

Development of Eco-Efficient Water Infrastructure Strategy in the Asia Pacific Region

박지선*, 정혜윤**, 강부식***, 이주현****, 이승호*****,
Jiseon Park, Hyeyoon Jung, Boo-Sik Kang, Joo-Heon Lee, Seung-ho Lee

Abstract

This study suggests '*Eco-Efficient Water Infrastructure*' as a breakthrough to the economically and ecologically challenged region; the Asia-Pacific. The study conceptualizes eco-efficient water infrastructure based on the understanding of eco-efficiency and variety of indicators for eco-efficient water infrastructure. Further, the guidelines for establishing national strategies for eco-efficient water infrastructure is introduced.

Key words: Eco-efficient Water Infrastructure, Asia-Pacific region, National Strategies

1. Introduction

This study aims to contribute toward improving the 'eco-efficiency' for water infrastructure in the Asia-Pacific region, where many countries like Bhutan, Philippines, Malaysia, Vietnam and China are vulnerable to water-related disaster and water-borne diseases due to lack of improved water infrastructures. At a time when the region should pursue both economic development and environmental conservation, the concept of eco-efficient water infrastructure emerges as an innovative alternative. The concept of eco-efficient water infrastructure is explored in the first part of the study and the latter part suggests the guideline to development of a national water strategy on eco-efficient water infrastructure depending on socio-economic, political and environmental circumstances.

2. Concept and Indicators

2.1 Concept of Eco-efficiency & Eco-Efficient Water Infrastructure

The idea of Eco-efficiency(E/E) originated from the business sector to achieve sustainable development at the global level. The World Business Council on Sustainable Development(WBCSD) defines Eco-Efficiency as ; 'the delivery of competitively priced goods

* 정회원 · 한국물포럼 · E-mail: kwf_matildap@koreawaterforum.org

** 정회원 · 한국물포럼 · E-mail: aileenjung@koreawaterforum.org

*** 정회원 · 단국대학교 토목환경공학과 · E-mail : bskang123@naver.com

**** 정회원 · 중부대학교 토목공학과 · E-mail: leejh@joongbu.ac.kr

***** 정회원 · 고려대학교 국제대학원 · E-mail: seungholee@korea.ac.kr

2010년 한국수자원학회 학술발표회

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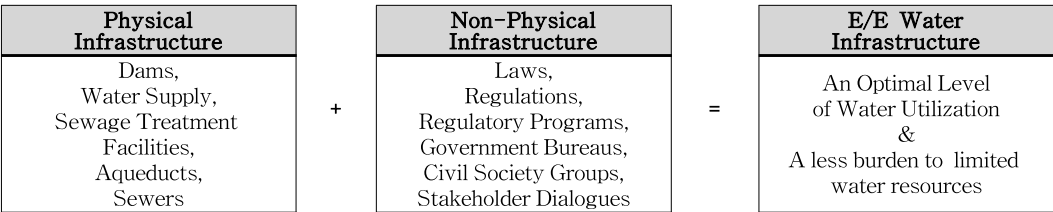
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and services that satisfy human needs and bring quality of life, while progressively reducing ecological impact and resource intensity throughout the life cycle to a level at least in the line with the earth’s carrying capacity’ (WBCSD, 2000). The term, ‘eco’, means both economy and ecology, as the definition implies that the eco-efficiency is to bring added values with less environmental impact. The below equation (1) clearly illustrates the eco-efficiency;

$$Eco - efficiency = \frac{Products\ or\ Service\ Value}{Environmental\ Impacts} \text{ -----(1)}$$

The dimensions of eco-efficient water infrastructure should cover not only physical infrastructures but also non-physical or institutional infrastructures. The eco-efficient water infrastructure adopts the sustainable processes of design, construction, operation and maintenance with less environmental impacts, institutional arrangements and policy measures that support water supply and sanitation services to entail an optimal level of water utilization, as well as a less burden to limited water resources. Below [Figure 1] displays the concept of eco-efficient water infrastructure implying *the significance of the balanced policy-making and implementation*.



[Figure 1] Concept of Eco-efficient Water Infrastructure

2.2 Indicators to Assess E/E Water Infrastructure

Regardless of eco-efficiency, the ultimate goal of ‘Water Infrastructure’ is to secure ‘clean and enough water’ to people and surrounding lives composing eco-systems. Hence, it should suffice the water resources demand. Measuring eco-efficiency for water infrastructure is to measure how to achieve the objective by minimizing water demand and maximizing water supply capacity through economically efficient and ecologically sound way. In this regard, indicators to assess eco-efficient water infrastructure should encompass water supply potential and actual water supply, water demand and the balance between water supply and demand, not to mention of economical and ecological factors.

[Table 1] Variables associated with each category

Supply-side	Demand-side	
Water Resources	Economic Sustainability	Ecological Sustainability
<ul style="list-style-type: none"> - Precipitation - (Renewable) Water resources - Recycled water resources - % of population with access to improved water sources - % of urban population with access to improved sanitation facilities 	<ul style="list-style-type: none"> - Population - Gross Domestic Product (Income) - Water demand by Municipal, Agricultural, Industrial Sector 	<ul style="list-style-type: none"> - In-Stream water demand - Waste water load (urban/rural/industrial area)

Above [Table 1] summarizes the overall variables consisting of supply-side and demand-side variables, while [Table 2] suggests indicators for Eco-Efficiency Indicators for Water Infrastructure (EEIWIN) in respect to categories of hydro-economic and ecological. The purpose of developing EEIWIN is to provide consistent standards for comparison over the time period.

[Table 2] Eco-Efficient Indicators for Water Infrastructure (EEIWIN)

Group	Indicators
Hydro-Economic	<ul style="list-style-type: none"> - Precipitation per Capita - (Renewable) Water resources per Capita - Recycled water resources per Capita - Precipitation per GDP - Precipitation per Capita per GDP - (Renewable) Water resources per GDP - (Renewable) Water resources per Capita per GDP - Recycled water resources per GDP - Recycled water resources per Capita per GDP - Water Balance (Water supply capacity vs Water supply demand)
Hydro-Ecological	<ul style="list-style-type: none"> - % of population with access to improved water sources - % of urban population with access to improved sanitation facilities - Recycled water resources per In-Stream water demand - Waste water load per (Renewable) Water resources - Waste water load per Recycled Water resources - In-Stream water demand vs total water resources
Hydro-Economic -Ecological	<ul style="list-style-type: none"> - Recycled water resources per Capita per GDP per In-Stream water demand - Waste water load per Capita per Recycled Water Resources

2.3 Procedures of development, testing and use of the EEIWIN

The overall procedure can be understood by 4 stages, which are: 1) Institutional Settings, 2) Survey and Implementation, 3) Assessment and evaluation and 4) Reporting. The development of eco-efficient water infrastructure is associated with the decision-making process; thus institutional arrangement should be preceded prior to further development. Survey is to identify already available indicators and in which institution and for what purposes they are being used. The implementation stage takes into account and select particular indicators in consideration of national priorities and strategies. Assessment and evaluation is a continuous process, which should be conducted throughout the development phase. The parties for assessment should include all levels of society government, business, epistemic community and civil society and encompass technical issues, decision-making issues to institutional support and capacity building issues. Providing platforms through establishing websites or mechanism for regular meetings are recommended for communication channels as such would facilitate collecting feedbacks and participation even from the very grassroots level. To further adjust and enhance the national indicators, the evaluation report is recommended with the following contents included, as [Table 3] shows.

3. Key Conceptual Elements of a National Strategy

A national strategy on eco-efficient water infrastructure; which is defined as ‘a variety of specific measures to establish physical and non-physical water infrastructure in an eco-efficient manner in accordance with adopted goals and policies for a country,’ is to assess whether the goals and policies are feasible. Water infrastructure in developing countries has been inclined toward the dimension of physical infrastructure due to the socio-economic and

political reasons. Moreover, an introduction of non-physical instruments in the water sector is prone to political pressure as it may invite social resistance and loss of political legitimacy. But without a paradigm shift of the water policy balanced towards the reform of the non-physical infrastructure sector, the current problematic water management system cannot be revamped and become more eco-efficient. It is imperative for developing countries to revise and re-establish a new mode of national water master plan accommodating the five guideline principles, which are: 1) integration; 2) decentralization; 3) participation; 4) life cycle; and 5) ecosystem integration in decision-making.

[Table 3] Standard Template on a National Report

Evaluation Report on Eco-Efficient Water Infrastructure	
Table of Contents	
A. Introduction	
1. Background and objectives	
2. Identification of the relevance to national decision-making	
3. Institutional, organizational and resource arrangements for indicator development	
B. Identification and selection of the indicators	
Description of the process through which the indicators are chosen, and the criteria for selection, including reference to:	
1. National strategies, targets and priorities	
2. Existing indicators and indicator programs	
3. Data availability	
4. Other parameters	
C. Indicator evaluation results	
1. Data collection	
2. Trend analysis for individual variables	
3. Development of linkages among the indicators, of national indicator frameworks and of aggregated indicators	
4. Comments and suggestions on changes and improvements	
D. Concluding remarks	
1. Problems encountered in data availability, reliability and delivery	
2. Strengthening, and training of human resources	
3. Other capacity-building needs	
4. Other	
E. Recommendations	

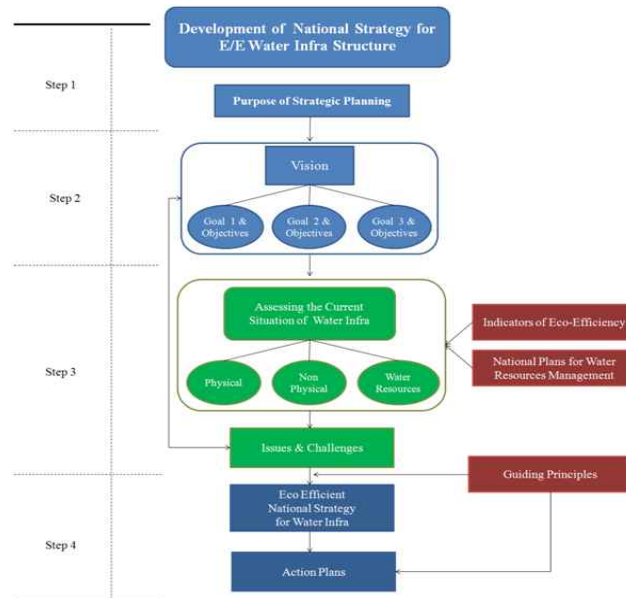
4. Suggested Process for Development of National Strategies

There are a number of different methods or tools for adoption and evaluation of eco-efficiency. The rational steps and components needed for the development of national strategy for eco-efficient water infrastructure can promote eco-efficiency and sustainability as well as for fostering strategic success of national plan for water resources management. The framework for the establishment of national strategy for eco-efficient water infrastructure development is illustrated as [Figure 2].

5. Conclusion & Recommendation

The application of the eco-efficiency into water infrastructure is not simple. Furthermore, the provided guidelines for development of national strategies for eco-efficient water infrastructure is not an one-size-fits-all solution for the whole region. However, with trial and error depending on respective national context, the implementation of the concept and guideline would pave a road toward achieving sustainable water management.

[Figure 2] Framework of Eco-Efficient National Strategy Development



** This study was financially supported by UNESCAP and KOICA.

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