ESTIMATION FOR RIVER MORPHOLOGY AND DESIGN ON THE DUDONG STREAM IN KOREA

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ABSTRACT

This study is to investigate the degree of river naturality according to the river morphology and the flora on the Dudong Stream at three regions during four seasons. Number of flexion was three at upper region and those of middle and low regions were one. Transversal and longitudinal sandbars were absent. Materials of river shore and river levee at low channel width were state of nature without protecting materials at upper region and those of middle and low regions were many artificial levee. At low region, materials of river shore at low channel width were composed of stonework, artificial vegetation, and natural type block. Land use in riparian zones within river levee was arable land (paddy fields, orchards). Land use in flood plains within river levee was artificial vegetation or natural vegetation mixed at low region. Transverse direction of artificial structures was bypass type. BOD level was high at low region and the ratio of sleep width/river width was 5-10%. Flood plains were distributed Gramineae vegetation. The construction of the reservoir has caused the quantitative collapse of the river area and cause the qualitative reduction of the riparian.

Keywords: Dudong Stream, Naturality, River morphology.

INTRODUCTION

Increasing human population and growth of technology require human society to devote more and more attention to protection of adequate supplies of water (Karr, 1991). Healthy and self-sustaining river systems provide ecological and services of critical importance to human societies everywhere (Postel & Richter, 2003).

Water, or its lack (dehydration), can influence cognition. Mild levels of dehydration can produce disruptions in mood and cognitive functioning. This may be of special concern in the very young, very old, those in hot climates, and those engaging in vigorous exercise (Popkin, 2010). The river has an aesthetically important function. For centuries society has interacted with rivers. They are an integral part of our local environment on which we historically depended for food, shelter and basic survival. A healthy environment is known to improve quality of life. Restoring rivers helps to provide quality environments and puts people in closer contact with nature. In urban environments this is particularly relevant, as restoring rivers can provide people with much needed green space, to offer people a place away from stresses. River restoration schemes can facilitate recreation and learning. Aesthetic issues play an important role in the public's perception of a recreational river area, for example public opinion surveys about desirable seaside resort characteristics have found that some 10% of respondents cite the importance of a clean beach (Oldridge, 1992). The principal aesthetic concern is revulsion associated with obvious pollution of the water body, turbidity, scums or odour (which may relate to inadequate levels of dissolved oxygen). Water pollution may cause nuisance for local residents and tourists as well as environmental problems and may lessen the psychological benefits of tourism (WHO, 1980). Some studies have shown that rivers of good microbial or chemical quality have been perceived as poor by the public because of aesthetic pollution (Dinius, 1981; House, 1993). Poor aesthetic recreational water and beach quality may, however, also imply poor microbial/chemical water quality.

River morphology is the shape or form of a river along its length and across its width and results from the complex interplay of many geomorphic process that occur in a basin at different spatial and temporal scales (Ibisate et al., 2011). Fluvial geomorphological processes and channel forms are determined by three main factors: discharge and sediment yield, which are the main drivers, and valley characteristics, which establish the boundary conditions (Newson, 2002). These factors are influenced by other variables within and outside of the catchment and by different human activities that frequently dictate the character of riverine landscapes (Church, 2002).

The numerical eco-friendly method is a new branch of applied design. This is a great progress in the civil engineering design, and it is a structural design method more scientific, more effective and more economic (Xu and Ding, 2008).

The Dudong Stream is started at the Dudong Reservoir and ends the Dudong River. Vegetation of the Dudong Stream provides water purification and flow rate of deceleration, and fish habitat. In addition, vegetation is the site of the distribution of fish, birds, amphibians, reptiles, etc and is very important to build food networks.

The many aquatic plants of the Dudong Stream were destroyed or damaged during the so-called Direct-stream Rivers Project: offsetting environmentally detrimental effects of man-made structural changes to the river. The principal factor controlling the distribution of aquatic plants is the depth and duration of flooding. However, other factors may also control their distribution and abundance, including nutrients, disturbance from waves, grazing, and human activity. The purpose of this study is to investigate the flora and vegetation on the Dudong Stream at three regions during four seasons before secondary indirect damages occur in this river by construct of beams. Therefore, this survey recorded material significance for the future appears in the environment to restore or improve the problem may be.

METHODOLOGY

Surveyed Regions

Geographical ranges of the Dudong Stream were a total length of 2.1 kilometers from the Dudong Reservoir to the confluence of the Dudong River. The flora and vegetation on the Dudong Stream were investigated at three regions and adjacent areas during four seasons (Fig. 1).

Methods

Index of degree of river naturality according to the river morphology was analyzed according to Table 1. Index of degree of river naturality according to the environment of river was also analyzed according to Table 2.

All plants were identified at each survey region to the emergence of bilateral embankment into the river embankment and the distribution characteristics (ecotype plants, naturalized plants, endemic plants, court protection plants, etc.) were also examined. The system of plant classification system was followed by Lee (2007). Naturalized plants were followed by Korea National Arboretum (2012).

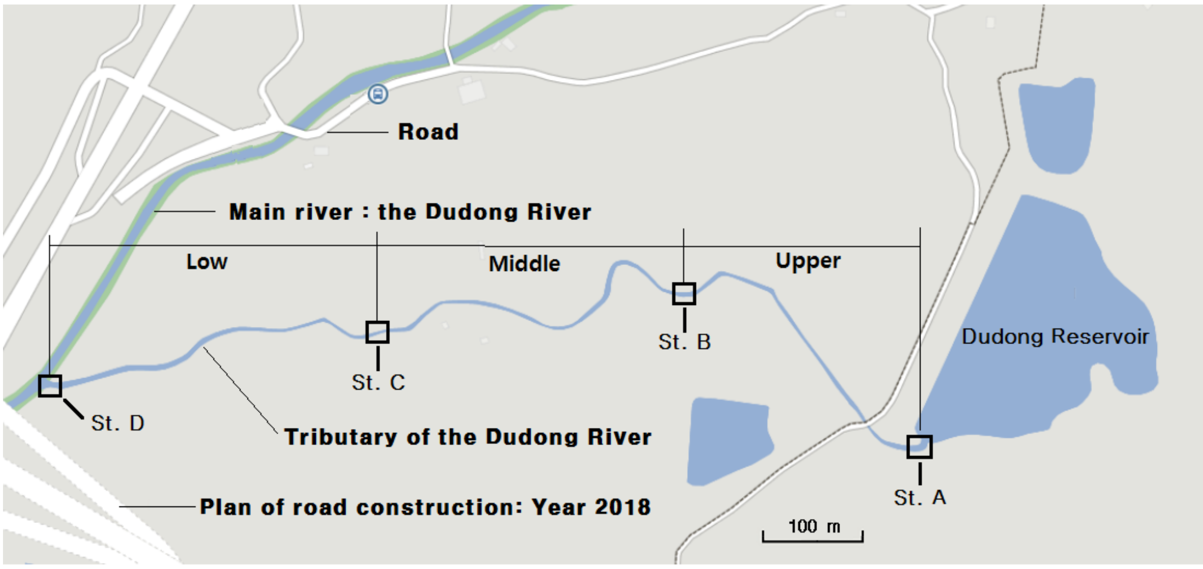

Figure 1: The four survey locations and three internodes at the Dudong Stream.

RESULTS

Upper Region

This area is the downstream region of the Dudong Reservoir. The river width at this region is about 1.5 m. Number of flexion was three in this region (Table 3). Transversal & longitudinal sandbars were absent. Velocity of flood was fast. Bed materials were composed of boulders. Materials of river shore and river levee at low channel width were state of nature without protecting materials and artificial levee. The law water's edge vegetation and flood way vegetation were shown naturally formed vegetation communities (Table 4). Land use in riparian zones and flood plains within river levee were bush or grassland with nature structures. Transverse direction of artificial structures was absent. BOD level was low (values were 1-2). The ratio of sleep width/river width was 20% or more. One embankment dam was constructed across a river to create the Dodong Reservoir in the valley behind by storing the water that flows into it naturally. The embankment dam is bank or hill shaped and is made mainly from natural materials like earth, gravel and small rocks. Near shore and riparian vegetation provides habitat for many wildlife species. Left area was distributed pine vegetation (*Pinus densiflora* and *Pinus rigida*) and right area was covered with *Pueraria thunbergiana* community. Riverbed area was dominated by *Persicaria thunbergii* community. Dominant species in flood plains were *Miscanthus sacchariflorus* and *Persicaria hydropiper* (St. A area). *Equisetum arvense* was distributed in riparian (St. B area). These plants give a feeling of luck and help emotions.

Middle Region

The river width at the region is about 2.5 m. Number of flexion was one in this region (Table 3). Transversal & longitudinal sandbars were absent. Velocity of flood was moderate. Bed materials were composed of boulders and gravels. Materials of river shore at low channel width were composed of natural materials and artificial vegetation. The law water's edge vegetation was shown natural weeds, shrubs, and mixed (Table 4). The flood way vegetation was shown both of natural vegetation and artificial vegetation. Land use in riparian zones and flood plains within river levee were arable land (paddy fields, orchards) and artificial vegetation. Transverse direction of artificial structures was absent. BOD level was low (values were 1-2). The ratio of sleep width/river width was 5-10%. There were occurred in *Erigeron annuus*, *Rumex crispus*, *Chenopodium album* var. *centrorubrum*, *Oenothera odorata*, *Lepidium apetalum*, *Amorpha fruticosa*, *Astragalus sinicus*, and *Trifolium repens. Phragmites japonica.* The dominant species in sand dunes was *Phragmites japonica* community which was existed with *Salix gracilistyla* and *Persicaria nodosa* (St. C area). However, because the plants are randomly distributed, the design of the stream is needed.

Low Region

The river width at the region was about 4.0 m. The sand dune areas were developed in the middle region. Number of flexion was one in this region (Table 3). Transversal & longitudinal sandbars were one. Velocity of flood was slight. Bed materials were composed of sand, silt, and clay. Materials of river shore at low channel width were composed of stonework, artificial vegetation, and natural type block. The law water's edge vegetation was shown artificial vegetation (Table 4). The flood way vegetation was shown both of natural vegetation and artificial vegetation. Land use in riparian zones within river levee was arable land (paddy fields, orchards). Land use in flood plains within river levee was artificial vegetation or natural vegetation mixed. Transverse direction of artificial structures was bypass type. BOD level was high. The ratio of sleep width/river width was 5-10%. Flood plains were distributed Gramineae vegetation (St. D). However, in this internode (low region), many riparian plants were removed for supplementation of river due to flooding. River design with ornamental plants as well as natural plants need to restored for aesthetics.

Table 1: Index of degree of river naturality according to the river morphology

Item	Estimated index and scores				
	1	2	3	4	5
No. of flexion	Over four	Three	Two	One	Absent
Transversal & longitudinal sandbars	Over 7	Five or six	Three or Four	One or two	Absent
Diversity of flow	Very fast	Fast	Moderate	Slight	Absent
Bed materials	Boulders	Boulders & gravel	Sand, silt, clay : 50% >	Silt, clay	Sand
Diversity of low channel width	Very large	large	Moderate	Slight	Absent
Materials of river shore at low channel width	State of nature without protecting materials	Natural materials + artificial vegetation	Stonework + artificial vegetation	Stonework or penetrating river shore	Concreted impervious
Materials of river levee at low channel width	State of nature without artificial levee	Artificial soil-levee (natural vegetation, lawn)	Stonework, natural type block with artificial vegetation	Stonework, penetrating levee with natural type block	Stonework, impervious levee with concrete

Table 2: Index of degree of river naturality according to the environment of river

Item	Estimated index and scores				
	1	2	3	4	5
The law water's edge vegetation	Naturally formed a variety of vegetation communities	Naturally formed various vegetation communities by natural erosion (sediment exposure) were absent	Natural weeds, shrubs, and mixed	Artificial vegetation composition	Vegetation blocked by stonework etc.
Flood way vegetation	Naturally formed a variety of vegetation communities	Naturally formed various vegetation communities by natural erosion (sand bar) were absent	Both of natural vegetation and artificial vegetation	Artificial vegetation with Parks, lawns, and so on	Remove vegetation artificially
Land use in riparian zones within river levee	Bush or grassland as natural floodplain	Arable land (paddy fields, orchards)	Arable land, urban, residential mixed	About 1/2 urban, residential mixed	1/2 or more urban, residential

Land use in flood plains beyond river levee	State of nature without artificial vegetation, manmade structures	Arable land or artificial vegetation	Artificial vegetation or natural vegetation mixed	About 1/2 park facilities, playground facilities	Impervious man-made structures, parking, etc.
Transverse direction of artificial structures	Absent	Bypass reservoir or slope waterway reservoir	Fish migration reservoir	Reservoir of height 0.3-0.4 m, fish migration difficulty	Fish move completely blocked
Water quality (BOD)	Class 1 (crystal clear)	Class 2 (clear relatively)	Class 3 (tan, the bottom green algae)	Class 4 (blackish brown, the floor is not looked)	Class 5 (an ink color, odor)
Sleep width /river width ratio	20% or more	20 ~ 10%	10 ~ 5%	5 ~ 1 %	Less than 1%

Table 3: River morphology of the Dudong Stream

Region	No. of flexion	Transversal & longitudinal sandbars	Diversity of flow	Bed materials	Diversity of low channel width	Materials of river shore at low channel width	Materials of river levee at low channel width	Mean
Upper	2	5	2	1	3	1	1	2.143
Middle	4	5	3	2	4	2	2	3.143
Low	4	4	4	4	3	3	4	3.714

Table 4: Index of degree of river naturality according to the environment of river at the Dudong Stream

Region	The law water's edge vegetation	Flood way vegetation	Land use in riparian zones within river levee	Land use in flood plains beyond river levee	Transverse direction of artificial structures	Water quality (BOD)	Sleep width /river width ratio	Mean
Upper	1	1	1	2	1	2	2	1.429
Middle	3	3	2	2	1	2	3	2.286
Low	4	3	2	3	2	3	3	2.857

DISCUSSION

Valley streams or rivers have the potential to collect, store, and slowly release runoff and floodwaters gradually over time. The degree of flood control depends on the size and shape of the wetland, its landscape position, the depth to the water table, soil permeability and slope. The storage function helps to minimize flooding of downstream properties, slow erosive flows in stream channels, and delay the arrival of peak discharges. For example, one study indicates that wetlands can store almost all of the snowmelt runoff generated in their watersheds, which can be very important in regions of the country where snowmelt flooding is a concern (Hayashi *et al.*, 2003). The value of stream flood storage is often greatest in urban watersheds where past development has sharply increased peak discharges during flood events. Trees and other wetland vegetation also impede the movement of flood waters and distribute them more slowly over floodplains. The Dudong Stream produce considerable biomass and contain a mosaic of upland and wetland habitat features that helps support their high biodiversity. Each wetland type offers a unique mix of habitat elements such as cover, food, water, nesting and other life sustaining features. Thus, rivers or streams should be designed in harmony with the river structure, tree distribution, riparian vegetation, and ecological aspects.

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