



Establishment and management of riparian buffer zones in Han River basin, Korea

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Abstract

Han River is the water supply source for 20 million residents in the capital region of Korea, but the water quality of the river has continued to decline due to increasing economic activities in the watershed. The Korean Government presented the 'Han River Water Supply Source Protection Master Plan' in 1998. This plan proposes a target to improve the water quality of the Paldang reservoir in the Han River watershed to CLASS-1 status by 2005. This goal is completed through the following counter measures: improve and manage water supply source protection measures; enhance basic environmental facilities; strengthen surveillance and supervision and improve legislation and institutional arrangements. In water supply source protection measures; allocation of total maximum load; designation of water fostering forest; establishment and management of riparian buffer zones were proposed. For critical regions, such as river and lakesides, riparian buffer zones were designated in 1999. The buffer zones may restrict pollution location, stabilize the stream bank and absorb and delay storm runoff containing pollutants.

1 Introduction

Riparian areas are generally long, linear areas along rivers and lakes. Maintaining these areas with forested buffers provides more than just a beautiful landscape. The combination of trees, shrubs and native grasses can improve water quality by removing nonpoint pollutants (sediments and chemicals) before they reach the waterway. A properly cared for buffer



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areas can moderate flooding, help recharge ground water, prevent soil erosion, and preserve or improve certain types of wildlife habitats. Especially as urban areas begin to expand and encroach, regions previously unaffected by development are now in need of strategies for protection and restoration of existing riparian forests to maintain or improve water quality.

2 Function of riparian buffer zones in Han river basin

2.1 Water quality improvement

Riparian vegetation has well-known beneficial effects on the water quality. Riparian forests of mature trees(30yrs~75yrs) are known to effectively reduce nonpoint pollution from agricultural fields.[5]. Vegetation in the riparian buffer is also a key component of the nutrient cycle. As ground water and surfaces water from the uplands run through the riparian areas, the dissolved nutrients they contain are removed through both the uptake by vegetation and adsorption to soil particles. The removal of sediment from upland erosion is another important function related to water quality that is provided by the buffer. But the most effective method in water quality improvement by riparian buffer is restriction of pollutant locations in buffer areas.

2.2 Habitat for wildlife and fish

Riparian areas provide valuable habitats in many forms for different types of wildlife. Establishing, managing and protecting these areas can increase biodiversity. In general, aquatic biodiversity is dependent on the quality of the riparian areas. Han River provide valuable stream corridors, many of which have been lost over the years, for agriculture expansion and housing development. The riparian system provides a reflection of the surrounding terrestrial ecosystems. Removal or degradation of riparian areas can have a domino effect with negative results in both aquatic and terrestrial ecosystems that are linked to it.

2.3 Aesthetics and outdoor recreation

One of the most important functions of Han River riparian areas is greenway systems. Greenways, established riparian forest buffers, will be particularly advantageous to residents of urban areas experiencing a shortage of green space. Riparian forest buffers can offer urban residents an alternative to cement and concrete and comforts for rest and relaxation.

3 Strategies for establishment of riparian buffer zones

3.1 Planning to establish riparian buffer zones

Almost all streams and rivers have suffered from some human impacts. Han River, also, is very different from what she was, because of major changes to the riparian areas, channel and water quality. There are many different problems in any stream, from sediment deposition to bad water quality or loss of habitats. Riparian forests are a part of these systems and trees are an integral part of flood plain and stream function. Therefore, it is very important to identify a goal for establishing riparian buffer zones, which assures what we want to achieve in streams and rivers. For establishing riparian buffer zones, the following items were considered:

- Identify what we want to achieve in streams
- Determine the problems affecting the streams
- Identify the range of options to solve the problems
- Designate the riparian buffer zones
- Develop a plan for restoration with expert advise

3.2 Buffer width and vegetation

One of the most important factors which determines the effectiveness of a buffer is its size or effective width. Buffers that are too narrow may not yet help enhance water quality or aquatic resources[6]. But there is no ideal buffer width for all applications in all areas. Many factors including slope, stream order, soil depth and erodibility, hydrology, stream banks, stormwater system, wetlands, adjacent land use, flood plain, vegetation type and watershed condition influence what can be planted[4].

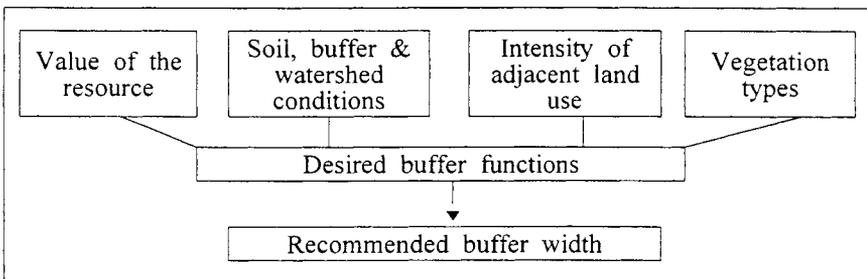


Figure 1 : Criteria for determining width of riparian buffers

Especially for urban(and/or suburban) setting, remaining watersheds such as the Paldang watershed that are ecologically viable or depended upon for water supply are reduced little by little. A design method that uses



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GIS(geographic information system) technology may provide an alternative for calculating effective riparian buffers. GIS models can be developed to combine soil information, hydrologic features, slope, current land use and land cover data with local land regulations to produce maps that portray areas that will maintain maximum benefits within functioning riparian forests or restore the highest levels of functions within degraded riparian zones[2].

3.3 Surveying stream conditions

In order to establish riparian buffer zones appropriately, it is important to recognize existing stream(and/or river) conditions. Streams and rivers are related to surrounding ecosystems(e.g., riparian areas). Changes within a surrounding ecosystem will impact the physical, chemical, and biological processes in the streams. Therefore, it is essential for establishment of buffer zones to gather information on situation of surrounding ecosystems including soil survey, climate, topography, native and exotic plants/animals, hydrology and land use. Because constructed buffer zones should be suitable for site-specific characteristics in stream restoration to fulfil a goal for successful installation. Besides, when establishing riparian buffer zones, it is significant to connect constructed buffers with existing forests, which serves as stream corridors for wildlife habitats. Because, in most cases, preservation is more effective than repair. These stream corridors can also serve fully as a green belt, which prevents excessive land development resulted from human encroachment.

4 Designation and management of riparian buffer zones

4.1 Designation

Riparian areas influence surface water quality directly, because runoff flows from surrounding area to the waterway without self-purification. Recently restaurants, hotels and concentrated animal farms have been occupied around riparian areas in the Paldang reservoir. The excessive land development in riparian areas and adjacent to the watershed has mainly negative effects on riparian and aquatic ecosystem. For fundamentally improving water quality, it may be essential for restoration activities to achieve ecological integrity. Dense forests have helped provide relatively healthy wildlife habitat as well as clean water until now in spite of heavy disturbance such as extreme land use and human encroachment. Therefore, designation of riparian buffer zones is required to sustain healthy forests and then improving water quality. The goal of designation of reservation areas is to enhance and protect surface water and ground water through recovering and preserving dense forest resources. Riparian

buffer zones can also protect against soil erosion and reduce sediment and nutrient delivery from uplands to the water. In the Paldang watershed, however, these forests are disturbed by numerous land owner associations, the central administration, local governments and private citizens.

Designation of riparian buffer zones were proposed as areas in 1km-width from boundaries of involved streams and lakes for the Paldang Special Measures Zone, and areas in 500m-width for the areas except the Special Measures Zones. In the end of 1998 riparian buffer zones are introduced by the 「Paldang Program」, and are confirmed legally on the 「Han River Act」. According to Sub-section 1, Section 4 of 「Han River Act」, (designation of riparian buffer zones), "Ministry of Environment should designate required areas among both sides of the Paldang reservoir, the South Han river, the North Han River and the Kyungan stream for riparian buffer zones, come under each Paragraph."

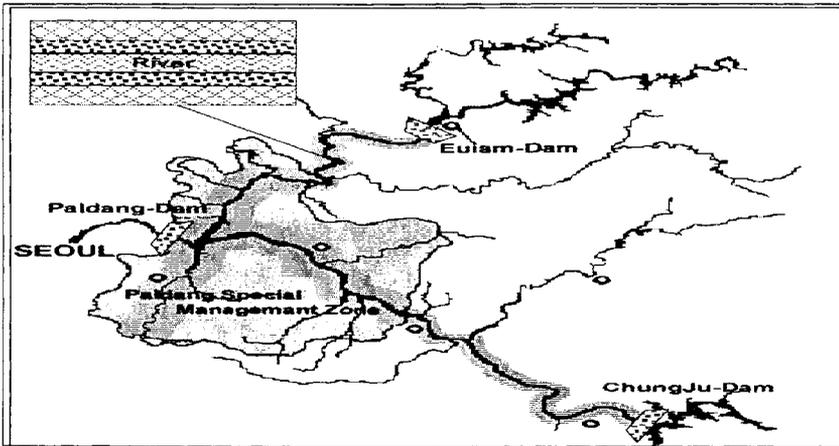


Figure 2 : Areas of riparian buffer zones in Han River basin

4.2 Plantation

Selection of vegetative species may be based on natural patterns of plant community distribution within stream ecosystem. Table 1 shows general distribution patterns of riparian plant species in Korea[1]. More detailed and site-specific plant community descriptions should be available by numerous researches for ecological restoration, especially for native plants and animals. Vegetation is a fundamental controlling factor in riparian buffer functions and, particularly, woody vegetation is the best stream bank stabilizer. Restoration of riparian buffers should protect existing native vegetation and restore vegetative structure to result in a contiguous and connected stream corridor.



Table 1 : Properties of riparian native plant species in Korea

Type	Water tolerance	Recommended plant species		Location in stream
		Major plant species	Minor plant species	
Tree	Strong	Willow, Korea weeping, Salicaceae		Stream bank & Streamside
	Medium	Elm, Chinese hackberry	Amur maple, Flowering cherry, Black pine, Goldenrain, Basswood	Stream bank & Streamside
	Weak	Elm, Cherry	Silk tree, Chestnut, Pine, Oak, Paulownia	Streamside
Shrub	Strong	Pussy willow, Salicaceae		Slope & Stream bank
	Medium		Spirea, Sumac, A kind of ivy, Golden-bell, Brier	Backslope & Streamside
	Weak		Bush clover, Kudzu	Backslope & Streamside

4.3 Management

Legal restrictions in riparian areas primarily include regulations on wastewater discharge facilities, animal waste discharge facilities, lodging facilities, public bath facilities and so on under Section 5. In riparian buffer zones, restrictions on new occupation as well as enhancement of management standards are implemented. This suggests that restaurants, hotels (and/or motel), public bathhouses, confined livestock farms and factories which are jumbled up and occupied newly should be controlled. For already existing facilities in riparian areas, effluent and management standard are fortified. Effluent standard of existing wastewater discharge facilities enhances twofold, from BOD 20ppm to 10ppm.[3]

Table 2 : Legal restrictions in riparian areas

	In the riparian buffer zones	Out of the riparian buffer zones
Wastewater discharge facilities	No installation	No installation
Animal waste discharge facilities	No installation	Only if all of waste can be transported to treatment facilities or manured, permitted
Businesses including Restaurants, Lodging, Public bath	No installation	Only if facilities discharge \leq BOD 10ppm after treatments, permitted

On the other hand, approximately 48% of land in the Paldang watershed is publicly-owned, while the remaining is owned by individuals. It may be desirable that riparian buffer zones should be public-owned land rather

than private-owned to improve water quality and accomplish integrity of stream ecosystem. Therefore, decreasing contaminant input and increasing self-purification capacity will be obtained through making vegetable buffers which are bought from individuals. To establish riparian buffers in the Han River watershed basically, land in riparian areas can be purchased, with Water-Use Charge System under Section 19 of 「Han River Act」. The following land of which property owners intend to sell their land is expected to be purchased for one hundred billion won per year supplied by Water-Use Charge System.

5 Conclusion

Riparian buffer zones controls water quantity and quality, moderates temperature, stabilizes channel geometry, and provides tree roots and woody debris for habitat. Designating riparian buffer zones in Han River watershed, these could not be fully understood what are functions of riparian ecosystems within watershed through intensive researches. But limitations should be improved by designing and managing riparian buffer zones. For urban(and/or suburban) circumstances, water quality can be protected by designation of riparian buffer zones. Riparian buffer zones alone is not adequate to ensure that water quality will be improved. Therefore, upland development adjacent the Paldang watershed, should be minimized. In connection with upland development, it has been also consequential concerns of purchasing land in the Paldang watershed to establish riparian buffer zones and especially to improve water quality. A variety of researches and projects related to riparian buffers in Han River should be investigated and conducted deeply.

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