Sustainable Water Resources Management – Policy Experiences from the Republic of Korea

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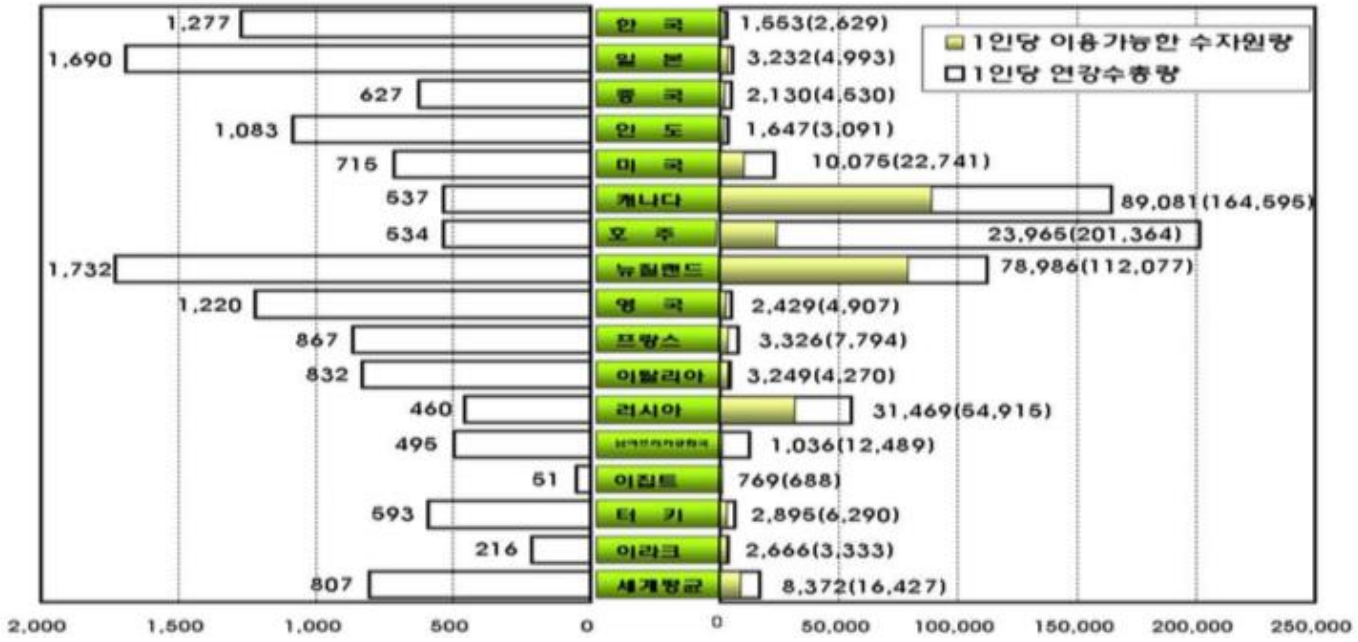
Table of Contents

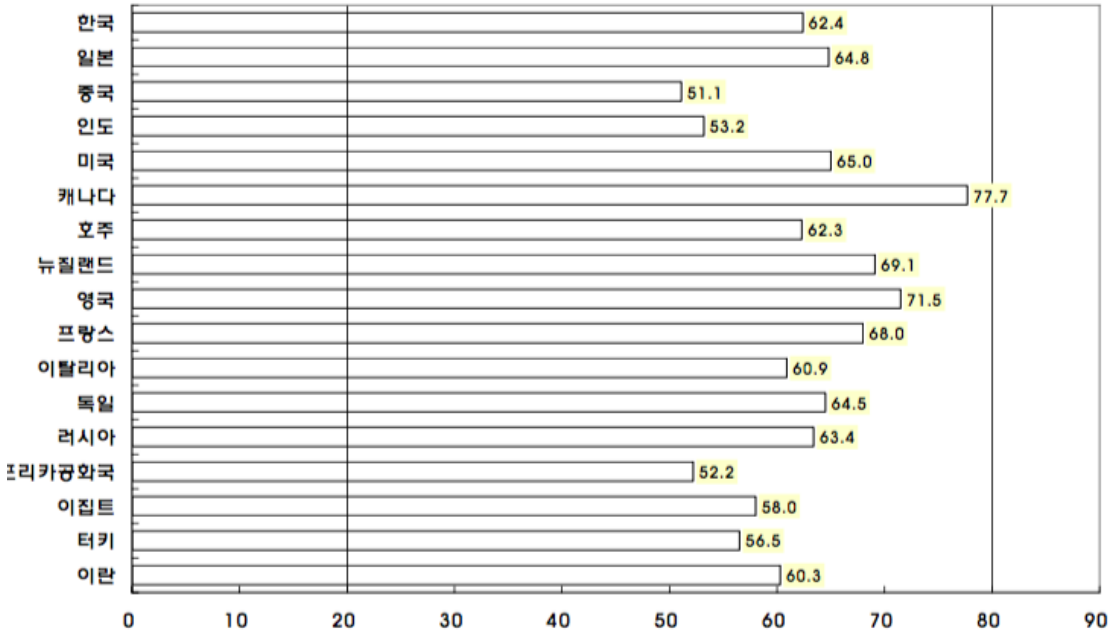
Introduction

Domestic Status and Features



Average annual precipitation(mm/year)

Amount of water resources available per person and total annual precipitation (m³/year/person)



[WPI(Water Poverty Index)]

The annual average precipitation in the Korean Peninsula is greater than the world average, but the total annual total amount of precipitation per person is 2,629m³, a mere sixth of the world average of 16,427m³.

Korea is categorized as a water-stressed country because of its unbalanced precipitation pattern

Introduction

Comprehensive water resources plan is…

- Proposals of future water resources vision and strategy
- Planning for action of climate change and realizing ‘Green Growth’
- Plan of safe realizing ‘territory-based’ by stable supply of water and minimizing flood damage
- Planning for arranging base of betterment institution and international cooperation
- Planning for meeting nation’s needs to use of river of high quality

Comprehensive Water Resources Plan (water vision 2020)

Vision and Basic goals

Realizing water power for green country 2020

Comprehensive plan of water use	A good supply of water for man and nature
Comprehensive plan of flood control	Building a secure infrastructure for climate change
Comprehensive plan of river environment	Creating a living water environment
Water resources research study and technical development plan	Advance water technology
Establishing a strategy for the future of water resources	Preemptive action of the future

Comprehensive Water Resources Plan (water vision 2020)

Water Use	- Safe and stable water supply and secure river maintenance flow - Expanding a healthy, multi-faceted water system - Enhancing power to handle abnormal drought caused climate change
Floods control	- Reducing the rate of area that is vulnerable to floods to less than 20% - Strengthening urban flood prevention system to prepare for flash-flood - Securing safety of existing facilities such as multipurpose dams
River environment	- Improvement river environment through river improvement work like four major rivers restoration project - Establishment and Application of evaluation system for river environment - Building a River Management System with local area

Comprehensive Water Resources Plan (water vision 2020)

Research study and technical development

- Development of technology to improve access to safe water and to use
- building a healthy water environment and development of management technology
- Development of productive water-use technology for economic development and overseas expansion

Strategy for the future of water resources

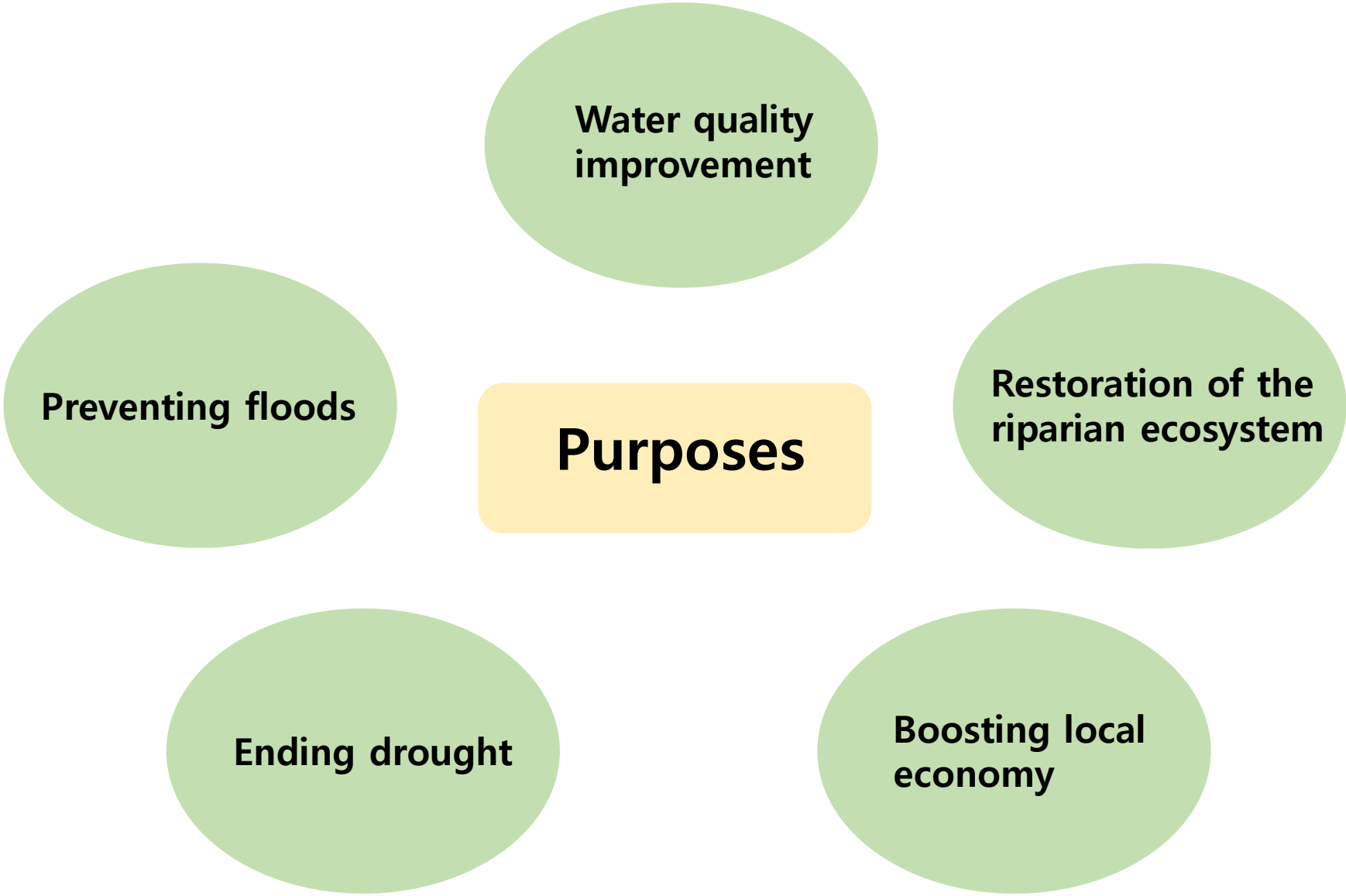
- Assessing the Effect of Water Resources on Climate Change and Analysis of Vulnerabilities
- Low-carbon green growth through water resource management
- Improving laws, systems and organizations related to water management in response to climate change

Four major rivers restoration project

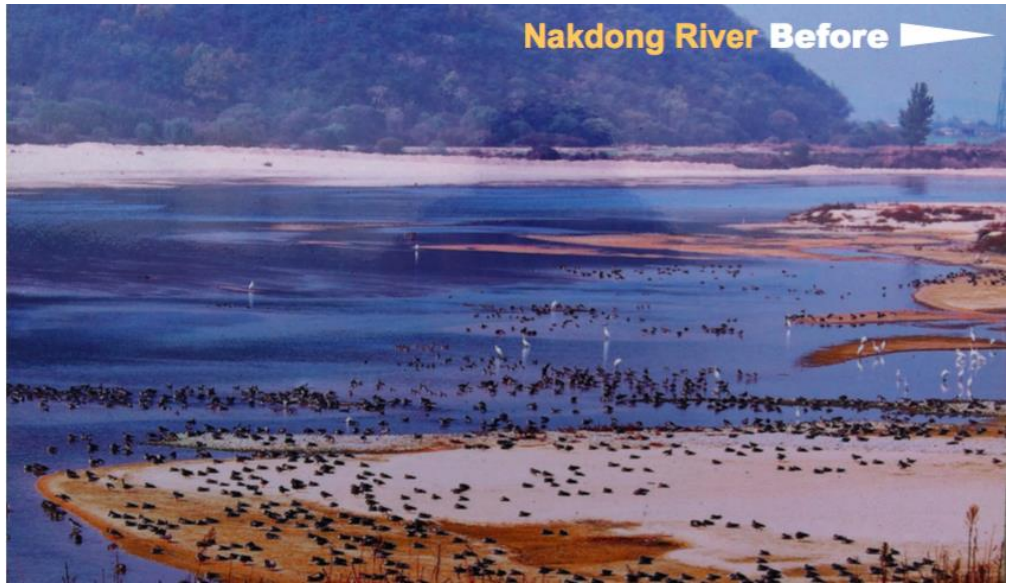
What is the 'four major rivers restoration project ?

- The four major rivers restoration project is the multi-purpose green growth project on the major rivers ,Han River, Nakdong River, Geum River and Yeongsan River in Korea
- The project was proceeded from 2008 to 2012
- The total budget of the project is expected to amount to about 22 billion won, making it the largest government project ever
- The project was designed to construct 16 weirs by dredging 570 million m³ of sediment and graveling almost 700 km of riverbed

Four major rivers restoration project



Four major rivers restoration project



Four major rivers restoration project

Results is..

- In case of water resources, the four-river project secured 1.17 billion m3
- 93.7 percent of existing flood-risk areas had reduced their flood risk.

- There have appeared in abundancy the toxic blue-green algae(Cyanobacteria) year after year
- The size of the wetlands has markedly decreased by constructing dams and dredging rivers

Heterogeneous Value of Water : Empirical Evidence in South Korea

- This is for investigating the heterogeneous water value and assessed a past mega project, the four major rivers restoration project, in the context of sustainable development to enhance national-level water value in Korea.

Survey data

- National-level water demand and value survey in terms of sustainability was conducted to collect information from 20 cites and provinces

- These cities and provinces are the best representatives watershed areas directly influenced by the four major rivers restoration project.

Figure 1. Four major rivers and 20 survey areas.

Heterogeneous Value of Water : Empirical Evidence in South Korea

Table 1. Variable description and summary statistics.

Variables	Description	Mean	95% Confidence Interval	
Sample	Sample size for each rivers (Quota sampling based on demographic and regional characteristics of population)	2850 (Han, 900; Nakdong, 850; Geum, 550; Yeongsan, 550)		
Gender	Male 1, Female 0	0.490 (0.009)	0.471	0.508
Age	Year	49.721 (0.311)	49.111	50.331
Job	White-color 1, otherwise 0	0.603 (0.135)	0.336	0.870
Education	Under elementary 1, under middle 2, under high school 3, college 4, college graduate 5, above college 6, otherwise 7	3.554 (0.034)	3.487	3.621
Household Income	<$2000 1, <$3000 2, <$4000 3, <$5000 4, <$6000 5, <$7000 6, <$8000 7, >$8000 8, Otherwise 9	4.347 (0.060)	4.229	4.465
Upstream dummy	Upstream 1, otherwise 0	0.596 (0.009)	0.578	0.614
City dummy	City 1, otherwise 0	0.438 (0.009)	0.420	0.456

Note: Numbers are mean and in parentheses are standard errors.

Table 2. Estimates of factor loadings from principal component analysis (PCA).

Questionnaire	Environmental Value	Social Value	Economic Value
River is an ecological place to animals and plants for their living	0.585		
River ecology needs to restore urgently	0.467		
River development should be conducted environmental friendly way	0.692		
Environmental friendly river development can provide environmental shelter for human	0.602		
River ecology will be degraded by outbound tourists	0.473		
River is a place for local history and culture		0.621	
Conservation of local river culture and modern succession are urgent issues		0.578	
River development should reflect local history and culture faithfully		0.699	
Historical river development can enhance local brand power		0.583	
Local river culture can be destroyed by a commercial development logic		0.465	
River should be a place for local economic benefits			0.602
River development is urgent for a local economy vitalization			0.684
River development should be supplement local economy			0.704
Economic river development can create more jobs and increase a household income			0.645
Economic river development can be delayed by emphasizing environmental and social river development			0.552
Total explained variance	32.49%	35.29%	40.93%

Heterogeneous Value of Water : Empirical Evidence in South Korea

Table 3. PCA scores for each city and province.

River	Cities/Provinces	Environmental Value	Social Value	Economics Value
Han	Chuncheon	0.26	0.07	0.05
	Gapyeong	−0.12	0.18	−0.02
	Namyangju	−0.16	−0.20	−0.07
	Seoul	0.18	0.04	−0.10
	Yeoju	−0.15	0.09	0.04
	Chungju	0.19	0.18	0.03
	Mean	0.07	0.04	−0.02
Nakdong	Yecheon	−0.34	−0.12	0.28
	Andong	−0.13	−0.04	0.11
	Sangju	−0.25	−0.14	0.14
	Daegu	0.04	0.04	0.06
	Yangsan	0	−0.08	0
	Jinju	−0.02	0.13	−0.06
	Mean	−0.05	−0.05	0.06
Geum	Cheongwon	0.03	−0.07	−0.19
	Gongju	0.10	0.14	0.09
	Daejeon	0.11	−0.03	−0.09
	Nonsan	0.11	0.07	0.42
	Mean	0.08	0.05	0.00
Yeongsan	Damyang	−0.31	−0.19	0.08
	Gwangju	−0.01	−0.08	−0.17
	Naju	−0.28	−0.12	−0.06
	Hwasun	−0.08	0.03	0.05
	Mean	−0.12	−0.05	−0.07

Table 4. Multinomial logit model estimates for cognizance on water value.

Variable	Coefficient	rrr	std. err.	$P > \|z\|$
Environmental Value		**(Base Outcome)**		
Social Value				
Intercept	−1.252	0.285	0.072	0.000 **
Gender	−0.012	0.988	0.010	0.907
Age	0.017	1.017	0.003	0.000 **
Job	0.007	1.007	0.007	0.351
Education	−0.033	0.966	0.029	0.260
Household Income	0.051	1.052	0.017	0.002 **
Upstream Dummy	0.004	1.121	0.124	0.303
City Dummy	−0.405	0.666	0.074	0.000 **
Economic Value				
Intercept	−0.523	0.592	0.132	0.020 **
Gender	0.050	1.051	0.093	0.574
Age	0.018	1.018	0.002	0.000 **
Job	0.008	1.008	0.006	0.190
Education	−0.077	0.925	0.025	0.004 **
Household Income	0.020	1.020	0.015	0.160
Upstream Dummy	0.073	1.076	0.103	0.446
City Dummy	−0.313	0.730	0.070	0.001 **

Log likelihood = −3004.0026

Number of Observation = 2850; LR $\chi^2(14)$ = 110.58; prob > χ^2 = 0.000; Pseudo R^2 = 0.0181

Note: ** indicates the significance at the 5% level.

Table 5. Results of marginal effect

Variable	Environmental Value		Social Value		Economic Value	
	dy/dx	$P > \|z\|$	dy/dx	$P > \|z\|$	dy/dx	$P > \|z\|$
Gender	−0.006	0.736	−0.007	0.656	0.013	0.479
Age	−0.004	0.000 **	0.001	0.013 **	0.002	0.000 **
Job	−0.002	0.197	0.000	0.720	0.001	0.280
Education	0.013	0.012 **	0.002	0.730	−0.015	0.007 **
Household Income	−0.007	0.019 **	0.007	0.005 **	−0.001	0.961
Upstream Dummy	−0.019	0.320	0.013	0.445	0.006	0.754
City Dummy	0.077	0.000 **	−0.042	0.017 **	−0.036	0.082 *

Note: * and ** indicates the significance at the 10% and 5% level, respectively.

Heterogeneous Value of Water : Results

- People with higher age and higher household income tend to prefer the social and local cultural demand on water value to its environmental value
- Individual education level has a significant positive influence on environmental value of water, but negative on economics value
- City dwellers have the highest marginal effect on all water values, positive to environmental value and negative to its social and economic value
- Gender, job, and upstream-downstream relation have insignificant marginal effects on all water values, meaning that conventional assumptions of upstream-downstream development agenda do not apply in four major rivers.

Conclusion and Implications

- The four major rivers restoration project was a monotonous implementing plan ignoring the fact that residences of Korea have various needs and desires for water usage and may exacerbate individual utilities in many dimensions

- This bureaucratic authoritarianism and myopic point of view may lead to the failure of the main goal of the project.

- Policymakers should realize these results and apply them when there is a plan for water policy reform and in the event future costly mega construction project like the four major rivers restoration project

- This might be the result of the failure of reflecting various stakeholders' demands and desires of water value or ignoring the trend of river restoration concept in terms of sustainability.

Thank you for your attention!

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