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TIME SUBMITTED	30-MAR-2019 06:16PM (UTC+0700)	WORD COUNT	3610
SUBMISSION ID	1102587813	CHARACTER COUNT	20313

Judging Restoration Success of Kamisaigo River Japan

Rita Lopa, Yukihiro Shimatani

Abstract—The focus of this research is 880m extension development along the Kamisaigo River. The river is flowing tributary of grade 2 rivers Fukutsu City, Fukuoka Prefecture. This river is a small-scale urban river and the river was formerly a straight concrete sea wall construction. The river runs through National Highway No. 3 from the confluence of Saigo River. The study covers the river basin about 326 ha with a catchment area of 20.63 ha and 4,700 m^3 capacity regulating pond. The river is not wide, shallow, and has a straight alignment with active (un-vegetated) river channel sinuosity (ratio of river length to valley length) ranging between 1 and 1.3. However, the alignment of the low-flow river channel does have meandering or sinuous characteristics. Flooding is likely to occur. It has become difficult to live in the environment for organisms of the river. Hydrophilic is very low (children cannot play). There is little connection with the local community. Overall, the Kamisaigo River watershed is heavily urbanized and from a morphological, biological and habitat perspective, Kamisaigo River functions marginally not well. For river improvement and maintenance of the Kamisaigo River, the workshop was conducted in the form of planning for the proposed model is presented by the Watershed Management Laboratory. This workshop showed the relationship between citizens, City Government, and University of mutual trust has been established, that have been made landscape, environment, usage, etc: retaining wall maintenance, hydrophilic zone, landscape zone, nature walks zone: adjacent medical facilities and adjacent to large commercial facilities. Propose of Nature walks zone with point of the design: provide slope that the wheelchair can access and walking paths to enjoy the scenery, and summary of the Kamisaigo River workshop: creating a multi-model study and creation of natural rivers.

Keywords—River restoration, river improvement.

Introduction

Rivers confer benefits on human beings in various forms. Rivers also contribute in creating landscape, nature and culture. Another reason why the rivers become a key element of all of civilization is that the rivers that support the commercial and social activities, such as shipping transportation and fisheries and so on. For example, by utilizing the Nile River of Egypt to achieve progress in the fields of culture and civilization, also including the main water source of the Arabs at that time. In addition to significant gains in social and commercial fields, the beauty of the scenery of a river is another gift to the human conscience. Water sources that pleased the eye and ear give a beautiful landscape/aesthetical value, and makes neighborhoods like it more valuable but the landscape of rights of access and management of water resources is changing rapidly, both for hydrological and political reasons.

River restoration is the harmony of the arts and the engineering to enhance a scenery and function of the river. We define river restoration as assisting the recovery of ecological integrity in a degraded watershed system by reestablishing natural hydrologic, geomorphic, and ecological processes, and replacing lost, damaged, or compromised biological elements (Ellen Wohl et al., 2004)[1].

Yukihiro Shimatani (2000) stated that there are seven basic concepts of river restoration: 1) Consider defining flood control, 2) Clearly recognize the current environmental state based on historical data, 3) Establish deterministic objectives, 4) Correctly understand the targets to be conserved and restored with their scales, 5) Accept expected changes, 6) Take full use of natural energy, and 7) Understand living things having homes there [2]. Whilst David L Rosgen (2011) have revealed restoration basics including: 1) Understand the cause of problems, 2) Identify the degree and nature of impairment, 3) Evaluate departure from stability, 4) Examine potential of river systems 5) How to fix, stabilize, enhance amongst great complexity and risk, and 5) Appropriate [3].

The nine step guides for stream restoration by USDA NRCS (2012) are follows: 1) Identify problems and opportunities: What stream characteristics should be changed? 2) Determine objectives: What are the desired physical, chemical and biological changes? 3) Inventory resources: Study the stream to understand the dominant physical processes, impacts on water quality, and abundance and distribution of biological populations, 4) Analyze resource data: Evaluate the collected information and decide what processes most influence the desired stream condition, 5) Formulate alternatives: Determine which processes can be changed. Include a no action option, 6) Evaluate alternatives: Which alternatives are sustainable and cost effective? 7) Make decisions: Develop a consensus-based decision by the stakeholders and interdisciplinary team regarding which alternative to implement, 8) Implement the plan and 9) Evaluate the plan: Perform post project monitoring, to assess performance and revise practices [4].

EPA Watershed Ecology Team revealed that restoration principles are: 1) Preserve and protect aquatic resources, 2) Restore ecological integrity, 3) Restore natural structure and function 4) Address causes of degradation, 4) Develop clear, achievable and measurable goals, 5) Focus on feasibility, 6) Use reference sites, 7) Anticipate future changes, 8) Involve a multidisciplinary team, 9) Design for self sustainability, 10 Plant native species, 11) Use natural fixes and bioengineering, and 12) Monitor and adapt where changes are necessary.

Civilizations have been developed along the river since early times. Restoration of urban rivers is a new endeavor. Restoring rivers are combination between art and technical or scientific challenge. River restoration and waterfront development are in the mode, ranging from Europe over the American continent to Australia, Japan and many other countries, there have been many restoration practices for small river ecosystems with mature restoration technology. The earliest river restoration

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projects are launched in Europe. River restoration started in Europe in the 1980ies, ranging from landscape gardening (improving the aesthetic value) and river training using bio-engineering approaches to restoring historical conditions (e.g. re-meandering river) or natural processes (e.g. adding wood to initiate natural channel dynamics), include the creation of secondary channels along the Rhine.

Generally the number of urban river rehabilitation schemes across Europe is still small. A total of about fifty urban river rehabilitation schemes, mainly from Europe, was identified. It became obvious, that there is an uneven distribution of potentially appropriate rehabilitation projects across the European countries. For instance, in Austria, France, Germany and Great Britain a comparatively high number of projects could be identified. The US started the activities in 1976. South of Korea started the big revitalization for the four river restoration in 2008, which is enhancing restoration along 929 km of ecological streams and wetlands including Han River, Nakdong River, Geun River and Yeong san River, hence the typhoon naemi in 2003 afflicted this country.

Nishikawa Sukenobu was born in 1671 and b*etween 1710 and 1722, Sukenobu published some fifty erotic works. This study contends that these works were an expression of political disaffection*. Therefore, with Sukenobu being based in the imperial city of Kyoto this provided him with more freedom and his thinking would be influenced by the environment.

Japanese rivers are unique. They are steep, short, flashy and sediment rich (ChihiroYoshimura et.al, 2005) [5]. 70% of Japan is mountains, hence rivers are short and steep and flow rapidly and violently. It has a narrow surface area, rapid run-off of precipitation, and high population density. Moreover, Japan has twice precipitation as much as that of the world average. Most of Japanese cities are susceptible to flooding because they are in lowland which is below the flood water level of the rivers. In Japan, 109 river systems that are especially important in terms of national land conservation and the nation's economy are defined as Class A water systems, and they are managed mainly by the Ministry of Land, Infrastructure, Transport and Tourism (partly by prefectures). Furthermore, other river systems that play an important role in the public interest are called Class B river systems. Class B and other river systems except for Class A river systems are managed mainly by prefectures.

After the Second World War Japan experienced a period of rapid industrialization and urbanization, this caused serious pollution of many rivers. Some devastating typhoons led to the initiation of a massive flood control project with a boom of large dam constructions and river channelization works. At least three endemic fish species have totally disappeared, and about 60 fish species are listed as endangered (ChihiroYoshimura 2005)[5]. The chemical water quality started to return to acceptable levels, but the physical condition remained poor, especially in lowland rivers. A rating system used in Japan to evaluate the condition of the river based upon assessments of river, river cover and habitat diversity. In 1970, the term "easy-access-to-water" used for the first time in Japan. It is that in order to create a variety of conservation and river scenery, and river management. Notification will be issued in 1990 for the promotion of "natural type river development" many natural rivers making this multi various efforts have been made in various parts of the country. In response to that, such as the improvement of river development remains challenging has been pointed out as a center small river, basic guidelines have been created. Although it is specified by the planning technical standards for erosion control rivers River Bureau Ministry of Land, Infrastructure and Transport. The idea of channel planning, and specific techniques of small and medium-sized river plan was unclear.

Then, Naturally-diverse river works (Japanese river restoration) officially started in 1990 by MOC (the Ministry of Construction) now MLIT (The Ministry of Land, Infrastructure and Transport and Tourism) with a purpose: Ecosystem with high biodiversity and beautiful landscape, and then river restoration activities have increased significantly. Based on a comprehensive database of >37,000 river restoration projects across the Japan country. The Itachi River restoration project was one of the earliest such project in Yokohama Japan starting in 1982 in order to restore the waterfront to its natural state (re-naturalization of waterway). A part of the riverbed of the cross sectional waterway was dug out. At the ends of the waterway, banking is done. This case is so famous that it is called the Itachi River method. There were several goals for this river restoration plan to maintain sufficient water depth (ie. to restore the water depth to pre-construction levels), to restore water front vegetation, to revive the riverbed micro-topography in both rapid and slow streams, and to develop the river-walk. Through experimentation with various construction method, the waterfront environment has now regained its natural vitality and once again attracts the local people (Yukihiro Shimatani 2000)[2].

Then, in 1998, "technical standards for river plan for small and medium-sized rivers," which summarized the considerations and basic idea of the preparation of small rivers river plan has been proposed. By 2010, incorporate the technical standards for the design and planning of the waterfront, seawall, the banks of the small rivers in the revision of the "technical standards on small river river plan" has been made. In urban river, this is even more pronounced. For this reason, only the natural river, thereby playing a clear structure abyss is difficult rapids, some construction methods during construction, and regenerating the abyss rapids is required. Thus, for the regeneration of deep structure, small urban rivers, various construction methods have been tried. However, currently, the repair process is still at the stage of trial and error in Japan.

The Kamisaigo River is not wide, shallow, and has a straight alignment with active (un-vegetated) river channel sinuosity (ratio of river length to valley length) ranging between 1 and 1.3. However, the alignment of the low-flow river channel does have meandering or sinuous characteristics. Flooding is likely to occur. It has become difficult to live in the environment for organisms of the river. Hydrophilic is very low (children cannot play). There is little connection with the local community. Overall, the Kamisaigo River watershed is heavily urbanized

and from a morphological, biological and habitat perspective, Kamisaigo River functions marginally not well.

Methodology

The focus of this research is 880m extension development along the Kamisaigo River (Figure 1). The river is flowing tributary of grade 2 rivers Fukutsu City, Fukuoka Prefecture. This river is a small-scale urban river and the river was formerly a straight concrete sea wall construction. Effect of straightening of the Kamisaigo River is high riverbanks that, the river improvement now proceed, using a variety of construction methods for each interval, the structure has been tried playing rapids. The river runs through National Highway No. 3 from the confluence of Saigo River. The study covers the river basin about 326 ha with a catchment area of 20.63 ha and 4,700 m^3 capacity regulating pond.

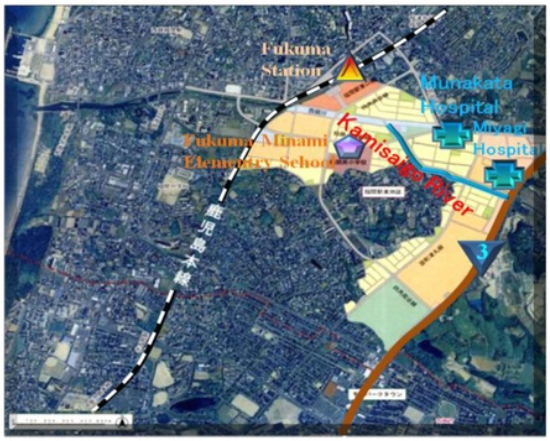

Figure 1. There is 880m extension development along the Kamisaigo River

For river improvement and maintenance of the Kamisaigo River, based on the basic proposal is summarized in 2005, and is intended to create a better plan was introduced the concept of Nature-friendly river. Redevelopment of the site required that the river be improved to create an attractive public amenity, because the site is prominently located in the heart of Fukutsu City. The workshop was hold to participate in both the valley district, the city council building south Fukuma Township Elementary School District, Kamisaigo River workshop members in 2005: Watershed Management Laboratory, Kyushu University, Civil Engineering officer Munakata, design consultants and local beneath.

Result and Discussion

The relationship between citizens, City Government, and University of mutual trust has been established. The workshop was conducted in the form of planning for the proposed model is presented by the Watershed Management Laboratory (Figure 2), that have been made landscape, environment, usage, etc: 1) November 10, 2007 Description of Kamisaigo River workshop, 2) March 14, 2008, retaining wall maintenance, 3) May 7, 2008, hydrophilic zone, 4) June 13, 2008, hydrophilic zone, 5) July 16, 2008, landscape zone, 6) September 1, 2008, Nature walks zone: adjacent medical facilities and adjacent to large commercial facilities, 7) October 20, 2008. Propose of Nature walks zone with point of the design: provide slope that the wheelchair can access and walking paths to enjoy the scenery, 8) November 26, 2008, Summary of the Kamisaigo River workshop: creating a multi-model study and creation of natural rivers. Construction plans cross linked change with Shiroumaru Bridge in 2008, Sakura Bridge in 2010, Kifune Bridge in 2010, and Himaki Bridge in 2012.

Figure 2. The landscape model of Kamisaigo River

The Kamisaigo River recently completed a third major river restoration project. One of the primary goals of this most recent project was the variety of the natural habitat river scenery. The restoration specifically involved placing logs and/or a series of boulders into the river. The restoration work has been started since November 2009. The first phase of the Kamisaigo River Restoration Project began at the Station 3 and ended about 70 m upstream in the winter of 2009. The second phase of the project began in the summer of 2010 and was completed during the winter of 2011. The third phase of the project began in the summer of 2011 and was completed during the winter of 2012. This second phase covered about 500 m of river from station 2 to 5, and was the primary focus of this research, Figure 3.

Figure 3. The first and the second phase of the Kamisaigo River Restoration Project.

What happened to a particular landscape in an effort to help the Kamisaigo River became stable. Rock gabions have been used to stabilize and protect steep banks. Gabions are made out of a small meshed wire grid filled with coarse gravel. Living sticks or sprouted plants are incorporated. Stabilization is enhanced through the roots of vegetation and the connection of all elements. Gabions are rectangular wire baskets made of heavy galvanized or coated wire mesh. They are filled with small to medium sized rock and soil. Gabions are laced together to form terraces or a wall. Placing live branches between each layer of rock filled baskets incorporates vegetation, Figure 4. The resultant design gave the erosion protection and increased flood capacity required while also greatly enhancing the habitat over the 300m.

Figure 4. Erosion control mats in the Kamisaigo River.

Restoration of native vegetation in the Kamisaigo River, retained for further consideration such as planting trees and shrubs, which has provided free or low cost native plants. Encouraging the growth of riparian vegetation would provide habitat cover for fish. The planting strategy employs groups and clusters of vegetation to increase chances of success with patchy development rather than randomization. Similar species will be planted together particularly with regard to the shrub species. *Salix gracilistyla* is a species of willow native to Japan known in English as *Rosegold Pussy Willow*. It blooms which appear in early Spring. It's shape is described as arching. It grows to a height of 3m and 4m in width. It has oval foliage that is gray/green. It produces flowers and this hardy plant grows with a strong and distinct shape and grows into a large and dominant plant. It requires a moist and rich soil, preferring full sun, and a position free standing, in water or by the side of water. This plant is likely to need pruning. It is susceptible to and should be protected from scale insects, rust, leaf spot, caterpillars and aphids. Bio-habitats provides habitat and is an aesthetic attraction.

In the future, it should be a harmony between citizens and the river. Many private citizens have been endeavors to nurturing the Kamisaigo River. By 2005, the Fukutsu government and Ministry of Land, infrastructure, Transportation and Tourism of Fukutsu Bureau, academia (university researchers and other experts) and citizens active in this effort and joined to create a network. Every season the stakeholders who initiate river restoration projects include private individuals, non-governmental organizations (NGOs), governmental organizations and various collaborative combinations of the above and the restoration community (practitioners, decision makers and scientists) conduct comprehension workshop for this river, which administrative organizations perform discussion and cooperation each other for constructing and coordinating an agreement toward success this river, Figure 5. Such activities are designed to love this river, such as education for elementary school students in which students played with aquatic life in the Kamisaigo River, clean up, cut the grass and plant the flower that a key to keeping this river beautiful, and other various events, Figure 6.

Figure 5. The stakeholder and the restoration community conduct comprehension workshop every season

Figure 6. Education on river environment

Conclusion

This workshop showed the relationship between citizens, City Government, and University of mutual trust has been established, that have been made landscape, environment, usage, etc: retaining wall maintenance, hydrophilic zone, landscape zone, nature walks zone: adjacent medical facilities and adjacent to large commercial facilities. Propose of Nature walks zone with point of the design: provide slope that the wheelchair can access and walking paths to enjoy the scenery, and summary of the Kamisaigo River workshop: creating a multi-model study and creation of natural rivers.

Acknowledgements

Thank you for opportunity to write this paper at 18th International Conference on Civil and Environmental Engineering (ICCEE 2016) in Tokyo. This work was supported by a grant from the Japan Bank International Corporation and by the Watershed Management Laboratory, Department of Urban and Environmental Engineering, Kyushu University.

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