp. 7	Exp. 8
Fee income increase effect									

Figure 5: Simulation Analysis Tool (Microsoft Excel Sheet, in Korean)

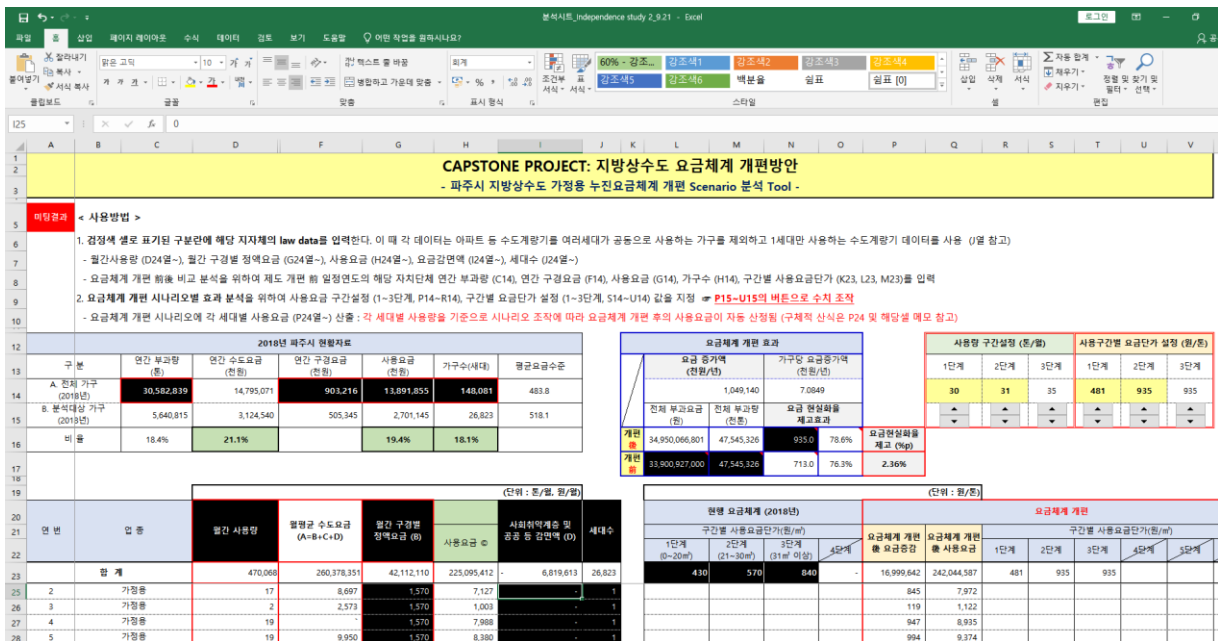
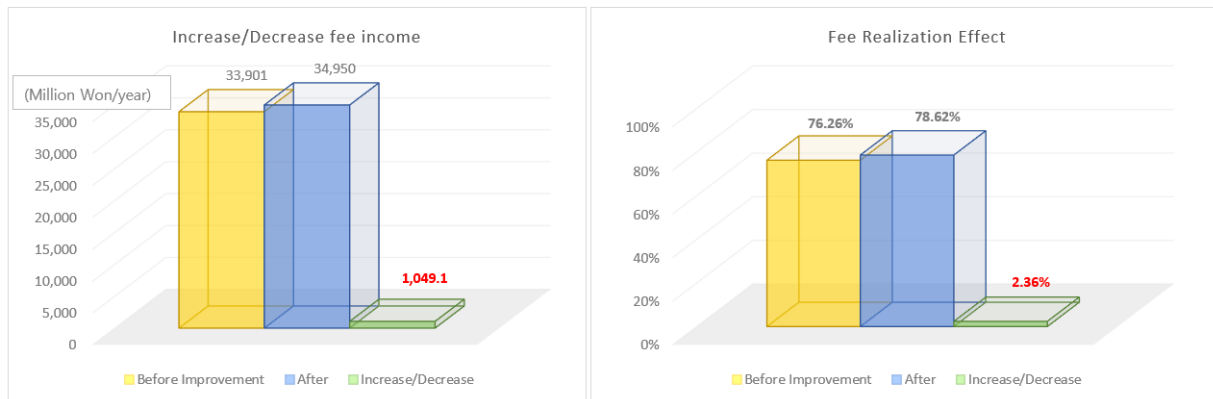


Figure 6: Fee system improvement effect graph (fee income increases and decreases and fee realization effects)



4.1.3 Scenario setting by variable

As mentioned above, the current increasing block fee system for households in the domestic local waterworks project does not reflect the change in the composition of household members due to the recent demographic and sociological changes, so the fee benefit goes to households with three or less members, while households with four or more have a higher burden for water usage fees.

Among 161 local governments across the country, 26.7% (43 districts) set the section setting for the first stage of household water usage that applies the lowest unit price to 10m³ or less, and 70.2% (113 districts) set the stage to 20m³ or less as has been mentioned previously.

Accordingly, the fact that the average income per person decreases as the number of household members increases is also inconsistent with the current increasing block fee system for households. I want to emphasize once again that it is difficult understand what decision-makers at the time expected when the system was first introduced.

Therefore, in this study, the usage interval scenario for the improvement of the household increasing block fee system is presented as follows.

First, based on the average income of each household, it is divided into households with three or less members, which are groups with more than average income, and households with four or more members. The burden of households with 4 or more who have been paying the increasing usage fee for stage 2 or higher up to now is slightly alleviated, but the benefits enjoyed by households with 3 or less members are slightly reduced due to the adjustment of the usage section and increase in the unit price for the first stage section.

If the standard usage in the first-stage usage section is set as the standard for a household of four, it will be necessary to secure objectivity in setting the usage in the corresponding section. It is judged that the most realistic way to secure objectivity is to use current waterworks statistics.

As of 2018, the daily consumption per person was 282 liters. If one person uses 282ℓ for 365 days, the monthly average is 8.58m³, and on the basis of a four-person household, the figure is calculated as 34.3m³⁶. If about 10% of the demand management target for inducing water conservation is given to this figure, the first-stage usage can be set to 30m³ or less per month.

The 2nd stage usage standard is set to more than 30m³ to secure a price signal for the so-called Super User, and the usage setting of the household increasing block system is completed in 2 steps. In addition, in order to analyze various scenarios, a scenario analysis that divides 39 m³ per month into stages 1 and 2 based on a five-person household is also carried out.

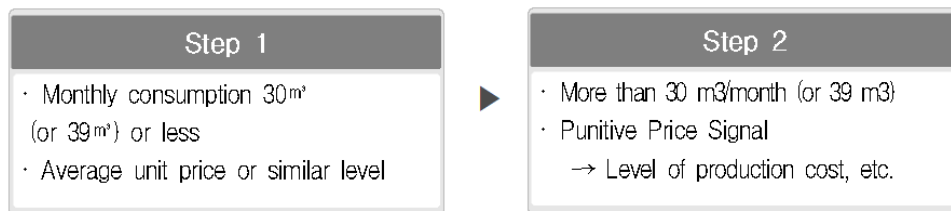
In this way, if the section is divided into two stages with less than 30m³ (or 39m³) and excess usage per month, the fee level for the first-stage usage section should, in principle, be at a level that can compensate for the operating cost for the average consumption of tap water.

In other words, it is necessary to adjust the fee at the lowest level of tap water use to be

⁶ 282ℓ/person/day × 365 days ÷ 12 months × 4 people = 34.3m³/month

at or close to the average unit price level. In addition, in the second stage section, in order to strengthen the price signal for water demand management, it is judged that a punitive unit price level should be applied, such as the overall cost level or the fee that applies between stages 2 or 3 to the average for households. However, even in this case, if the unit price of the second stage exceeds the production cost level, it is judged that it is desirable to set the fee within the production cost range, as it may face opposition from consumers.

Table 8: Improvement plan for increasing the block fee system for household water usage



4.2 Scenario Analysis on 2018 Single-Year Data for Paju City

By using the usage and fee status of the residential sector in Paju City in 2018, this study aims to analyze the effect of adjusting the unit price for each usage section and stage as suggested above.

As mentioned earlier, in order to increase the reliability of the analysis, households in which several households, such as apartments, pay the total bill in installments through a representative meter reading, or households without usage, were excluded from the data used for this study.

In other words, the analysis was based on households that paid their own bills individually. Accordingly, the total number of households analyzed using 2018 data was 26,823, or 18.1% of the 148,081 households using water for household purposes.

The usage section for each section is divided into two stages, with the first stage setting

up to 30 m³ per month and the second stage exceeding 30 m³ per month. The overall effect of the unit price adjustment for each usage section and stage is calculated by estimating the percentage of usage fee (19.4%) corresponding to the target price as the total usage fee size.

Table 9: Current status of water usage charges for households in Paju City (2018)

(Unit: 1,000m³, million won)

Division	Charged amount	Usage fee	Number of households	Step-by-step usage section and unit price
All	30,583	13,892 (100.0%)	148,081	Stage 1 : 0~20m ³ : 430 Won/m ³ Stage 2 : 20~30m ³ : 570 Won/m ³ Stage 3 : 30~: 840 Won/m ³
Analysis target	4,969	2,701 (19.4%)	26,823	

* Source: K-water Water INFos (Paju Water Management Group, 2018)

4.3 Quantitative Effectiveness of the Research

4.3.1 (Scenario 1) Stage 1: Average unit price, Stage 2: Production cost

In Scenario 1, the unit price for the first stage was set at 481.0 won/m³, which is the average unit price for households in Paju, and the fee for the second stage was analyzed by setting the production cost of 935.0 won/m³ for the previous year.

As a result of the analysis, it appears that the usage fee income increases by 1,049 million won per year, which is equivalent to a 7.1% increase in the household fee and the effect of raising the fee realization of the Paju waterworks project by 2.3%.

In this case, it was analyzed that the average monthly fee burden of 590 won⁷ per month for consumers in the residential sector in Paju City increased.

According to the first-stage usage section and fee unit price adjustment, there was relatively little change in the fee burden for the four-person household using the monthly level

⁷ Usage fee increase (KRW 1,049 million) ÷ Number of households (148,081 households) ÷ 12 months

of 30m³. However, in the case of households with one to three people who used less than 20m³ per month, the charge burden increased slightly.

As pointed out earlier, it was found that the existing household increasing block fee system overcomes the problems of equity and income redistribution and contributes to the improvement of water supply management. For reference, if the first-stage usage section is set to 30m³, the unit price level at which the cost burden of a four-person household using 30m³ per month does not change is 476.7 won/m³⁸.

Table 10: Improvement of the Increasing Block Fee System for Household Water Usage (Scenario 1)

(Unit: Won/m³, million Won)

Division	Stage 1	Stage 2	Stage 3	Usage fee	Home use Average price	Fee realization Rate
	water consumption(m ³ /month)					
	unit price(won/m ³)					
Current system (a)	until 20	until 31	from 31	13,892	483.8 ⁸⁾	76.3%
	430.0	570.0	840.0			
Scenario 1 (b)	until 30	from 31	-	14,941	518.1	78.6%
	481.0	935.0	-			
(b-a)	10	-	-	increase	increase	increase
	51.0	365.0	-	1,049	7.1%	2.3% p

4.3.2 (Scenario 2) Stage 1: Average unit price, Stage 2: 1.9 times the fee of Stage 1

In Scenario 2, the unit price of the first stage was set at 481.0 won/m³, which is the average unit price for households in Paju City, and the unit price of the second stage was set at 931.9 won/m³, which is 1.9 times the fee of the first stage. The reason that the unit price of the second stage was set at 1.9 times that of the first stage was based on the average and median unit price⁹ of the second and third stages of the current local waterworks household water usage.

⁸ $(20\text{m}^3/\text{month} \times 430 \text{ KRW}/\text{m}^3) + (10\text{m}^3/\text{month} \times 570 \text{ KRW}/\text{m}^3) = 481 \text{ KRW}/\text{m}^3 \times x$ (unit price without change in charge burden)

⁹ Household 1st and 2nd stage unit price multiple: average 1.4 times, median 1.4 times, maximum 2.3 times.

As a result of the analysis, it appears that the usage fee income increases by 1,003,000,000 KRW per year, which has the effect of raising the household fee by 6.8% and raising the fee of realization of the entire water supply fee in Paju City by 2.2%.

In this case, it was analyzed that a household's monthly bill burden increased by about 565¹⁰ won. According to the first-stage usage and fee adjustment, the bill burden of a four-person household using 30 m³ per month is almost the same, but less than 20 m³ per month. For households with three or less people, the fee burden will rise slightly.

Table 11: Improvement of the Increasing Block Fee System for Household Water Usage (Scenario 2)

(Unit: Won/m³, million Won)

Division	Stage 1	Stage 2	Stage 3	Usage fee	Home use Average price	Fee realization rate
	Water consumption(m ³ /month)					
	Unit price(won/m ³)					
Current system(a)	until 20	until 31	from 31	13,892	483.8	76.3%
	430.0	570.0	840.0			
Scenario 2(b)	until 30	from 31	-	14,895	516.6	78.5%
	481.0	913.9	-			
(b-a)	10	-	-	increase	increase	increase
	51.0	343.9	-	1,003	6.8%	2.2%

4.3.3 (Scenario 3) Stage 1: Average unit price, Stage 2: 1.4 times the fee of Stage 1

In Scenario 3, the unit price of the first stage was set at 481.0 won/m³, which is the average unit price for households in Paju City, and the unit price of the second stage was set at 673.4 won/m³, which is 1.4 times the fee of the first stage.

The reason that the unit price of the second stage was set at 1.4 times that of the first stage was based on the average and median unit price of the second and third stages of the current local waterworks household water usage.

Household 2nd and 3rd stage unit price multiple: average 1.9 times, median 1.9 times, maximum 3.4 times

¹⁰ Usage fee increase (KRW 1,003 million) ÷ Number of households (148,081 households) ÷ 12 months

As a result of the analysis, it appears that the usage fee income increases by 482,000,000 KRW per year, which has the effect of raising the household fee by 3.2% and raising the fee of realization of the entire water supply fee in Paju City by 1.0%. In this case, it was analyzed that a household's monthly bill burden increased by about 271 won ¹¹

Table 12: Improvement of the Increasing Block Fee System for Household Water Usage (Scenario 3)

(Unit: Won/m³, million Won)

Division	Stage 1	Stage 2	Stage 3	Usage fee	Home use average price	Fee realization rate
	Water consumption(m ³ /month)					
	Unit price(won/m ³)					
Current system(a)	until 20	until 31	from 31	13,892	483.8	76.3%
	430.0	570.0	840.0			
Scenario 3 (b)	until 30	from 31	-	14,374	499.5	77.3%
	481.0	673.4	-			
(b-a)	10	-	-	increase	increase	increase
	51.0	103.4	-	482	3.2%	1.0%

4.3.4 (Scenario 4) Stage 1: 476.7 won/m³, Stage 2: production cost

In Scenario 4, the unit price of the first stage was 476.7 won/m³ and the unit price of the second stage was 935.0 won/m³, and the production cost of the previous year were analyzed.

The reason that the unit price for the first stage is set at 476.6 won/m³ is because the unit price for a four-person household does not change when the usage section for the first stage is set to 30m³

As a result of the analysis, it appears that the usage fee income increases by 934,000,000 KRW per year, which has the effect of raising the household fee by 6.3% and raising the fee of realization of the entire water supply fee in Paju City by 2.1%. In this case, it was analyzed that a household's monthly bill burden increased by about 525 won¹².

¹¹ Charge increase (482 million won) ÷ Number of households (148,081 households) ÷ 12 months

¹² Charge increase (934 million won) ÷ Number of households (148,081 households) ÷ 12 months

Table 13: Improvement of the Increasing Block Fee System for Household Water Usage (Scenario 4)

(Unit: Won/m³, million Won)

Division	Stage 1	Stage 2	Stage 3	Usage fee	Home use average price	Fee realization rate
	Water consumption(m ³ /month)					
	Unit price(won/m ³)					
Current system (a)	until 20	until 31	from 31	13,892	483.8	76.3%
	430.0	570.0	840.0			
Scenario 4 (b)	until 30	from 31	-	14,826	514.3	78.4%
	476.7	935.0	-			
(b-a)	10	-	-	increase	increase	increase
	46.7	365.0	-	934	6.3%	2.1%

5. Conclusions and limitations of the study

The original purpose of introducing the Increasing Block fee system was to expect water saving and income redistribution effects by charging higher fees to consumers who use a lot of water. However, the problem with the uniform increasing block fee system is that does not consider the purpose of usage is not effective is raised which distribution or water savings, and the arbitrariness of water service providers is greatly intervened in the fee determination for each progressive section.

In the case of households with high water consumption, the increasing block fee system may be effective, but in the situation where local governments that set 20m³ as the first-stage when the use section exceeds 70%, lower fees have been imposed for the first-stage water consumption from the past to the present.

As mentioned earlier, the relatively high-income households consist of less than 4persons, which account for 54% of the total households, pay the first-level at a cheaper fee, and the reality is that the fee is being passed on to households with four or more members with a low average per capita income. In other words, the current increasing block fee system is regressive¹³ and this is the reason why it can be said that it is directly contrary to the purpose of introducing the increasing block fee system.

Considering the recent trend of increasing households with three or less members and the income level of households by number of members, local governments have abolished the increasing block fee system and introduced the uniform fee system. It can be confirmed that the reason for the abolition of the Increasing Block fee system is that it can also reduce administrative waste such as household division work that has been derived from the abolition of the increasing block fee system.

¹³ A phenomenon in which people with lower incomes have a higher tax burden. The value-added tax is a representative tax of regression, and the progressive tax is a representative tax that is not regressive.

As of 2018, the fee of realization of water fees was only 77.5%, and domestic households only pay 62% to 82% of the appropriate water usage fees.

Looking at the household tap water use section in metropolitan cities, Busan City sets the lowest average water use per household as 0 to 10m³ per month¹⁴, setting the upper limit for the average use of single-person households. In case of Incheon, Gwangju, Daejeon, and Ulsan, they sets the minimum usage section as 0-20m³ for monthly usage, and sets the average usage for two people as the upper limit of the lowest usage section.

It should be noted here that households with two or less members living in local governments where the average usage of households with two or less is applied as the minimum usage section compared to households with three or more (59.5-78.2% of average water bill).

As such, the average monthly water consumption per household in Korea is 30m³, which is the standard amount for a three-person household. By setting the lowest section to 10m³ or 20m³, which is lower than the 30m³ that can be used by a three-person household, single-person households or two-person households with high income levels pay low fees.

The continuous increase in the number of households with one to three members increases the number of households belonging to the lowest water fee range in terms of tap water usage. As a result, this proves that the cross-subsidy phenomenon from households with four or more to households with three or less is increasing.

In general, while applying a household fee that is much lower than the production cost, the setting of a water consumption section that does not reflect socio-demographic conditions such as changes in household composition causes side effects in terms of fees.

¹⁴ The reason why the water use section is set at 10m³ per person is because the current local governments have designed the use section in stages based on the amount of water supplied per person per day (335ℓ as of 2015), and the actual water use section per person is 1 day per person. It is desirable to apply the amount used (282ℓ as of 2015)

Along with the problems of the increasing block fee system, the low cost recovery fee of local water fees acts as a budget subsidy from the central government every year. The size of the subsidy in 2018 was 931.9 billion Won, which is a huge amount that is equivalent to the annual salary of 38,800 office workers with a monthly salary of 2 million Won.

Table 14: Unrecovered amount due to the increasing block fee system for household water bills (2018)

(Unit: million won)

Fee application standards	Number of households using increasing block fee system	Unrecovered amount ¹⁶⁾		
		Sum	Metropolitan city	Etc
Current fee (realization rate 77.5%)	Households of 3 or less	440,124	193,802	246,322
	Total number of households	299,999	132,100	167,899

* Source: Waterworks statistics for 2018 (Ministry of Environment, 2019), National Statistics Portal of Statistics Korea (KOSIS)

The increasing block fee system failed to recover the annual cost of 440.1 billion KRW while supplying tap water at fees that are too low for households of three or less in a situation where water fees were not realized. In terms of total households, even considering the relatively high cost of “cross subsidy” for households with four or more members, it is not possible to recover the cost of about 300 billion KRW per year.

In this report, an improvement plan was proposed for the increasing block fee system for households in consideration of recent socio-demographic changes, that is, the size of the number of members in each household and income level.

As a result of the scenario analysis conducted in this report, it was found that there is a significant quantitative effect in terms of fee income and fee realization by adjusting the water usage level and unit price by step.

¹⁵ Estimated based on the comparison value (127.1%) of the household water fee income of other local governments (932.8 billion KRW) and the special city household water fee income (734.1 billion KRW)

However, it is a big disappointment that the study on the acceptability of stakeholders for such system reform was not dealt with, and it is considered that additional research is needed in the future. In addition, it is considered that additional research on the amalgamation and abolition of water usage and adjustment of the unit price for each usage type should be additionally conducted.

The reality is that it is very difficult to implement an increase in water fees based on production costs due to external factors such as local government political considerations and resistance by residents. Through the improvement of the system suggested in this report, it is expected that the realization fee will be improved without a fee increase, the fiscal income of local governments will increase, and the fee equality for each household will be secured.

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Appendix

Appendix 1. Increasing Block Fee System Improvement Simulation (Micro Soft excel sheet) Interface

