Analysis of Korean and Global Indicators and Policy Proposal for Sustainable Development Goals: Focusing on the Water Sector

By

MIN, Jungeun

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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Abstract

Climate change has emerged as a serious challenge for South Korea in terms of sustainable water management and is demanding changes in the water management policies. Since the severe drought that occurred in Chungcheongnam-do and Gangwon-do in 2016, I learned that Korea is no longer immune to drought. Furthermore, I recognized the need for a sustainable water management policy to achieve the UN SDG, which aims to ensure access to safe water for everyone. In this context, this study analyzes the results of recent studies on sustainable development goals and the Goal 6 Target established by the UN. In addition, it compares and analyzes SDGs global indicators and Korea's K-SDGs indicators in the water sector. Each indicator reviews the level of implementation in South Korea and presents complementary indicators suitable for the current situation. In conclusion, in order to improve areas with low SDGs performance, this study proposes a policy direction focusing on water infrastructure public projects in South Korea.

Keywords: Sustainable Development Goals, Water Management Policies, Climate Chan ge, Water and sanitation, SDGs Indicators

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I. Introduction

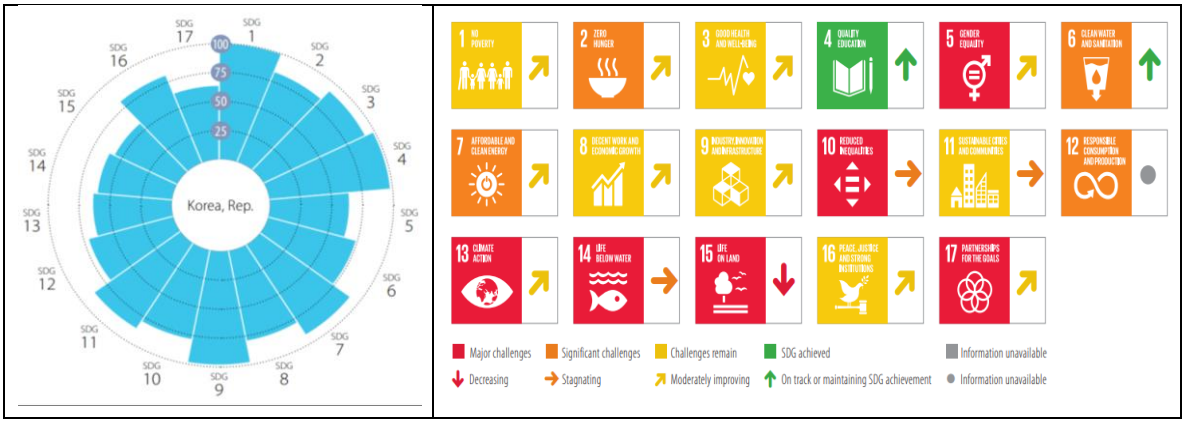
Water problem in Korea. Korea was once recognized as a water-rich country, but the resource became increasingly scarce due to the rapid economic growth process, and water quality, especially of rivers, deteriorated due to industrialization. And as a result of much effort in investing in water infrastructure since the 1970s, 16 large-scale multi-purpose dams have been built, and the supply rate has reached more than 97%, allowing water to be used freely anytime, anywhere. However, unlike these external indicators, Korea still has the risk of water shortages. Based on precipitation, Korea has been experiencing a serious level of drought every five to seven years over the past 30 years. Nevertheless, water scarcity has not emerged as a serious social problem because efficient water management has been carried out through the establishment of infrastructures such as multi-purpose dams that can store enough water during the drought.

Meanwhile, Climate change has emerged as a serious challenge for sustainable water management in Korea and is demanding changes in water management policies. In the past, droughts were caused by small precipitation in winter and spring. In recent years, however, there has been less rain in summer, causing serious droughts in certain areas. The severe droughts that occurred in Chungcheongnam-do and Gangwon-do in 2015 and 2016 indicated that South Korea was no longer a drought-safe country and provided an opportunity to recognize the need for a sustainable water management policy to achieve the UN sustainable development goals.

Low level of implementation in SDGs water sector. Since the UN adopted the Sustainable Development Goals in 2015, it has been evaluating the implementation status for member countries, and the level of SDGs implementation in the Korean water sector has

been low. According to the 2021 Sustainable Development Report (SDSN, 2021), SDGs performance score of Korea is 78.6 out of 100. In particular, Goal 6 (Clean water and sanitation), which will be covered in this study, is "Significant Challenges" and has low performance levels. In order to implement UN-SDGs tasks in the water sector, government ministries and the public and private sectors need to monitor, continuously improve and supplement the performance of SDGs.

Figure 1. SDGs Implementation Progress in South Korea



Note: Reprinted from 2021 Sustainable Development Report, by UN Sustainable Development solution Network (2021).

Lack of research on Goal 6 (Water sector). Previous studies have mentioned the need for a comprehensive public role related to sustainable development goals, but there are limited studies on domestic implementation status and specific implementation methods for each Goal6 target. Therefore, in this study, I will compare the global and Korean indicators of Goal 6 and present complementary indicators suitable for the Korean situation. In addition, by evaluating the level of Korea for each indicator, I will consider the water infrastructure policy goals and propose the public role and vision in connection with Goal 6.

This study is largely composed of five chapters. The first chapter introduces the background and purpose of the study. The second chapter will analyze the results of recent

studies on various fields of sustainable development goals through previous studies and by Goal 6 Target established by the UN. The third chapter will compare and analyze SDGs' global indicators and K-SDGs indicators in the water sector. In addition, the fourth chapter will review the level of domestic implementation and present complementary indicators suitable for the Korean situation. In addition, in order to improve areas with low performance, I will present policy directions focused on water infrastructure public projects in South Korea.

II. Literature Review

2.1. Review of previous studies related to sustainable development goals

At the 2015 UN General Assembly, member states agreed to implement 17 Sustainable Development Goals and 169 targets by 2030. Against this backdrop, to better achieve the goals, South Korea also stipulated the definition of sustainable development and the legal basis for national and local implementation plans in related laws[1]. In addition, a 20-year "Basic Plan for Sustainable Development" was established every five years. In 2020, the Korean government established the "4th Basic Plan for Sustainable Development," K-SDGs, after deliberation by the Sustainable Development Committee and the Green Growth Committee. The plan includes on five strategies: "Implementing an inclusive society where everyone can live like a human by 2030, preserving a clean environment enjoyed by all generations, improving the quality of life, building human rights protection and inter-Korean peace, and global cooperation," and consists of a total of 122 targets and 214 indicators.

Among them, "Water and sanitation" was a sub-goal belonging to the Goal 7 (Sustainable Environment Conservation) in the Millennium Development Goals (MDGs) of UN, which is a development goal from 2000 to 2015, but was adopted as a separate goal in the new agenda, Sustainable Development Goals (SDGs). Notably, water was selected as an independent agenda in the field of environmental conservation because it is an indispensable factor for human life around the world, and safe water use is a basic right for everyone and is closely related to climate change, a key medium and serious problem for sustainable development.

[1] The Sustainable Development Act (Act No.13532) and the Framework Act on Low Carbon Green Growth (Act No.16646)

However, in South Korea, while there are various studies focusing on Goal 4 (Quality education), Goal 5 (Gender equality), and Goal 13 (Climate action), there has not been much research on the water infrastructure development.

Research conducted mainly on Goal 6 by SDGs in South Korea includes "Kim (2021)" and "Lee & Hong (2015).” In a study by Kim (2021), focusing on the indicators presented by the UN, the evaluation index for each sector was measured by dividing by detailed goals in the water resource sector, energy sector, and food sector of Asian countries. Based on these results, investment priorities were suggested for 16 developing countries, including ASEAN countries. In addition, in the study of Lee & Hong (2015), new indicators were derived through principal component analysis to present the direction of water-related ODA. Through this, a plan to support international development cooperation centered on the Korean water sector was proposed.

2.2. The goal and target related to the water Sector

This chapter will examine in detail the target of Goal 6. The UN emphasized the accessibility and sustainability of everyone in the water through Goal 6, which consists of a total of 8 targets.

Target 6.1 and Target 6.2 discuss universal access to drinking water and Sanitation. Target 6.1 (Drinking water) emphasizes the safe and affordable accessibility of everyone, including vulnerable groups and rural areas, by 2030, and suggests that continuous monitoring is necessary for this. Target 6.2 (Sanitation and Hygiene), like the water sector, emphasizes the proper supply of hygiene facilities to everyone.

Target 6.3 and Target 6.6 involve securing clean and safe water sources. Target 6.3 (Water Quality) focuses on measuring and managing the amount of pollutants flowing into the river,

reducing the untreated sewage ratio, and improving water quality by reusing sewage. Target 6.6 (Ecosystems) aims to expand conservation areas, installation and monitoring of conservation facilities to protect water-related ecosystems such as forests, swamps, rivers, groundwater layers, and lakes to establish a sustainable use system.

Target 6.4 and Target 6.5 aim to secure sustainable water sources. Target 6.4 (Water use and scarcity) is to ensure substantial increase in water efficiency, water security, and sustainable intake and water supply by 2030. Specifically, it aims to significantly increase water efficiency and solve water shortages through water supply chain improvement, sewage reuse, and seawater desalination. Target 6.5 aims to maximize flood and drought coping ability by linking existing dams and rivers through "Transboundary cooperation" and "Integrated water resources management." The UN defines "Integrated Water Resources Management (IWRM)" as "more efficiently considering the use of all water resources" and has the meaning of a process, not a means or its own goal.

Target 6.a and Target 6.b are about strengthening international cooperation and community participation support in the water sector. Target 6.a (Cooperation) states increasing international cooperation and capabilities through water harvesting, sewage treatment, recycling, and seawater desalination technologies sharing to increase efficiency and secure water resources. International cooperation refers to activities in which the international community jointly promotes the economic and social development of developing countries through various cooperation methods such as development aid, other public funds, export credit, and private investment (Molit, 2014). Target 6.b (Particulation) states that when establishing policies related to water and sanitation improvement, participation with the local community is required in the entire process of decision-making, such as prioritization, planning, implementation, and monitoring.

Overall, it can be seen that the sustainable water management of SDGs is subdivided for each purpose. Furthermore, this study will analyze the differences between global and Korean indicators in terms of public infrastructure in the water management by category and propose policy directions and tasks for public projects on water infrastructure to improve the level of implementation and insufficient indicators in South Korea.

III. Analysis of South Korea and Global Indicators in the Water sector

Accurate indicators and data are very important to use as practical tools for SDGs implementation. The UN presents 11 indicators for Sustainable Development Goal 6. The Korean government has also established National Sustainable Development Goals (K-SDGs) to be implemented for 20 years to promote the implementation of international agreements on sustainable development and national sustainable development. However, it was difficult for this plan to include all targets and indicators for the 17 goals across all areas of society, environment, and economy, and was established on the premise of continuous revisions and supplementations. Accordingly, it is necessary to supplement and modify measurement indicators suitable for the Korean situation.

3.1. Korean Indicators (K-SDGs)

In 2018, the Ministry of Environment established K-SDGs, which set visions, goals, targets, and indicators for sustainable development. K-SDGs are also linked to UN-SDGs, reflecting domestic conditions, and have established 122 targets, as compared to the 169 UN-SDGs. Indicators for each target will be analyzed in detail by comparing them with global indicators in the next chapter.

Figure 2. A comparison between UN-SDGs and the 4th K-SDGs

Institution	Final year	Goal	Target	Indicator
UN-SDGs	2030	17 goals	169 targets, Society (25%), Economy (30%), Environment (24%), Others (21%)	232
K-SDGs	2030	17 goals	122 targets, Society (29%), Economy (292%), Environment (25%), Others (17%)	214

Note: Adapted from the 4th Basic Plan for Sustainable Development 2021-2040, by Korean government (2020).

Establishing perfect targets and indicators in all 17 target fields in a short period of time has practical limitations. In the case of the UN, for example, it took about 15 years to reorganize MDGs into SDGs, and detailed indicators are still being established. On the other hand, the K-SDGs were established within about a year, with 71 unfinished indicators, and no statistical calculation methods. Indicators of domestic standards presuppose continuous revisions and supplementations.

Figure 3. The 3rd K-SDGs incomplete Indicator

Reason for incomplete.	Indicator	Complementary plan
The final target values has not been set	45	Set the final target value through social consensus
No statistical calculation method	26	After developing a statistical calculation method, set the final target value

Note: Adapted from the 4th Basic Plan for Sustainable Development 2021-2040, by Korean government (2020).

3.2. Comparison of South Korea and global indicators by category

This study aims to analyze the indicators published by three leading organizations in the world's water field. Global indicators for measuring SDGs implementation have been announced by several organizations, including the UN Statistical Commission, Sustainable Development Solutions Network, and UN-Water. Here, global indicators are joint goals for all member countries, and complementary indicators for each country can be set by individual countries according to the state capabilities or degree of development.

The first global indicator was released by the UN Statistical Commission. This global indicator was developed by an IAEG-SDG on SDGs indicators and was first agreed upon at the 48th UN Statistical Committee meeting in 2017. However, the global indicator framework is improving every year and will be reviewed comprehensively again at the 56th UN Statistical Committee in 2025 (UN Statistics Division, 2021). In particular, in the water field, a lot of

discussions are still needed on the measurement methodology of indicators and the availability of data to monitor the implementation of sustainable development goals. In other words, the development of measurable indicators that are accurately related to each goal is still underway.

Second, in 2015, the Sustainable Development Solutions Network (SDSN) presented a total of 100 global monitoring indicators to measure SDGs implementation status. SDGs indicator monitoring work of SDSN serves to complement the formal monitoring of the UN Statistical Commission. SDSN cooperates with various organizations to check the progress of SDGs achievement at the national and regional levels. Official and informal indicators are used to measure the rate of achievement of each SDG goal to identify the priorities of actions to achieve SDGs by 2030, understand key implementation tasks, track progress, ensure accountability, and identify gaps between countries. The global edition of the SDG index and dashboard has been published annually since 2016 by SDSN and Bertelsmann Stiftung.

Third, UN-Water is a mechanism of cooperation between UN agencies on all freshwater and hygiene-related issues. UN-Water focused on the development of indicators of Target 6.6 for SDGs for water in a report titled "A Compensation of Expert Advice on Water and Sanitation Related Indicators Coversing Targets 6.1 to 6.6 and 11.5 (2015)." This report was derived from a wide range of technical consultations between UN member states and partners of UN-Water and among water experts and other stakeholders, consisting of key and several supplementary indicators. Throughout the SDGs implementation period, the development of complementary indicators will continue in response to new issues, the situation of member states, and the application of new measurement methods.

3.2.1. Analysis of "Accessibility to Water and Hygiene" Indicators

Figure 4. Comparison of global indicators and K-SDGs indicators by target 6.1&6.2

Target	Indicator	Institution			
		UN	SDSN	UN Water	K-SDGs
6.1 Drinking water	• Proportion of population using safely managed drinking water services	○	○	○	○ (Rural)
	• Percentage of wastewater flows treated to national standard		○		
	• Proportion of total water resources used		○		
	• Percentage of population with basic hand washing facilities with soap and water at home		○		
	• Percentage of pupils enrolled in primary schools and Secondary schools providing basic drinking water, adequate sanitation, and hygiene services		○		
	• Percentage of beneficiaries using hospitals, health centers and clinics providing basic drinking water, adequate sanitation& hygiene		○		
	• Satisfaction with tap water				○
6.2 Sanitation and hygiene	• Percentage of population using safely managed sanitation services	○	○	○	
	• Percentage of population with basic hand washing facilities with soap and water at home	○	○	○	
	• Proportion of the population connected to collective sewers or with on-site storage of all domestic wastewaters		○		○ (Rural)
	• Percentage of population practicing open defecation		○		
	• Percentage of pupils enrolled in primary schools and secondary schools providing basic drinking water, adequate sanitation, and hygiene services		○		
	• Percentage of beneficiaries using hospitals, health centers and clinics providing basic drinking water, adequate sanitation & hygiene		○		
	• Number of locations for maintenance measures in the management area focusing on sewage maintenance				○

Note: Indicators for the 4th basic plan for Sustainable Development 2021-2040, by Korean government (2020), for the Sustainable Development Goals Report 2021, Extended Report Goal 6 by UN Statistics Division (2021), for indicators and a monitoring framework for the Sustainable Development Goals by SDSN (2015), and for a compilation of expert advice on water and sanitation related indicators covering targets 6.1 to 6.6 and 11.5 by UN-Water (2015).

Target 6.1 and Target 6.2 are objectives related to access to water and hygiene. The UN selected one comprehensive indicator, and SDSN created various indicator frameworks for detailed monitoring in 2015. The SDSN indicator consisted of indicators corresponding to countries with poor basic and safe water systems. On the other hand, K-SDG excluded indicators showing high achievement in the evaluation of water and hygiene accessibility. In

addition, indicators centered on rural areas with relatively low water infrastructure conditions and "Satisfaction with tap water" were added. Target 6.2 also established the sewage supply rate in rural areas as a measurement index.

3.2.2. Analysis of "Clean and Safe Water" Indicators

Figure 5. Comparison of global indicators and K-SDGs indicators by target 6.3&6.6

Target	Indicator	Institution			
		UN	SDSN	UN -Water	K -SDGs
6.3 Water quality and waste water	• Proportion of domestic and industrial wastewater flows safely treated	○	○ (reuse)	○	
	• Proportion of bodies of water with good ambient water quality	○		○	
	• Water quality target achievement (based on TOC)				○
	• Indicator on water resource management(to be developed)		○		
	• Water circulation rate by basin (to be developed)				○
	• Number of new pollutant management items				○
6.6 Eco - systems	• Change in the extent of water-related ecosystems over time	○			
	• Proportion of total water resources used		○		
	• Share of coastal and marine areas that are protected		○		
	• Area of forest under sustainable forest management as percent of forest area		○		
	• Anthropogenic wastewater that receives treatment (%)				
	• Percentage of change in wetlands extent over time			○	○
	• Evaluation index of habitat and waterfront environment				○
	• Fish Health Evaluation Index				○

Note: Indicators for the 4th basic plan for Sustainable Development 2021-2040, by Korean government (2020), for the Sustainable Development Goals Report 2021, Extended Report Goal 6 by UN Statistics Division (2021), for indicators and a monitoring framework for the Sustainable Development Goals by SDSN (2015), and for a compilation of expert advice on water and sanitation related indicators covering targets 6.1 to 6.6 and 11.5 by UN-Water (2015).

Target 6.3 and Target 6.6 are the goals for "clean and safe water." Both the UN and SDSN selected the ratio of safely treated sewage and wastewater as indicators. On the other hand, K-SDGs did not select the ratio of safely treated wastewater as an indicator. Only, it is similar to

the index selected in Target 6.2, “Sewage use rate in rural areas.” However, there is a limitation in not adopting “Proportion of bodies of water with good ambient water quality” as a measurement index without considering the ratio of industrial wastewater other than household sewage. In addition, “Indicator on water resource management” of SDSN and "Water circulation rate by basin" of K-SDGs are indicators that the current concept is not specifically established or are under development. "Wetland and wetland protection area" of K-SDGs is related to “Percentage of change in wetlands extent over time” of UN-Water. In addition, "Fish health evaluation index" of K-SDGs can be said to be the only indicator of direct evaluation of organisms affected by the aquatic ecosystem.

3.2.3. Analysis of "Sustainable Water Source Securing" Indicators

Target 6.4 and Target 6.5 aim to secure sustainable water sources. Both the UN and UN-Water used “Level of water stress” as an important indicator. However, K-SDGs did not include this common indicator. It is presumed that the "Level of water stress" is measured at the national level and is difficult to manage in connection with climate factors. Only, new indicators of "Water leak rate" and "Sewage treatment water reuse rate" that measure water efficiency were added. SDSN proposed a "Crop water productivity" index, and annually publishes the results of the national evaluation of “Scarce water consumption embodied in imports” There are no K-SDG indicators of Target 6.5 at all, but “Integrated Water Resources Management (IWRM)” of UN and UN-Water are usually evaluated by country. It also does not include indicators related to political issues, such as “Proportion of transboundary basin area with an operational arrangement for water cooperation.”

Figure 6. Comparison of global indicators and K-SDGs indicators by target 6.4&6.5

Target	Indicator	Institution			
		UN	SDSN	UN -Water	K -SDGs
6.4 Water use and Scarcity	• Change in water-use efficiency over time	○		○	
	• Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	○		○	
	• Crop water productivity (tons of harvested product per unit irrigation/ water) (to be developed)		○		
	• Proportion of total water resources used		○		
	• Scarce water consumption embodied in imports(m3/capita)		○		
	• Water leak rate				○
	• Local water supply self-sufficiency				○
	• Sewage treatment water reuse rate		○		○
6.5 IWRM	• Degree of integrated water resources management (IWRM) implementation (0-100)	○		○	
	• Proportion of transboundary basin area with an operational arrangement for water cooperation	○		○	
	• Proportion of total water resources used		○		
	• Reporting of international river shed authorities on transboundary river-shed management (to be developed)		○		

Note: Indicators for the 4th basic plan for Sustainable Development 2021-2040, by Korean government (2020), for the Sustainable Development Goals Report 2021, Extended Report Goal 6 by UN Statistics Division (2021), for indicators and a monitoring framework for the Sustainable Development Goals by SDSN (2015), and for a compilation of expert advice on water and sanitation related indicators covering targets 6.1 to 6.6 and 11.5 by UN-Water (2015).

3.2.4. Analysis of "Means of Implementation" Indicators

Target 6.a and Target 6.b aim to strengthen international cooperation and community participation. In Target 6.a, the UN is using "Amount of water and sanitation-related official development assistance that is part of a government-coordinated spending plan." SDSN is developing a specific measurement index method, and K-SDGs have no indicators. In Target 6.b, the UN uses the ratio of local governments participating in water and hygiene management to local communities as an indicator, but K-SDGs use the number of water-related administrative agency committees as an indicator. In other words, it is calculated as an indicator

of the number of meetings held, which is difficult to see as an indicator of direct strengthening of community participation. In addition, K-SDGs established "The ratio of reflecting the budget for supporting water conservation activities" as an indicator, but according to the 4th Basic plan for sustainable development 2021-2040, statistics have not been calculated. On the other hand, the UN presents "Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management" as an indicator. This can be said to be an applicable indicator because it can be measured by local governments in K-SDGs.

Figure 7. Comparison of global indicators and K-SDGs indicators by target 6.a&6.b

Target	Indicator	Institution			
		UN	SDSN	UN -Water	K -SDGs
6.a Cooperation	• Amount of water and sanitation-related official development assistance that is part of a government-coordinated spending plan	○			
	• Indicator on international cooperation and capacity building in water and sanitation-related activities (to be developed)		○		
6.b Participation	• Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	○			
	• Indicator on participation of local communities for improving water and sanitation management (to be developed)		○		
	• The operation performance of the water-related administrative agency committee				○
	• The ratio of reflecting the budget for supporting water conservation activities (to be developed)				○

Note: Indicators for the 4th basic plan for Sustainable Development 2021-2040, by Korean government (2020), for the Sustainable Development Goals Report 2021, Extended Report Goal 6 by UN Statistics Division (2021), for indicators and a monitoring framework for the Sustainable Development Goals by SDSN (2015), and for a compilation of expert advice on water and sanitation related indicators covering targets 6.1 to 6.6 and 11.5 by UN-Water (2015).

Ⅳ. Analysis of the implementation level by South Korea & global indicators

Since Korea is currently advanced in terms of water infrastructure, it is at a high level in evaluating various indicators. However, the level of indicators, which are fundamentally difficult to solve due to geographical and climate characteristics such as the water stress index, is low and is not included in K-SDGs, Korean indicators. This study aims to evaluate the level of implementation of South Korea and global indicators based on data published by organizations such as UN Statistics Division, UN-water, Ministry of Environment, and the Ministry of Foreign Affairs. As a result, I would like to suggest what strategies and policy tasks South Korea should pursue to achieve Goal6 among the sustainable development goals.

4.1. Analysis of implementation level by category and policy

4.1.1. "Accessibility to Water & Hygiene" Indicators Implementation Level and Policy

Figure 8. The results of the evaluation by indicators in South Korea (Target 6.1&6.2)

	Indicator	Achievement level	Goal level 2030
6.1	• Satisfaction with tap water	2017: 46.6%	Increase
	• Water supply rate in rural areas	2019: 78.6%	Increase
	• Population using at least basic drinking water services	2019: 99.3%	Increase
	• Population using safely managed water services	2019: 97.7%	Increase
	• Inappropriate water pipeline ratio(21 years or more)	2019: 34.0%	Decrease
	• Ratio of high water purification facilities	2019: 44.4%	Increase
6.2	• Sewage use rate in rural areas	2018: 72.6%	85%
	• Population using at least basic sanitation services	2017: 100%	100%
	• Population using safely managed sanitation services	2017: 99.9%	Increase
	• Number of locations for maintenance measures in the management area focusing on sewage maintenance	2019: 12	150

Note: Data for the 4th basic plan for Sustainable Development 2021-2040 by Korean government (2020), for the sustainable development report 2021 by SDSN (2021), for waterworks statistics by Ministry of Environment (2021), and for 2018 sewage statistics by Ministry of Environment (2020).

The water supply rate in South Korea related to the implementation of Target 6.1, the goal

of safe water accessibility, reached 97.7% as of 2019, almost reaching the goal. However, only 78.6% of rural areas show that there is an imbalance in water supply benefits by region. In addition, the nationwide public sewage supply rate was 93.9% as of 2018, which is the level of advanced countries, but the sewage supply rate in rural areas was only 72.6%. In other words, it can be seen that continuous public investment is needed to improve the sewage supply rate in rural areas.

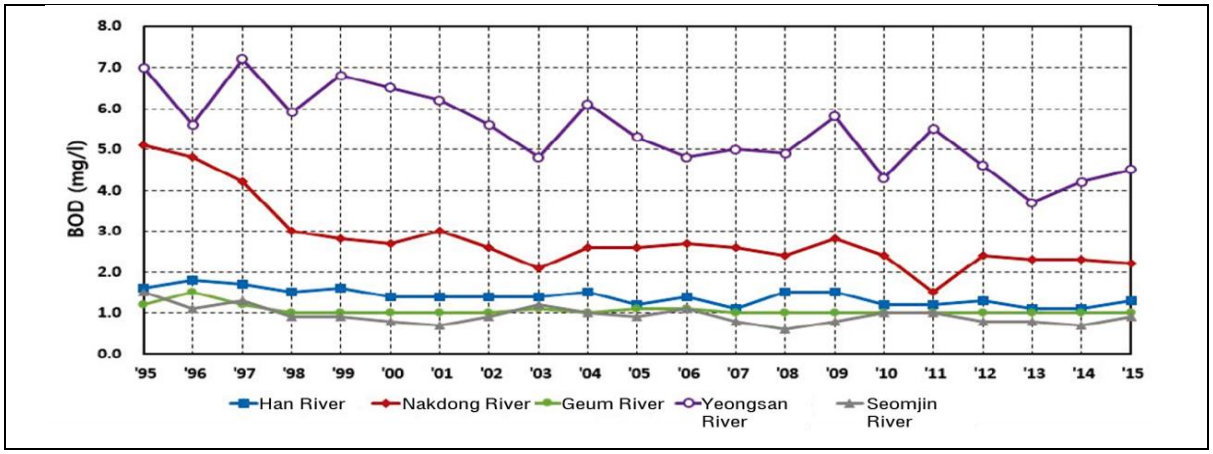
In terms of water infrastructure, the gap between urban and rural sewage services remains, and improvement is needed. If sewage treatment facilities in rural areas are integrated and linked by region, small-scale sewage treatment facilities can be easily installed and efficiency can be increased. In order to solve the problem caused by exceeding the sewage treatment capacity in case of torrential rain, it is necessary to minimize the occurrence of flooding damage in urban areas due to torrential rain and suppress water pollution caused by discharged water.

In addition, when looking at the results of the "Satisfaction with tap water" indicator, it is very low at 46.6%. A detailed analysis of this shows that the cause can be found through 2021 Survey on Drinking Tap Water of the Ministry of Environment. In other words, because of the high distrust of tap water, half of the people drink water through a water purifier when they drink water at home. The reason for this distrust is that the increase in aging facilities (34.0% of pipes, 68.2% of water purification plants) over 21 years has prevented clean water from being supplied to the home safely and could threaten health due to rust generated in old water pipes. As of 2019, the replacement rate of old water pipes was only 0.6% and the improvement rate was only 0.8%. (MOE, 2021). Although the water quality is improving due to the continuous increase in the introduction ratio of high-water treatment facilities to 44.4%, it is necessary to strengthen the crisis response system for water pipe damage or water pollution accidents.

4.1.2. "Clean and Safe Water" Indicators Implementation Level and Policy

Next, the implementation levels of Target 6.3 and Target 6.6, which are clean and safe water targets, were analyzed. Figure 9 is a graph of the trend of water quality changes by year upstream of the five major rivers in South Korea. In general, water upstream of the dam is suitable for water with good water quality (BOD 3 mg/L or less). However, when examining the downstream of rivers and rivers, water quality management measures are needed due to the influence of non-decomposable organic substances.

Figure 9. Changes in the water quality of the five major rivers [2](1995-2015)



Note: Data for the 4th Comprehensive Plan for Water Resources (2016-2020) by Ministry of Land, Infrastructure and Transport (Molit) (2016).

In 2019, "Water quality target achievement (based on TOC)" in South Korea is very low at 41%. To increase this, it is necessary to strengthen the management of water pollutants to suppress the discharge of pollutants in public waters such as rivers. In order to improve TOC pollution, which is total organic carbon, it is necessary to strengthen monitoring of river water quality, strengthen TOC discharge water quality standards for each basin, and establish reduction measures to reduce the occurrence of non-decomposable organic substances. In

[2] Han River (Paldang), Nakdong River (Mulgeum), Geum River (Daecheong), Yeongsan River (Naju), and Seomjin River (Juam)

addition, in order to strengthen pollutant monitoring, the number of new pollutant management items also aims to increase from 56 in 2019 to 66 as of 2030. In addition, water quality such as saponification and algae breeding prevention can be improved by pre-processing through wetlands that grow artificially created aquatic plants before river water contaminated with untreated domestic sewage flows into the reservoir.

Figure 10. The results of the evaluation by indicators in South Korea (Target 6.3&6.6)

Target	Indicator	Achievement level	Target (2030)
6.3	• Water circulation rate by basin	To be developed	NA
	• Water quality target achievement (based on TOC)	2019: 41%	60%
	• Number of new pollutant management items	2019: 56 types	66 types
6.6	• Evaluation index of habitat and waterfront environment	2017: C grade 52 points	B grade
	• Fish Health Evaluation Index	2018: C grade, 52.9 points	B grade
	• Wetland and wetland protection area	2020:3,106㎢	Increase
	• Anthropogenic wastewater that receives treatment	2018 :76.8%	Increase
	• Change in the extent of water-related ecosystems over time	To be developed	NA
	• Ecological river restoration section (Number)	2019: 12	Increase

Note: Data for the 4th basic plan for Sustainable Development 2021-2040 by Korean government (2020), for the the sustainable development report 2021 by SDSN (2021), for waterworks statistics by Ministry of Environment (2021), for 2018 sewage statistics by Ministry of Environment (2020), and for the sustainable development goals report 2021, extended report Goal 6 by UN Statistics Division (2021).

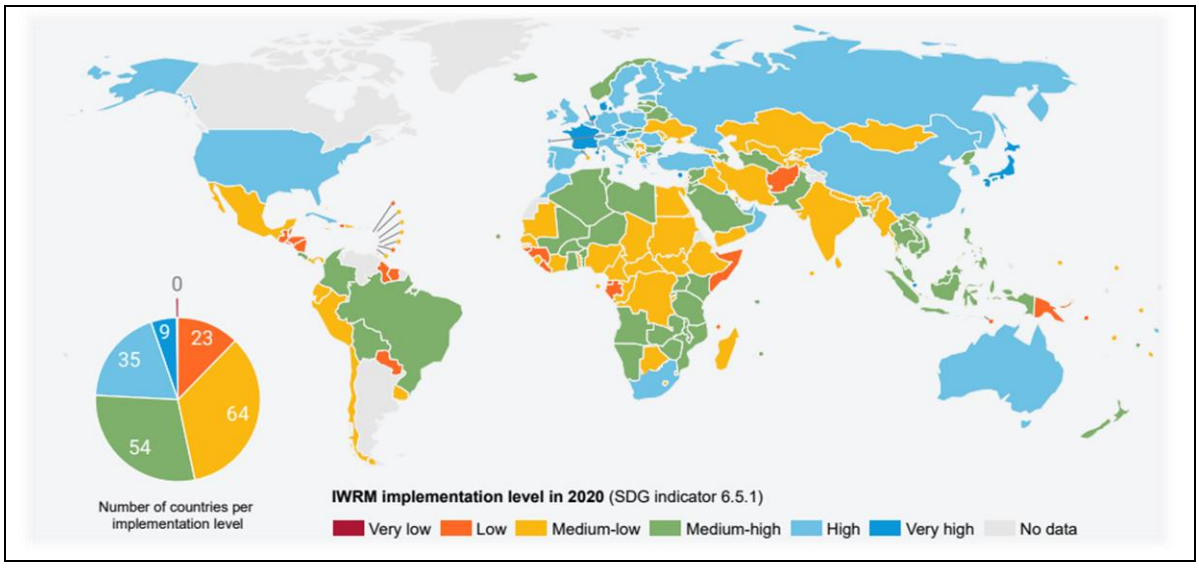
As of 2018, "Fish health evaluation index" was also evaluated as "C grade." As of 2030, it will be improved to "B grade." In addition, it is urgent to evaluate the implementation and monitoring of watershed management for biodiversity preservation, such as a decrease in the appearance of domestic endemic species and an increase in the appearance of foreign species due to increased disturbance in the river. It is necessary to monitor river aquatic ecosystems, develop habitat creation technologies, and operate aquatic ecosystem management programs involving local residents. In addition, the river ecosystem can be protected by restoring the

damaged river ecosystem to the original healthy river as much as possible.

4.1.3. "Sustainable Water Source Securing" Indicators Implementation Level and Policy

Next, we will look at the level of Korean indicators implementation of Target 6.4 (Water use and Scarcity). According to the UN Statistics Division (2021) report, improving water use efficiency (WUE) can be an important way to reduce water intake or reduce water stress. High water stress (taking too much fresh water from natural resources compared to available fresh water) can have fatal consequences for securing sustainable water resources. For example, when more than 25% of the water resources available in a country are taken in, it is referred to as a "water stress country." South Korea was also classified as a "water stress country" with a water stress index of 25-70% in the "Level of physical water stress" released by the UN. In addition, in the Environmental Outlook 2050 report released by the OECD, it was pointed out as the country with the most water shortage among OECD countries. As such, South Korea has been classified as a water stress country several times. This can be said to be because the rainfall concentrated in a specific season, the high-water intake rate according to limited water resources, and the amount of water used per capita are also higher than in other countries.

Figure 11. IWRM (6.5.1) implementation level by country (2020)



Note: Reprinted from national reporting on status of IWRM implementation 2020 by UNEP-DHI Centre (2021).

What are the results of the Integrated Water Resource Management (IWRM) evaluation index of Target 6.5 in South Korea? According to the National Reporting Status of IWRM Implementation 2020, it ranked 36th out of a total of 185 surveyed countries with "High" as of 2020 (United Nations Environment Program, 2021). However, compared to OECD countries, water management conditions such as Singapore and the Netherlands are rather low.

As a detailed item, infrastructure facilities are well equipped, but the level of implementation in governance and financing is relatively low. For example, "Organizational framework for transboundary water management" is rarely achieved, and data sharing and joint use of shared rivers are very poor for political reasons. In addition, there is no financing for cooperation in the border region, and the establishment of a separate budget system for IWRM's implementation is insufficient.

Figure 12. The results of IWRM implementation in South Korea (2020)

IWRM implementation Section	Average Score
Section 1 Enabling environment	71
a. National water resources policy, or similar.	70
c. Arrangements for transboundary water management	50
Section 2 Institutions and participation	87
e. Organizational framework for transboundary water management.	0
Section 3 Management instruments	83
a. Basin management instruments.39	70
d. Transboundary data and information sharing between countries	50
Section 4 Financing	63
b. National budget for IWRM elements(investments and recurrent costs)	70
b. Revenues raised for IWRM elements	60
c. Financing for transboundary cooperation	0
d. Sub-national or basin budgets for IWRM elements49 (investment and recurrent costs)	60

Indicator 6.5.1 score = Degree of IWRM implementation (0-100)	76

Note: Data for national reporting on status of IWRM implementation 2020 by UNEP-DHI Centre (2021).

Why is there a lack of data sharing and cooperation implementation between countries in Korea's international shared river? The Bukhan River and Imjin River in the Han River basin are representative shared rivers between the two Koreas belonging to North Korea. North Korea operates Imnam Dam on the Bukhan River and Hwanggang Dam on the Imjin River, and South Korea has suffered casualties due to the lack of information on the release of the dam by North Korea. Since 2000, inter-Korean relations have made several efforts to consult with North Korea for efficient use of shared rivers, but they have not been continuously promoted.

Figure 13. Shared rivers in Korea (Bukhan River, Imjin River basin)

Basin	Category	Sum	South Korea	North Korea
Bukhan River	The area of the basin.	10,124	7,787(76.9%)	2,337(23.1%)
	The length of the river	291.3	158.8	132.5
Imjin River	The area of the basin.	8,118	3,009(37.1%)	5,109(62.9%)
	The length of the river	273.5	91.1	182.4

Note: Data for the 3rd plan of the 4th comprehensive plan for water resources (2016-2020) by Ministry of Land, Infrastructure and Transport (2016).

Figure 14. The results of the evaluation by indicators in South Korea (Target 6.4&6.5)

Target	Indicator	Achievement level	Target (2030)
6.4	• Water leak rate	2018: 10.8%	9.0%
	• Local water supply self-sufficiency	2018: 53.9%	Increase
	• Sewage treatment water reuse rate	2018: 15.5%	20.5%
	• Freshwater withdrawal (% of available freshwater resources)	2014: 85.2%	Increase
	• Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	2018: 85.2 points	Increase
6.5	• Degree of integrated water resources management (IWRM)	2020: 76points	Increase
	• Proportion of transboundary basin area with an operational arrangement for water cooperation	2020: 0	Increase

Note: Data for the 4th basic plan for Sustainable Development 2021-2040 by Korean government (2020), for the the sustainable development report 2021 by SDSN (2021), for waterworks statistics by Ministry of Environment (2021), for 2018 sewage statistics by Ministry of Environment (2020), and for the sustainable

development goals report 2021, extended report Goal 6 by UN Statistics Division (2021).

Reducing tap water leakage to increase "Water use efficiency" can also be effective. Although the nationwide "Water leak rate" has remained at around 10% over the past five years, regional variations are very large. As of 2019, the water leak rate in Seoul was 1.8%, but it can be seen that regional variations such as 23.3% in Jeollabuk-do, 24.1% in Gyeongsangbuk-do, and 43.2% in Jeju-do are very large (MOE, 2020). In addition, old pipelines for more than 30 years also maintain 10% of the total length of the pipeline, so a policy to support the replacement of old pipelines in leaked areas is needed.

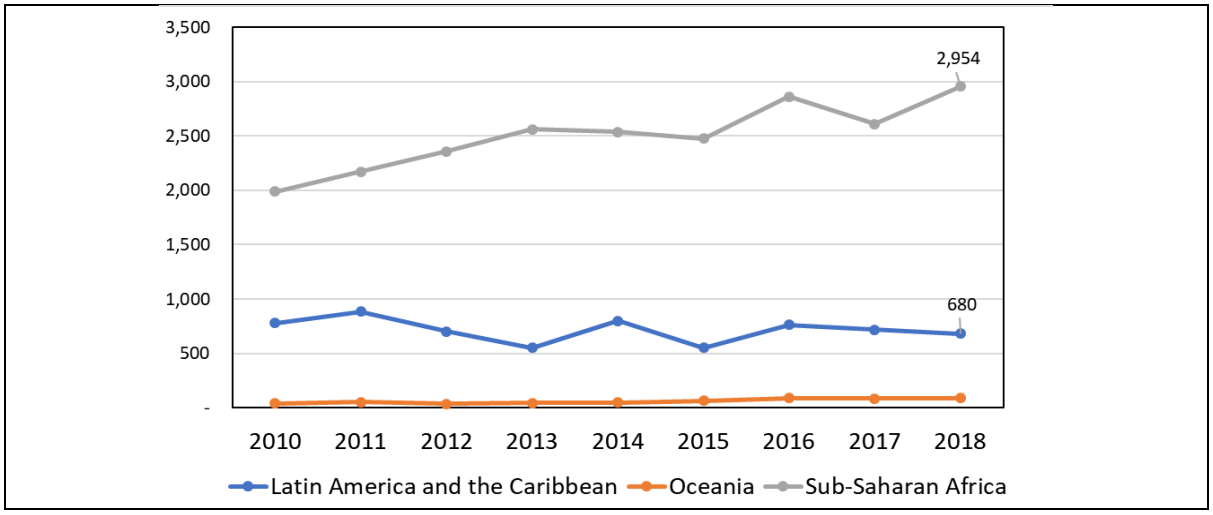
It is also important to increase the "Sewage treatment water reuse rate" in order to effectively utilize limited water resources. As of 2019, the "Sewage treatment water reuse rate" is 15.5%. The reuse rate is low because the treatment cost is higher than that of water supply, but considering the priority for sustainable water resource utilization, a separate budget allocation is required. In addition, in order to discover alternative water resources and increase efficiency, it is necessary to introduce seawater desalination facilities, integrate water supply facilities into metropolitan units to secure responsiveness to materials, provide reusable water information, and support policies.

4.1.4. "Means of Implementation" Indicators Implementation Level and Policy

The following is the level of implementation of Korea indicators of the goal of strengthening international cooperation and community participation (Target 6.a and Target 6.b). Water cooperation between countries is very important in encouraging regional integration, promoting sustainable development, solving regional security problems and supporting adaptation to climate change.

Korea has actively participated in efforts to solve the international community's water problem in the water field. Through the 2015 World Water Forum, topics such as response to climate change, water and food security, and water and hygiene were discussed in connection, and it contributed to water-related policy cooperation and business exchange activation. As of 2018, the amount of process development aid related to the water sector was about 3772 million dollars. Among them, South Sahara Africa accounts for about 78%.

Figure 15. Amount of development aid related to water by recipient region ($ million)



Note: Data for the Open data portal, by KOICA, retrieved from https://www.oda.go.kr/opo/sdgs/detail.ao (2021).

Figure 16. The results of the evaluation by indicators in South Korea (Target 6.a&6. b)

Target	Indicator	Achievement level	Target (2030)
6.a	• Amount of water and sanitation-related official development assistance that is part of a government coordinated spending plan	2018: 3772 million $	NA
6.b	• The operation performance of the water-related administrative agency committee	2019: 13.7 meetings	Increase
	• The ratio of reflecting the budget for supporting water conservation activities.	to be developed	NA
	• 6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	to be developed	NA

Note: Data for the 4th basic plan for Sustainable Development 2021-2040 by Korean government (2020), for the sustainable development report 2021 by SDSN (2021), and for the sustainable development goals report 2021, extended report Goal 6 by UN Statistics Division (2021). Data for the Open data portal, by KOICA, retrieved from https://www.oda.go.kr/opo/sdgs/detail.ao (2021).

The indicator to measure for the implementation of Target 6.b is "The operation performance of the water-related administrative agency committee." The number of meetings held as an indicator of the operation performance of the cooperative committee is calculated, which is difficult to see as a number of direct strengthening of community participation. The UN presents " Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management" as an indicator. This can be a way to involve citizens as members or include the stage of citizen participation when establishing water-related plans among 160 local governments. In addition, it is necessary to analyze the current status of resident participation governance and prepare an autonomous system for stakeholders by basin.

4.2. Improvement of Korean indicators

For SDGs-related laws, institutional mechanisms, policies, and problem solving, it is essential to establish and modify each indicator that can be monitored based on South Korea at this point. In the case of the UN, it took about 15 years to reorganize MDGs into SDGs, but K-SDGs were established in a short period of about a year. Therefore, there were practical limitations in establishing perfect targets and measurement indicators in all 17 target fields in a short period of time. In addition, the global indicator framework of UN is still being developed by SDGs indicator agencies and expert groups and member states are supplementing them according to regional and national conditions. Accordingly, this study intends to present the direction and complementary indicators of Korea indicators that may be consistent with the

target.

Figure 17. Proposal of K-SDGs and complementary indicators by target

Target	Indicator	
6.1 Drinking water	K-SDGs	• Satisfaction with tap water • Water supply rate in rural areas
	Complementary indicators	• Proportion of population using safely managed drinking water Services (UN) • Inappropriate water pipe ratio (Waterworks Statistics) • Ratio of high water purification facilities (Waterworks Statistics)
6.2 Sanitation, hygiene	K-SDGs	• Sewage use rate in rural areas • Number of locations for maintenance measures in the management area focusing on sewage maintenance
6.3 Water quality and wastewater	K-SDGs	• Water circulation rate by basin • Water quality target achievement (based on TOC) • Number of new pollutant management items
	Complementary indicators	• Proportion of domestic and industrial wastewater flows safely Treated (UN) • Proportion of bodies of water with good ambient water quality (UN)
6.4 Water use and Scarcity	K-SDGs	• Water leak rate • Local water supply self-sufficiency • Sewage treatment water reuse rate
	Complementary Indicators	• The rate of use of gray water (Sewage statistics) • Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (UN)
6.5 IWRM	Complementary indicators	• Degree of integrated water resources management(IWRM) (UN) • Proportion of transboundary basin area with an operational arrangement for water cooperation (UN)
6.6, Ecosystems	K-SDGs	• Evaluation index of habitat and waterfront environment. • Fish Health Evaluation Index • Wetland and wetland protection area increase or decrease
	Complementary indicators	• Change in the extent of water-related ecosystems over time(UN) • Ecological river restoration section (km, MOE)
6.a Cooperation	Complementary indicators	• Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan (UN)
6.b Participation	K-SDGs	• The operation performance of the water-related administrative agency committee. • The ratio of reflecting the budget for supporting water conservation activities
	Complementary indicators	• Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management (UN)

First of all, SDGs were added to the 4th Basic Plan for Sustainable Development (K-SDGs) index established in accordance with domestic conditions. Among the indicators that can be calculated from global and other statistical data, the indicators that need to be applied domestically and those that can be measured with existing data were presented as "Complementary indicators." In addition, the average level of South Korea, such as the water supply rate and sewage treatment rate, is higher than that of other countries, but the regional gap is large, so it is presented as indicators that need to be managed by local governments. One of the important principles proposed when the UN established SDGs is to determine whether the goal has been achieved for people of marginalized or vulnerable classes. This is related to the core value of the goal of sustainable development, "Leave no one behind (KoFID, 2016)." In other words, water supply rate and sewage use rate in rural areas, which are measured for rural areas, are indicators to be continuously managed.

The inappropriate water pipe ratio or ratio of high water purification facilities can be said to be measurement indicators considering aging facilities of Korean water infrastructure. In addition to the reuse rate of public sewage, indicators such as the rate of use of gray water in sewage statistics used for business facilities, and proportion of domestic and industrial wastewater flows safely treated can also serve as complementary indicators.

And currently, there are no indicators for Target 6.5 (IWRM) in K-SDGs, but the "Degree of integrated water resources management" proposed by the UN can also be "Complementary indicators." This indicator is published annually by UNEP-DHI Centre for each country around the world. In addition, the level of water stress is also published by the OECD or the UN for member countries, but it is not managed as South Korea indicators. However, this indicator needs to be managed on its own to implement SDGs, even if it is fundamentally difficult to

solve depending on geographical and climate conditions. In addition, "Proportion of transboundary basin area with an operational arrangement for water cooperation," an indicator that is not easy to achieve goals related to political issues between South Korea and North Korea, is one of the indicators that requires implementation efforts even if it is difficult to solve. In other words, it is a task that must be continuously promoted for the success of cooperation in shared rivers between countries, Target 6.5 (IWRM).

The "Fish health evaluation index" index of Target 6.6 (Ecosystems) is not measured in other countries, but is an indicator measured in Korea and can be said to be the only indicator of direct evaluation of organisms affected by the aquatic ecosystem. The "Ecological river restoration section" is a project that invests a large budget each year to restore damaged rivers, which can be an indicator that meets the purpose of Target 6.6 (Ecosystems) for damaged rivers. In addition, the "Amount of water and sanitation-related official development assistance that is part of a government-coordinated spending plan" indicator, which is managed by the Korea International Cooperation Agency (KOICA), will also serve as a Complementary indicator for Target 6.a.

V. Policy implication and recommendation

It is a common sense that the world should pay more attention to environmental issues in the face of serious issues including climate change and environmental diseases. Furthermore, the recent severe drought and high-water stress index served as an opportunity to inform the fact that South Korea is not a stable country for sustainable water management. It also made us aware of the need for effective water management policies for sustainable development. Many countries have recognized these problems and agreed to implement their Sustainable Development Goals by 2030. In this study, global and Korean indicators were compared and analyzed. Furthermore, newly defined indicators were derived.

In addition, in terms of public infrastructure for water management, policy tasks in the domestic water sector were presented for each field to improve the level of implementation of SDGs and insufficient indicators. In order for South Korea to successfully achieve its sustainable development goals, it should present the role and vision for the public, prioritizing certain policies and actively promoting them. Since South Korea is currently advanced in terms of the water infrastructure, it is at a high level in evaluating various indicators. However, there are indicators that are relatively difficult to achieve depending on geographical and climatic conditions such as the water stress index. Nevertheless, if the government and the public focus on improving areas that are difficult to achieve in SDGs goals, the situation in South Korea will gradually improve.

First, while the overall water supply rate is high in South Korea, the rural and island areas is relatively low. The supply of safe drinking water should be strengthened, centering on rural areas with low access to water. In other words, securing water human rights, a top priority in

water issues, is a challenge faced by both developed and developing countries, and requires the government's strong will to promote it. In order to expand water supply facilities in rural areas, small-scale water facilities should be integrated, branch roads should be installed, and emergency water should be secured by utilizing groundwater facilities.

Second, the water stress index is very high in South Korea. In other words, there is a high tendency to focus on a specific period of annual precipitation, making it difficult to use efficiently. The average annual precipitation in South Korea is 1300 mm (1986-2015), 1.6 times larger than the world average, and the total amount of water resources is high, but due to the high population density, the total annual precipitation per capita is only about 1/6 of the world average. In addition, the annual precipitation is concentrated in summer and precipitation varies greatly by region and basin, making it vulnerable to water use and flood management (Molit, 2016). The water stress index is an important indicator that can determine basic water resource conditions by country. Water shortages can occur if water usage per capita is higher than in other countries or if there is no available water infrastructure. Therefore, it is necessary to develop water resources from a comprehensive perspective including the amount of water available, the amount of water used, and the water access rate. It is necessary to expand the capacity of existing dams to secure stable water resources in water-deficient areas or develop alternative water sources such as multipurpose reservoirs, eco-friendly small and medium-sized dams, groundwater and seawater desalination. In addition, reducing tap water leakage is a way to increase water use efficiency. Furthermore, it is essential to urgently promote the replacement of old pipes for more than 30 years, centering on some local governments with high water leakage rates.

Third, in order to secure clean and safe water, it is necessary to manage water pollution, reuse water, and continuous integrated management of water-related ecosystems. It is

necessary to strengthen water source pollution prevention measures and water circulation systems to reduce pollutants, eliminate hazardous waste, minimize chemical generation, reduce wastewater rates, increase recycling rates, and improve water quality by 2030. In order to secure the health of the aquatic ecosystem, it is necessary to expand river surveys and evaluation points, make it mandatory for local governments to restore ecological rivers, and restore large rivers and tributaries including various local governments. In addition, it is necessary to protect habitats of endangered species in the aquatic ecosystem, establish restoration measures, and conduct specialized research and research in the aquatic ecosystem field.

Fourth, considering water as a medium of cooperation can be an important key to solving increased uncertainty regarding climate change. Investment and aid plans should be systematically established through the establishment of master plans for international cooperation in the water resource sector, and jointly planned with related ministries such as the Ministry of Foreign Affairs and Development (ODA) and the Foreign Economic Cooperation Fund (EDCF). Furthermore, the Korean government should actively participate in international joint programs operated by the UN and international organizations related to water resources. And it is also important to participate in the decision-making process at meetings related to the water resources sector at water-specialized organizations specializing in water. In addition, it is essential to form a joint committee of the Imjin River and the Bukhangang River to share information, analyze the impact of the development of upstream dams of shared rivers, and establish mid- to long-term plans for shared river water resources.

Finally, in order to strengthen community participation, it is necessary to break away from the typical "top-down method" of the existing water management plan. This is a method that is decided by a small number of administrative officials and water resource experts in the central

government, confirmed after deliberations by formal public hearings and committees, and executed by local governments. The lack of participation of community members in existing water resource management does not reflect the opinions and interests of various subjects, while weakening the coordination function in the event of conflicts between each entity during the water resource management plan (Ann, 2010). To this end, there should be legal and institutional grounds and practical policy establishment to ensure the participation of related members in various processes of water resource management, sharing the paradigm of sustainable development, strengthening responsibility in local communities, and resolving disputes and water management among local governments.

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