

Water purification and ecological restoration effects of the Keumhak stream Sustainable Structured wetland Biotope, Korea

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ABSTRACT

A ecological water purification wetland was constructed in order to purify non-point pollution sources of rivers and to clean habitats and to create and restore riverbanks and wetlands. Ecological study, such as the hydrophilic nature observation as to create space. The first case is the restoration of Kyungan Stream, which is composed of a national river (lower stream) and a local river (upper stream). shows the map of the 49.3 km-long Kyungan stream and restoration sites.[Fig1] A Sustainable Structured wetland Biotop (SSB) system was constructed on the floodplain of Kyungan stream in May 2009. It purifies polluted water of Keumhak stream which is the most polluted one of branches of Kyungan stream and flows into it and, it is applicable to diverse domestic river according to their ecological and hydrological characteristics. With proven water-purifying efficiency and functionality in restoring the aquatic ecosystem, the system has been well verified in an array of rivers, channels and floodplains across the nation and has been granted patents related to the restoration of the river environment, and has been certified by the Ministry of Environment as the nation's unique New Excellent Technology (NET No. 258).

1. Introduction

Most natural aquatic ecosystems are deteriorated due to increasing urban development, as well as due to floods and droughts triggered by climate change. Accordingly, the emerging issues that take precedence in terms of the restoration of ecological rivers and wetlands are to improve water quality, and to restore the hydraulic ecosystem. However, the practical and theoretical foundation is not yet properly established for research and related education, neither are the legal prerequisites for ecological and environmental restoration. Restoring ecological rivers and wetlands around local rivers and small streams should be guided by facilitating such diverse functions as hydrological stability, water quality improvement, ecological restoration and

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amenities for people (Byeon, 2006a, 2006b, 2010b). In order to do this, it would be helpful to have reference sites that are successfully constructed already, such as restored ecological rivers and wetlands. A Sustainable Structured wetland Biotope (SSB) system was constructed on the floodplain of Kyungan stream in May 2009. It purifies polluted water of Keumhak stream which is the most polluted one of branches of Kyungan stream and flows into it. Water samples were collected twice a month at inlet and outlet from March 2011 to December 2012 BOD₅, SS, T-N and T-P were analyzed. Ten plant species were naturally introduced into the system, however, they did not make up a significant portion of the plant populations compared with the planted species. Planted species were *Iris pseudacorus*, *Phragmites australis*, *Zizania latifolia*, *Typha orientalis*, *Persicaria thunbergii*, *Nymphaea teragona*, *Nymphoides peltata*. Invasive species were *Pseudoraphis ukishiba*, *Bidens fondosa*, *Trifolium repens*, *Robinia pseudoacacia*, *Potamogeton distinctus*, *Potamogeton crispus*, *Humulus japonicus*, *Chelidonium majus* var. *asiaticum*, *Alix gracilistyla*, *Salix korensis*.

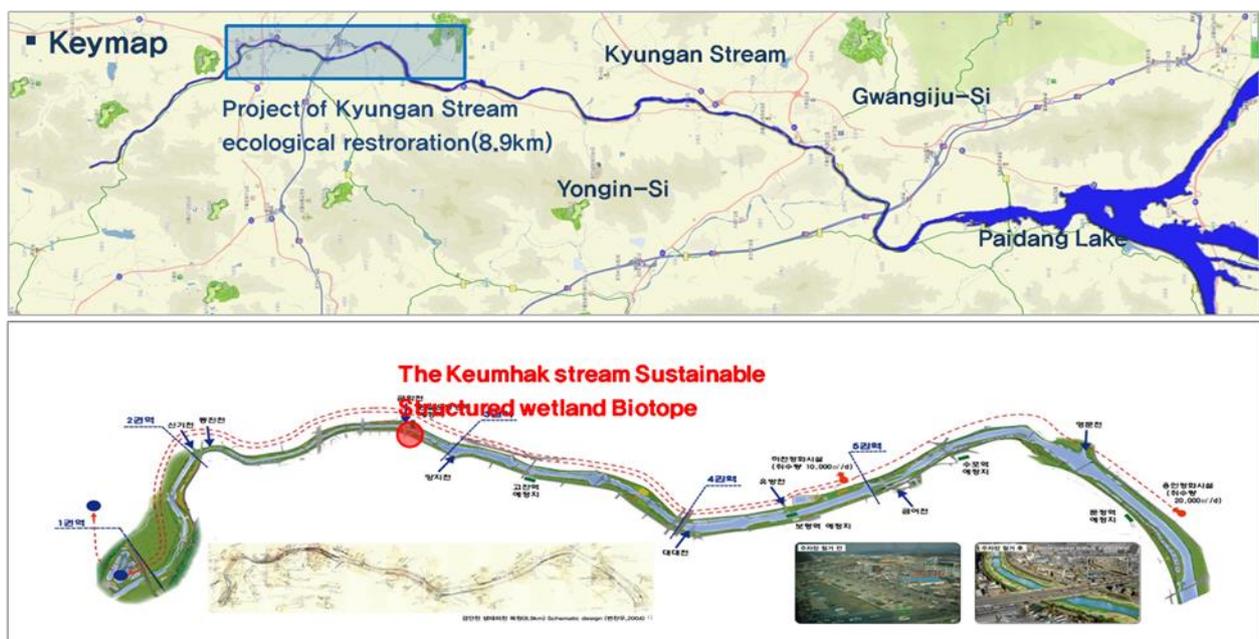


Fig.1 Key map and location of Keumhak stream Sustainable Structured wetland Biotope

2. Results

2.1 Strategies for Ecological restoration process

2.2 Designing Keumhak stream Sustainable Structured wetland Biotope

2.3 Inter-disciplinary convergence and integration

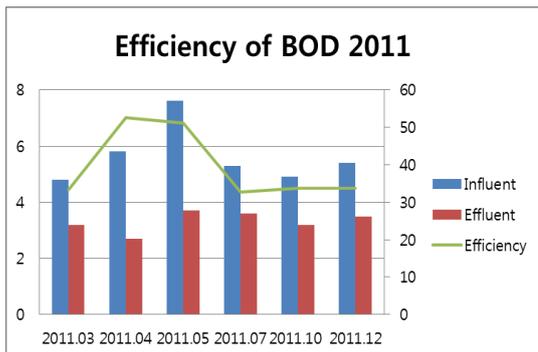
2.4 Directions of ecological and environmental site-specific restoration

2.5 Site-specific aspects

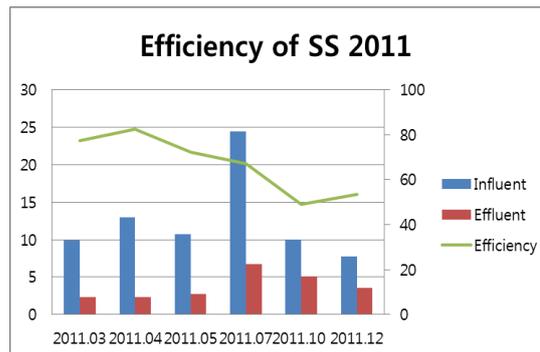
2.6 Ecological restoration and water purification

3. CONCLUSIONS

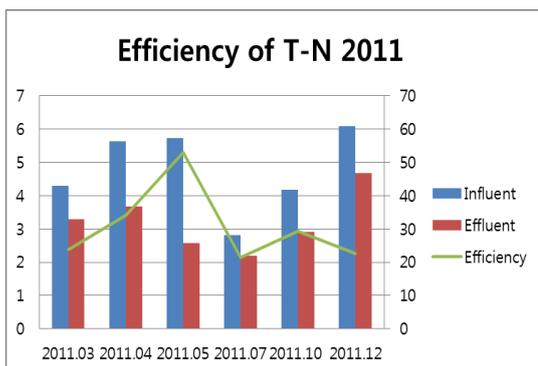
Water samples were collected twice a month at inlet and outlet from March 2011 to December 2011 BOD5, SS, T-N and T-P were analyzed. Average influent and effluent BOD5 concentration was 5.3mg/L and 3.2mg/L, respectively and BOD5 removal was 36.1%. SS concentration of influent and effluent was averaged 11.1mg/L and 3.4mg/L, respectively and SS abatement amounted to 61.7%. Average influent and effluent T-N concentration was 4.7mg/L and 3.2mg/L, respectively and T-N retention was 28.2%. T-P concentration of influent and effluent was averaged 0.3mg/L and 0.2mg/L, respectively and T-P removal amounted to 26.7%.



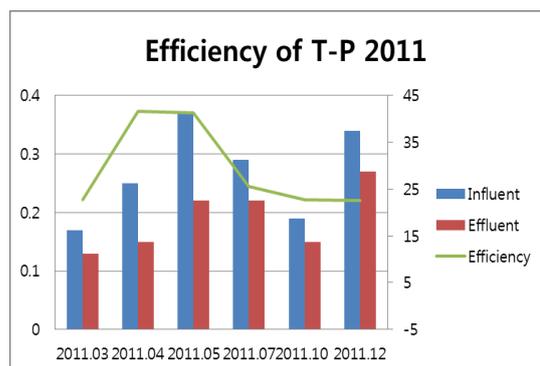
Graph1. Efficiency of BOD 2011



Graph2. Efficiency of SS 2011

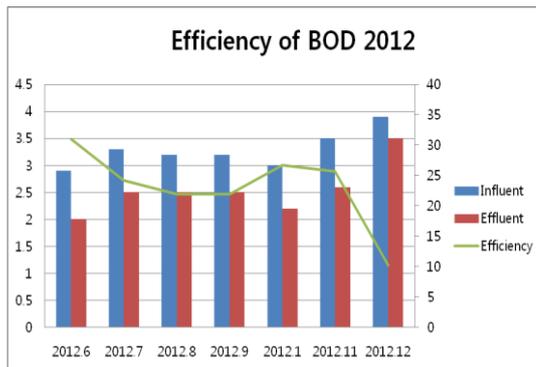


Graph3. Efficiency of T-N 2011

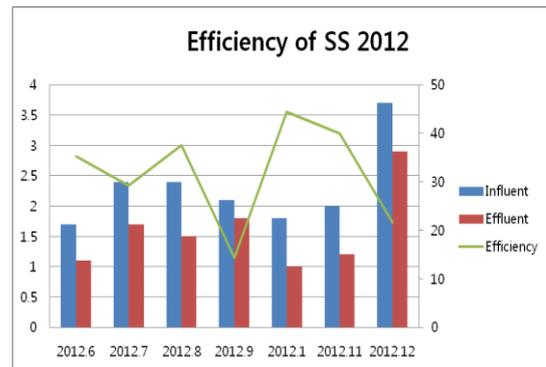


Graph4. Efficiency of T-P 2011

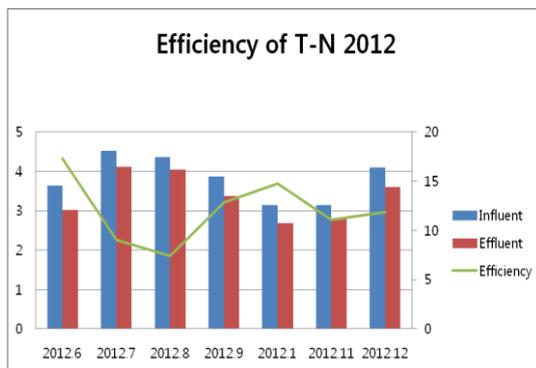
Water samples were collected twice a month at inlet and outlet from June 2012 to December 2012 BOD5, SS, T-N and T-P were analyzed. Average influent and effluent BOD5 concentration was 3.2mg/L and 2.5mg/L, respectively and BOD5 removal was 22.1%. SS concentration of influent and effluent was averaged 2.2mg/L and 1.5mg/L, respectively and SS abatement amounted to 31.5%. Average influent and effluent T-N concentration was 3.8mg/L and 3.3mg/L, respectively and T-N retention was 12.15%. T-P concentration of influent and effluent was averaged 0.24mg/L and 0.19mg/L, respectively and T-P removal amounted to 21.9%.



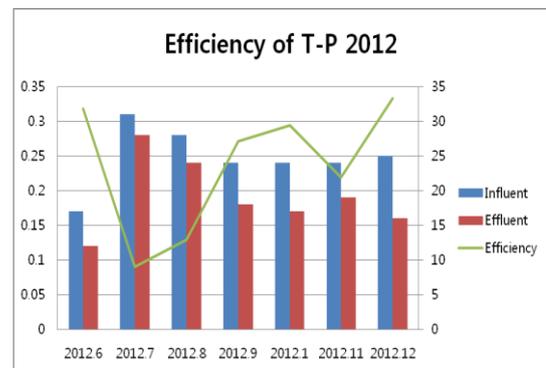
Graph5. Efficiency of BOD 2012



Graph6. Efficiency of SS 2012



Graph7. Efficiency of BOD 2012



Graph8. Efficiency of BOD 2012

REFERENCES

Byeon CW (2010c). Ecological river fitting natural features: For restoration of ecological rivers with structural stability, environmental water quality improvement, ecological restoration, water friendly landscape, Namudosi Publishers, Seoul, Korea.

Byeon CW (2012). Ecological restoration of rivers and wetlands with a sustainable structured wetland biotope (SSB) system. *KSCE Journal of Civil Engineering* 16(2): 255-263.

United States Environmental Protection Agency (US EPA)(1993). *Constructed wetlands for Wastewater Treatment and Wildlife Habitat*, Washington, D.C. : Office of Water, EPA 832-F-93-005, p.11.

United States Environmental Protection Agency (US EPA)(1999a). *Free Water Surface Wetlands for Wastewater Treatment*, Washington, D.C. : Office of Water, EPA 832-F-99-002, p.5-5.

Mitsch, W. J. 1993. *Landscape design and the role of created, restored, and natural*

riparian wetland in controlling nonpoint source pollution, In Olson R. K.(ed), *Created and Natural Wetlands for controlling nonpoint source pollution.*

Shutes, R. 2001. Artificial wetlands and water quality improvement, *Environment International*, 26 : 445-446.

Ministry of Environment Korea(2010a). *Ecological stream restoration projects*, p.11