

Restoration of severely polluted and damaged streams within Jeju City

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1. Introduction

Streams play a vital role as a source of drinking water and as a place where flora and fauna can naturally flourish; however, many urban rivers have lost their ecological fecundity due to the construction of concrete riverbanks and industrial pollution. Mounting public interest in environmental and quality of life issues has resulted in a number of recent attempts to restore polluted urban rivers, but there have been complications. Efforts to clean polluted streams are at odds with developers who would otherwise prefer to develop the economically valuable land adjacent to the rivers. Thus, any feasible restoration of urban streams must demand environmental sensitivity of both policymakers and local residents, in addition to a well-developed business strategy that can ensure economic vitality. Jeju City, a city in Korea with a vital tourism industry, is now highly praised for its success in stream restoration as well as providing a viable commercial plan for the city. It is an example of how such sustainable urban development measures can be attained. Jeju City started by reclaiming the Sanji River area that stretches through the city by first tearing down dilapidated concrete over-structures built in the 1960s, and then restoring the area back to its original natural habitat. This project commenced in March 1996 and was completed in June 2002.

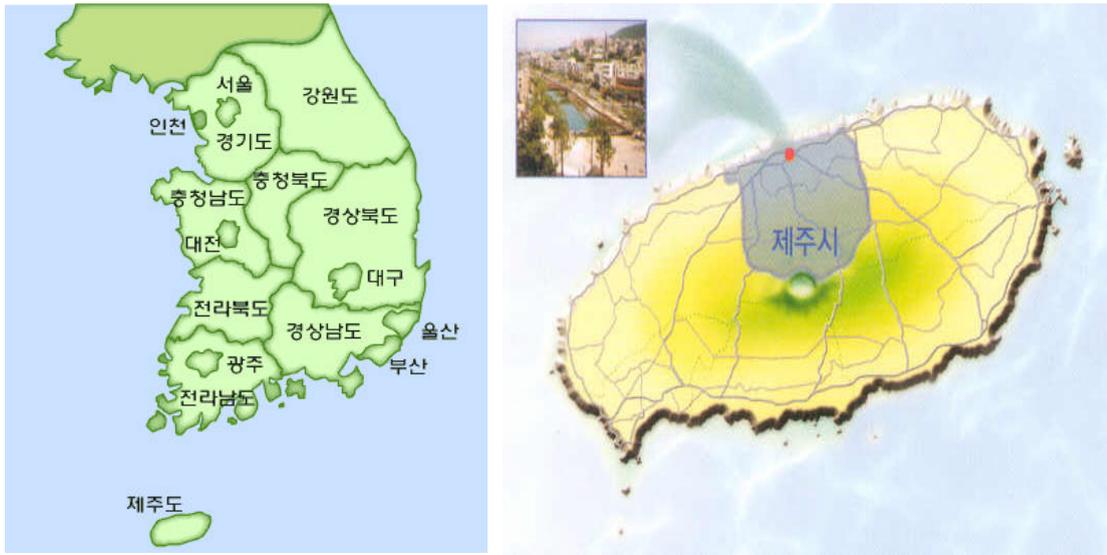
The Sanji River, running through downtown Jeju City, was covered over in 1965 during a period of brisk urban development. Commercial districts formed successively out of the 14 apartment and retail complexes that were built on it. Since then, the Sanji River zone has played an important role in the local economy and supported diverse activities. But by the 1990s, the concrete over-structures of the rivers had deteriorated and were dismantled in some parts due to safety concerns. During the decision-making process that determined the dismantlement of the over-structures, Jeju City authorities gathered many opinions from all sectors of society with most supporting the reclamation of the regional rivers back to their original, natural beauty. Jeju City authorities accepted this majority opinion and then proceeded to devise and implement the ecology preservation project.

This ecological restoration achievement was recognized and granted an award at the Reform Expo 2002, a forum for self-governing bodies of Korea. Additionally, Jeju City was highly praised for its success in the mountain river restoration project and was awarded as the top self-governing body for sustainable city evaluation as supervised by the Korea Planners Association and Citizens' Coalition for Economic Justice. This article presents the Sanji River Restoration Project as a distinguished example of urban environment renewal.

2. General background

The Sanji River runs through Jeju City, which is the provincial capital of Jeju Island and situated on the northern coast. Jeju Island lies approximately 90 kilometers directly south of the Korean Peninsula (just beyond the Jeju Straights, at Long. 126° 25' ~ 126° 39' E, Lat. 33° 17' ~ 33° 32' N). As the primary gateway to the island, Jeju City is an important hub as there are major highways as well as an international airport and ferry terminals serving several ports of the Korean mainland, in addition to China and Japan. Jeju City is also the island's epicenter for education, culture, and commerce. The population of Jeju City has been rising continuously because of active local development and increased opportunities. There are now approximately 280,000 people living within the 255.36km² area, with a sustainable level of population distribution.

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Map of Jeju Island

There are 11 watercourses running through downtown Jeju City, with a total length of approximately 9km. The Sanji River is a main water artery starting from Samuiyangoreum and disgoring into the sea at Sanjipogu. The stream courses through some parts of Ildo1-dong, Ildo2-dong, Ido1-dong, Ido2-dong, and Geonip-dong in the city. The population in the areas near the Sanji River is approximately 106,680, which constitutes about 38.2% of the total population of Jeju Island. The Sanji River area is thus considered the center of the metropolitan area of Jeju City, where the population density is relatively high.

<Table 1> Population in the Sanji River areas (2001) (unit: 1 person)

	Total number of families	Total population	Location
Jeju City	90,562	279,087	
Sanji River basin	33,740	106,635	
Ildo1-dong	1,775	4,571	
Ildo2-dong	12,289	40,817	
Ido1-dong	2,761	7,669	
Ido2-dong	12,791	41,330	
Geonip-dong	4,128	12,247	

The Sanji River used to be a natural river, but it was artificially covered over in 1965. Fourteen buildings were built on the covered part of the river and 286 occupants moved into the new buildings and developed the area as a commercial district. The ecological habitats surrounding the river began to seriously deteriorate over time, and the area started to suffer from flooding and many other instances of environmental destruction. Due to these environmental problems, the pollution did not seem to have any possibility of abatement. Moreover, the Sanji River grew to be the most seriously contaminated river in Jeju Island even though it was located near Jeju Harbor, which lies on the relatively clean Yellow Sea. The once popular central commercial district began to lose its charm as a center for business activity because of the overwhelming offensive stench and pollution. When concerns arose in 1991 about the serious

dilapidation and safety of the structures covering the Sanji River, the majority of public opinion advocated their removal. As a result, Jeju City authorities initiated the Sanji River Restoration Project.

At first, the Sanji River Restoration Project was planned primarily to enhance the economic value of the surrounding area, namely, renovating the covering structure and re-establishing the main function of the district as the center of transportation and commerce. However, local residents pushed for the river to be restored back its natural ecological state, so Jeju City changed the original focus into one of reclaiming the river. This environmental project, costing 36.5 billion won, had imperceptible economic effects but was pushed forward thanks to the high environmental consciousness of both the local residents and the policy makers, although the city's total budget was 242 billion won.

This Sanji River Restoration Project was driven forward with the aim of restoring the river into a natural ecological habitat running through the city center in order to enhance local civic culture. The ecosystem was reclaimed, forestation promoted, and some historical sights restored.

Reclaiming the Ecosystem

The natural ecosystem of the Sanji River was greatly destroyed and therefore needed a considerable amount of effort and expense to restore it to its original natural state. At the time of reclamation the surrounding habitat lacked a natural distribution of flora and fauna. The ill-balanced ecosystem was due to the disruption caused by sewage disposal and the over-development of bridges and buildings that also disrupted the natural flow of rainwater that caused considerable flood damage. As for the academic value as a site for biological studies, the restoration project was much more important.

Establishing Forestation

Reclamation of the Sanji River was important because it could restore the lack of green tracts of land. With the rapid increase of roads and bridges brought upon by the rising population and commercial development, Jeju City needed to create green tracts of land that could play an important role as a refuge for its citizens from the concrete urban landscape. The number of green tracts of land and resting places in Jeju City was scarce, and creating new green areas was administratively difficult due to high downtown real estate values and private property rights.

Establishing green areas around the Sanji River had an advantage because the river ran through the city center, real estate was not relatively expensive, and there would be less resistance from residents. In addition, the slope of the Sanji River was sharp, providing for easy maintenance and preservation of the new green areas and establishment of an esplanade along the river that would discourage indiscriminant garbage disposal.

Restoration of Historical sites

The Sanji River is the birthplace of Jeju's cultural history. The history of Jeju Island developed alongside the Sanji River similar to how most civilizations developed along riversides. From Tamra, the origin of Jeju 1-do, 2-do, and 3-do "dongs", or neighborhoods, Jeju City played its role as the social center of Jeju Island, and the Sanji River was the venue through which civilization flowed throughout the island. Because the Sanji River area was central to the historical origin and development of Jeju Island's civilization, the restoration of this historical and cultural site was an important goal of Jeju City planners.

3. Situation prior to project implementation

Originally, the Sanji River was the only major waterway located within city borders, becoming an important factor of Jeju City's space composition. When the city began to expand during the Japanese invasion period, new harbors, public facilities, and shipbuilding plants were built along the riverbanks. In 1960s, the lower reaches of the river were built over because of the increased population, and the area began to develop as the commercial center of the city.

When site demarcations were delineated during the 1970s, and as the southern area of the city developed,

Yeon-dong, a new section of the city was developed and the Sanji river became deprived of its main function as the city's downtown due to decreasing marine transportation. This later led to environmental problems.



1950s: the Sanji River prior to being covered



1960s: Construction of the structures covering Sanji River



1970s: Sanji River after covering



1990s: Sanji River prior to restoration

Effects of the covering of the Sanji River

Shortly after the river was covered, the ecosystem of the river totally deteriorated. There remains only a little data about the flora and fauna inhabiting the area, but there are ample witnesses that testify that sweetfish and plenty of migratory fish used to be found in the river. Many birds and flocks of wild ducks could also be found, and the upper reaches of the river were accentuated with trees. Moreover, the Sanji River was used as a source for tap-water as well as agricultural irrigation due to its greater volume compared to surrounding rivers.



Wild ducks inhabiting the Sanji River



The Sanji River contaminated after being covered over

The Sanji River with its serious water pollution



The Sanji River as a waterside resort



The Sanji River dried up

The Sanji River deprived of waterside culture

The covering of the Sanji River was done without regards for the environmental impact, and as result, a tremendous amount of ecological destruction followed. The flora and fauna were decimated. Moreover, there was a severe lack of sewage treatment so large amounts of filth and pollutants were discharged into the river. As can be seen in the photo (above, left), the seriousness of the pollution can be easily surmised. Because the river was shut off from wind and sunlight, the river lost its ability to purify itself, further aggravating the pollution problem. The powerful stench of the polluted Sanji River had a baleful influence on the living environment of the neighborhood.

Because the construction covering the Sanji River failed to take into account the river's flow and volume, heavy rainfalls directly caused major flooding of the surrounding areas. In addition, the covered section presented a point of resistance to the natural flow of the river resulting in a rise of the water level.

Before being covered over, the Sanji River had a riverside that offered a natural site for refuge and mild recreation. Adults utilized this place for eel or sweetfish fishing, and children played in the water. After development in the 1960s, this recreational resource disappeared and the riverside culture of Jeju along the Sanji River was wiped out. This was an obliteration of the quality of life of Jeju's residents.

4. Process

Warnings of an imminent collapse of the structure were made in the early 1990s. The Korean Society of Civil Engineers reported their results in a safety survey of the over-structure, in which the structure's angle was 18/1000. This was greatly exceeding the safety standard of 1/1000. On August 24th, 1995, the structure was declared unsafe under the Disaster Administration Law and dismantlement was planned for the period 1996 to 1998.



Removal of the Sanji River over-structure

Afterwards, to prepare the full-scale improvement project of the Sanji River, Jeju City authorities invited public participation of citizens and experts to offer recommendations for the future development of the Sanji River. The majority of public opinion advocated for the restoration of the river to its former natural beauty so that citizens could be provided with a cultural recreation area. This was the beginning of the Sanji River Restoration Project, which was headed by a 24 person advisory committee.

<Table 2> Opinions concerning redevelopment of the Sanji River (1998)

Counterproposals	Residents Of Sanji River Neighborhood	Jeju City Citizens	Jeju Province Inhabitants	Others	Sum.
Utilization of the Site after Covering	6	1	-	-	7
Commercial Development of the Site(Business, Tourism)	6	9	2	1	18
Civic and Cultural Use	4	6	-	1	11
Natural Stream	11	21	1	7	40
Sum.	27	37	3	9	76

The Sanji River Restoration Project was implemented by rehabilitating historical and cultural features and restoring the natural stream that would serve as a resting place for the citizens. The objectives of the project were to restore the ecosystem, secure water usage, and improve the environment of the watercourses.



Wall Fountain of the Sanji River



Music Fountain of the Sanji River



Illumination of the Sanji River



Bridges and Trees

Installations built by the project

The restoration project focused on reclaiming the natural ecosystem of the stream. Natural stream reclamation aims to restore a river's environment by not obstructing the natural flow of the stream in order to improve the variety of wildlife and overall stability of the habitat. This is possible when the disturbed geographical features are rehabilitated. In the case of the Sanji River Restoration Project, natural pebbles were laid along the riverside of Shinjicheon, and sluices were installed to produce a fishery where fish could thrive.

Some sections of the stream were designed to be filled with seawater to recover its original hydrophilic properties, and other sections were filled with flowing freshwater. Stairways were built to improve the access, utility, and safety of the riverside.

Historical structures surrounding the Sanji River were also rehabilitated to be used as tourist attractions and serve as resting places and venues for culture and art. Facilities were installed to harmonize with the scenery of the river, and a water and sewage system was rebuilt to control flooding.

The engineering works included roads, bridges, gardens, planting of trees, and illumination, rebuilding of the water and sewage system, piling of natural pebbles, creation of a hydrophilic area, and water fountains accompanied by music.

<Table 3> Contents of the Sanji River Restoration Project

Objectives	Public Works Projects	Characteristic Features
Restoring the Ecosystem	Piling of natural pebbles	A natural river scene was produced by piling natural pebbles along the riverside.
	Installation of underwater beams	The sloping of the river bottom was alleviated and the water flow controlled thus stabilizing the upper reaches of the river. Automatic sluices were installed for conservation of water quality.
Revitalizing hydrophilic property of the streams	Construction of a hydrophilic area along the riverside	Seats and stages of tiers were constructed as well as and stairways accessing the riverside.
	Bridges	Wooden as well as stone Rahmen bridges were built.

	Musical Water Fountain	A water sculpture synchronized with music was installed. Automatic, compressed air system. The system utilizes a programmable, automatic compressed air water-jet system that shoots streams of water into the air according to the artists design. Water quality used is maintained at a potable level for the safety of children who may play within or around the water streams.
	Wall Fountain	Water is pumped from the lower reaches of the river and produces a natural scene as well as assists with water purification.
Improvement of the surrounding environment	Road Construction	Roads constructed for fire-fighting and general traffic, painted dark green for aesthetic harmonization with other facilities.
	Trees and Gardens Planted	Evergreen and broadleaf deciduous trees as well as a variety of bushes were planted. Trees were specially selected with a view to harmonize with the characteristics of each area. Facilities were reduced to the bare minimum in order to secure the greatest area of green tracts of land
	Illumination	Street and riverside lamps were designed to augment the facilities and greenery. Riverside lamps can especially be utilized for delightful strolls in the evening.
	Water and Sewage Systems	The sewage system running into the riverside was cutoff in order to preserve the water quality. A new rainfall disposal system was built to prevent flooding.

A total expenditure of 36,332 million Korean won was invested, including a dismantlement cost of 17,969 million won, road compensation of 7,596 million, land compensation for public facilities of 1,540 million, and restoration projects worth 9,500 million. In seeking sources for this fund, Jeju City requested a national government subsidy of 7,439 million won and 2,000 million of financial aid from Jeju Province. Jeju City issued local bonds of 15,000 million won, and the rest of the funds were allocated for the 4th quarter budget.

<Table 4> Investments on the Sanji River Restoration Project (unit: 1,000,000krw.)

	Dismantlement and Compensation	Cost of Restoration		Sum.
		2000	2001	
Public Funds	1,160	2,411	3,922	7,439
Provincial Funds	2,000	-	-	2,000
City Funds	23,672	1,206	1,961	26,839
Sum.	26,832	3,617	5,883	36,332

5. Effectiveness

Rivers in the city today do not have the same functions and roles as in pre-modern times. As urban areas expanded, hills and farmland were encroached upon and the functions of rivers and their branches' changed to being used more for recreation. Restoring the Sanji River with these functions brought back to life is now giving the Jeju City area tremendous environmental and community benefits.

The restoration of the Sanji River is important not only because of its environmental impact, but also due to resultant economic effects. The Jeju City region is especially important for Jeju Island because it is the largest center of tourism for South Korea. Bringing back the former beauty of the Sanji River has led to a revival of the tourism industry of Jeju Island.

Also, the reformation of waterside culture by the Sanji River restoration has contributed to the city's cultural development. The restoration of cultural succession and historical sites were developed into the Jeju City's unique waterside culture.

A precise quantifiable measure of improvement is not possible because of a lack of actual data, but the effects can be appreciated by looking at the images shown in this article.

Environmental Effectiveness

Results of an inspection in March 2002 found young gray mullets and freshwater eels to be living in the Sanji River. An overall January 2000 ecologic report on the Sanji River goes further to explain the improvement of environmental indices in detail, so it is clear that the ecosystem is recovering very quickly as a result of removing the covering structure. As well as obvious and immediate improvements to the natural environment, the Sanji River reclamation project has also contributed immeasurably to the quality of life and sense of civic pride of the local citizens. The watercourses, rich in aquatic life, provide an environmental ideal for recreation and relaxation, exercising, nature studies, as well as cultural activities.



The lively ecosystem of the Sanji River prior to construction of the over-structure



The serious water pollution of the Sanji River



The Sanji River as a resting place



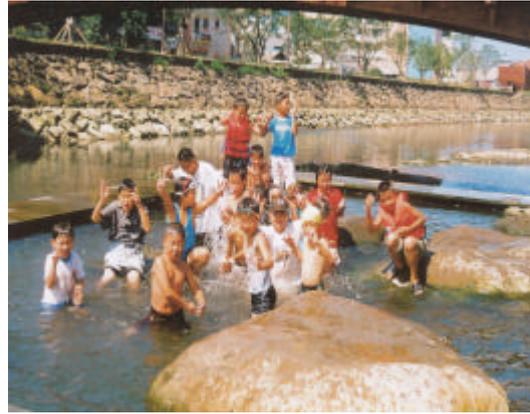
The Sanji River dried up





The revived ecosystem of the Sanji River

Reclaimed ecosystem of the Sanji River



Resting place reclaimed

The Sanji River as a resting place for citizens

Economic effectiveness

As well as the environmental improvement, the economic impact of the Sanji River Restoration Project contributes greatly overall to Jeju province. Jeju Island is one of the major tourist attractions of Korea, boasting unparalleled natural beauty from the rest of the country, but the growth rate for the tourism industry was slowing down and needed a significant boost. Thus, the Restoration Project of Jeju was significant because of its contribution to the tourism industry overall. <Table 4> shows the result of a huge, 7.6 fold increase of tourist traffic from a modest 144,000 prior to the project to the current 1,095,000 people per year. This is because of the expansion of tourist attractions from Sarabong Park into the belt area of cultural tourism spreading from Sarabong Park, then Tap-dong square, Mokgwanaji, Chilseongtong, Saejumunhaegeori, and finishing at Sanjecheon.



The Sanji River deprived of its natural charm



Deteriorated environment and cultural assets





The Sanji River with its natural charm restored



New tourist attractions of the Sanji River

New birth of tourist attractions

<Table 5> Economic Effectiveness

	Before the Project	After the Project	Effectiveness
Number of Tourists	144,000 / year	1,095,000 / year	Increase of 951,000
Belt area of cultural tourism	Sarabong Park	Tap-dong square – Mokguanaji – Chilseongtong – Saejumunhaegeori – Sanjecheon – Sarabong Park	Creation of a new belt of cultural tourism

Cultural Effectiveness

One of the issues emphasized during the Sanji River Restoration Project was the restoration and reproduction of history and culture. Therefore, wooden bridges, washing places, and refugee boats of the 1950s (which usually berthed in the Sanji River harbor) were reproduced. By reviving the features of days past with a cultural atmosphere, the plentiful stories of the joys and sorrows of the Jeju people could be told.

6. Lessons learned

Global Forum '92 established the idea of Environmentally Sound and Sustainable Development (ESSD) and adopted Agenda 21 as the code of conduct for the administration of the global environment. At the same time, establishment of Local Agenda 21 as the local code of conduct was recommended.

According to the result, 3,000 self-governing bodies of 73 countries from around the world are actively moving forward with Local Agenda 21. The Korean government submitted its “National Plan of Action for Implementing Local Agenda 21” to the UN in October 1996, and started to propagate the “Framework of Local Agenda 21”. Many local self-governing bodies are preparing the Local Agenda 21 practices with a huge interest.

However, the basic citizenry habits of Korea are weak and a ‘participation culture’ is generally lacking. This is mostly because citizens are generally used to a ‘to-down’ administrative approach from the government. Because of such a social tradition, actualizing Local Agenda 21, which emphasizes autonomous participation of citizens and close co-operation among civilian, government, and military organizations, can be a challenging proposition.

However, as this paper shows, the Sanji River Restoration Project can be an example of successful

implementation of Local Agenda 21 as well as the representative model for restoring streams, from which other local self-governing bodies can gain lessons.

Assessment

The Sanji River Restoration Project can be evaluated in three areas.

First, this project could establish a successful model of local autonomy by completing tasks of river restoration by accurately assessing environmental conditions, collecting public opinions, and cooperating for settlement of final decisions through the local government body itself.

Second, the construction of ecological scenery along the river by removing the over-structures could be connected to distinct tourist development, which could bring out economic effectiveness and the reality of sustainable development.

Third, the success of the project presents a model for reclamation of a river flowing through the center of a city where citizens reside, and positively impacts the overall business and dramatically improves the quality of life within an urban setting.

Suggestions

The Sanji River Restoration Project took about 6 years and cost 36.5 billion Korean won, a huge amount for the time. On the other hand, narrow-minded development can create environmental problems and bring about enormous sacrifices of time and cost. The objective of the Sanji River Restoration Project was about not only the removal of the over-structure, but restoration of the covered areas of the river, and revival of natural ecology. The project could have ignited great conflict between residents and city authorities during the initial process; however, this project was successfully executed because the majority of the citizens supported it and it was skillfully managed by the Sanji River Special Committee. It can be inferred from this case that sustainable development necessitates the cooperation of residents, local committees, and self-governing bodies of the local community.

Local history and culture are deeply related to rivers. The Sanji River also plays an important role as part of the urban structure of Jeju City and is filled with the lives, joys and sorrows of the local residents. A restoration project disregarding these factors could have diminished this significance. The Sanji River Restoration Project, however, was promoted with historical and cultural preservation and reproduction in mind, and this value could lead to its success. Thus, an important lesson to keep in mind is that reclamation of the polluted areas of a city should also include the consideration of historical and cultural assets.