

# 国際シンポジウム

## 河口地域の自然と社会の関わり合い —アジアの持続的資源利用モデルをめざして—

*Dynamics of nature and society in estuarine to coastal regions  
- toward Asian sustainable resource-use model*

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長良川河口域の漁撈生態環境史  
Ecohistory of fisheries in the Nagara estuary

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This study aims to describe inland fishing and the use of aquatic creatures for food in the Nagara estuary, Japan amidst the social and environmental changes occurring in riverine areas, and also to clarify changes in people's concerns and the management of the environment and resources connected with the interrelationship between fishing activities and food use.

The data was collected from fishing statistics and the author's own field works, in particular, those related to the Nagara river basin in Central Japan.

A variety of fishing techniques and equipment has been developed, and food preparation practices have also been long established in this area with variations in the local environment. These methods are recognized as part of the inland fishing culture which has been developed within the context of the country's society and culture. This shows the highly diversified ways in which the environment is used, reflecting the rich bio-diversity.

Since 1950s, the estuarine environment has changed greatly. Under the influence of industrialization, there have been many changes to the shape of the landscape, and the quality and quantity of the water, as a result of land development together with increases in the demand for water to be used in the industrial and agricultural sectors. Water pollution and works carried out on the riverbanks has also changed the shape of the river. It has damaged the natural habitats of aquatic creatures. The destruction of their habitats has also led to considerable conflict amongst them. This has caused a decline in available aquatic food stocks, although some fishermen have been putting up some resistance by establishing regional fishing co-operatives, working towards the conservation of these resources, and attempting to prevent further destructive developments. Fishing has also been in decline due to changes in rural living. The use of estuarine fish for the food trade has also been in decline.

Increased concerns about the riverine and estuarine environment, highlighted by fishing activities and the use of fish caught in the estuarine, will raise people's awareness of the importance of the regional environment as it is a familiar part of their daily life, and it is influenced by their actions.

# 1. 木曾三川河口域の漁業資源と環境変化—日本

*Fishery-resource and environmental changes in the Kiso estuarine region - Japan*

## 伊勢湾木曾三川河口域におけるハマグリ漁業と流域管理政策との関連 Clam fisheries in the Kiso estuaries of Ise Bay, central Japan, as related to water catchment management policy

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The brackish water clam *Corbicula japonica* is endemic to eastern Asia. The clam is commonly found in estuarine waters throughout Japan except for the Ryukyu Archipelago, southern Japan, which geographically belongs to the Subtropical/Tropical Zone. The species is a target for clam fisheries in Japan, especially in the Kiso estuaries of Ise Bay, central Japan. Despite several regulations imposed to manage *Corbicula* fisheries, annual catch yields of *Corbicula* species in Japan (of which approximately 99% is *C. japonica*) have decreased drastically over the last two or three decades (Fig.1), probably through the progress of eutrophication in the estuarine and coastal waters of Japan. This is true for the yields in the Kiso estuaries, as well as other areas of Japan. Traditionally in Japan, the larger hard shell clam *Meretrix lusoria* has been commercially more important than *C. japonica*. A drastic decrease in the yield of *M. lusoria* in the Kiso estuaries occurred in the late 1970S, when the yield of *C. japonica* abruptly increased (Fig.2). This resulted in a much greater fishing effort for *C. japonica*. However, the yields of *C. japonica* in the Kiso estuaries has drastically decreased since early 1980s despite several regulations imposed on the fishery. The causes or mechanisms by which the drastic decrease in the yields of *C. japonica* in the Kiso estuaries, as well as the other areas of Japan, may be driven are not well understood.

Recent studies on marine benthic invertebrates have emphasized the role of larval recruitment in the population dynamics of intertidal and subtidal organisms that have complex life cycles (those that include planktonic and benthic phases), although few studies have been made in the marine environment, probably due to difficulties in identifying

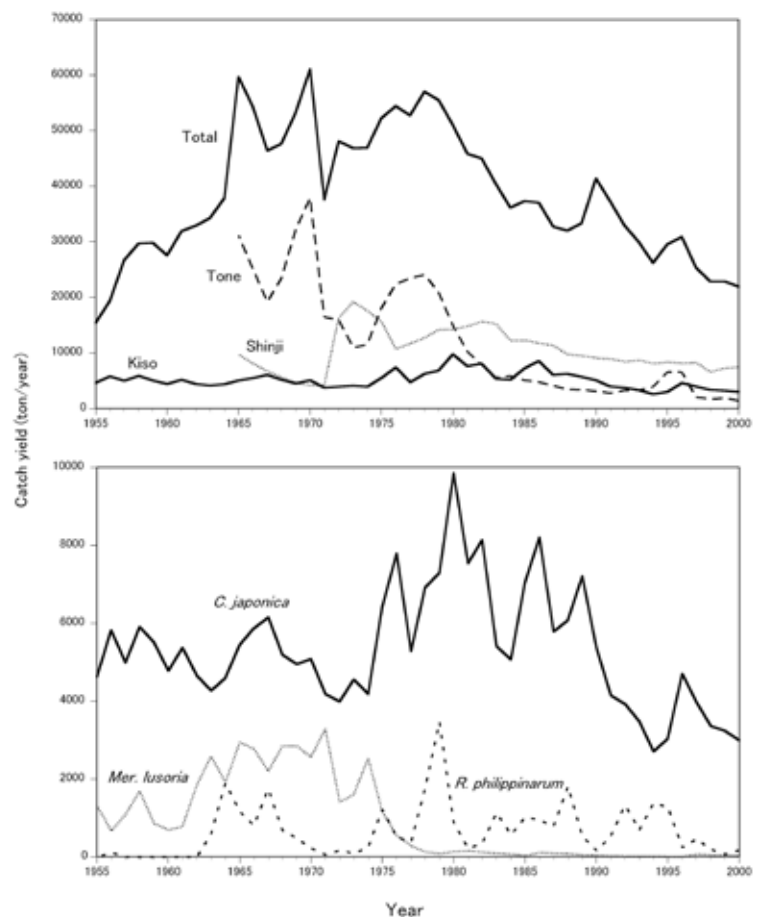


Fig. 1

# 1. 木曾三川河口域の漁業資源と環境変化—日本

## *Fishery-resource and environmental changes in the Kiso estuarine region - Japan*

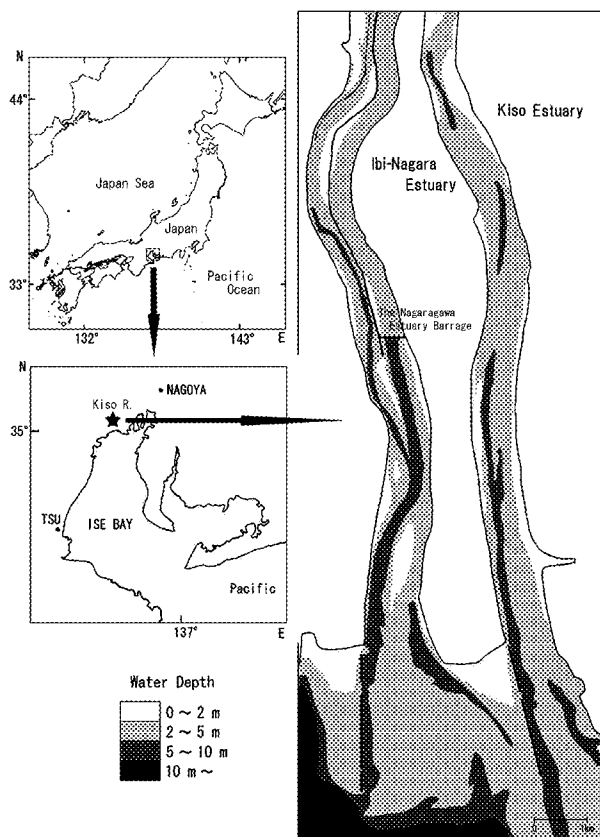


Fig. 2

planktonic larvae, in examining the coupling of larval transport and dispersal with oceanographic conditions, and in discovering larval settlement processes. This situation has been true also for brackish/marine bivalves, including the clams that are commercially important in Japan.

Fortunately, according to the studies of Sekiguchi and his co-workers dealing with population dynamics of *C. japonica* in the Kiso estuaries as related to larval recruitment over the last decade, we have sufficient data on larval recruitment of *C. japonica* similar to those of the clam *Ruditapes philippinarum* which dominates Japanese tidal flats. Recently, central/local governments try to establish the Kiso River Catchment Management Policy (Prevention of flood disaster, enhancement of water supply for drinking, agriculture irrigation and various industries, and forest conservation etc) coupled with environmental reservation of the catchment, including the Kiso estuaries and further Ise Bay.

I will examine the current status of clam fisheries in the Kiso estuaries of Ise Bay, central Japan, as related to water catchment management policy,

based on available data and publications to date to talk about the below issues:

1. Overview: Characteristics of the Kiso River Catchment as related to clam fisheries in the Kiso estuaries
2. Interannual variation in annual catch yields of *Corbicula* bivalves in the Kiso estuaries, as well as in Japan
3. Interannual variation in annual catch yields of *Corbicula* bivalves in the Ibi-Nagara and Kiso Estuaries
4. Resource management/control policy for *Corbicula* fisheries in the Ibi-Nagara and Kiso Estuaries
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  - successful fisheries recruitment
6. Larval recruitment processes vital for determining the strength of successful fisheries recruitment of *Corbicula* bivalves
  - (1) Overview of early life history of *Corbicula* bivalves
  - (2) Spatio-temporal variation in densities of different life stages (planktonic larvae, new settlers, small and large individuals, and commercial individuals) of *Corbicula* bivalves in the Kiso estuaries
  - (3) Unveiling benthic population dynamics of *Corbicula* bivalves based on cohort separation
  - (4) Growth and mortality in early life history of *Corbicula* bivalves
  - (5) Variation in the strength of new recruits vital for determining the strength of fisheries recruits of *Corbicula* bivalves in the Kiso estuaries
  - (6) The place of larval settlement of *Corbicula* bivalves within the Kiso estuaries as related to settlement processes
  - (7) Reconstruction of environments in early life history of *Corbicula* bivalves as revealed based on the examination of larval shell morphology
  - (8) Reservation of habitats of *Corbicula* bivalves within the Kiso estuaries
  - (9) Comparison of habitats among several commercial bivalves, including *Corbicula* bivalves.
7. A new resource management policy for *Corbicula* fisheries in the Kiso estuaries
8. Governmental policies for managing the Kiso River Catchment coupled with estuarine environmental reservation
9. Key issues for environmental reservation in the Kiso estuaries, as well as Ise Bay, for developing clam fisheries

## 2. メコンデルタの水産養殖と環境変化－ベトナム

*Aquaculture and environmental changes in the Mekong Delta - Vietnam*

### 持続的イネ－エビ交替農業システムと水質との関係－ ドンタップ省タムノン郡の事例

### Sustainable Rice - Prawn Rotation Farming System in Relation to Water Quality Improvement in Tam Nong District - Dong Thap Province

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An investigation on the sustainable rice-prawn rotation farming system with 3 treatments (TI, TII and TIII) in 9 rice fields (5,000 m<sup>2</sup>/rice fields) at different stocking densities of 6, 9 and 12 PL/m<sup>2</sup>, supplying by pellet feed (30 – 45 %) and trash fish combination that carried-out in Tam Nong district Dong Thap province in 2006.

The research results showed that under an efficient impact of new canals for moving and supplying water to rice-prawn farming systems, there have been changing and improving the water quality during operation the rice-prawn culture farming systems in this areas such as: water pH (4.9 – 8.5), water transparency (22 – 75 cm), oxygen concentration 2.3 – 5.5 mg/l, ammonium (0.02 – 1.7 mg/l), P – PO<sub>4</sub><sup>3-</sup> (0.008 – 0.7 mg/l), H<sub>2</sub>S (0.01 – 0.21 mg/l), COD (3.7 – 29.4 mg/l) and increasing biomass of natural feed in cultured rice-prawn farming systems. After 6 months of a cultured cycle, the average survival rate, the final mean weight and the yield of prawn in treatment I of 26 %, 46.7 ± 9.3 g and 730 kg/ha respectively, concerning treatment II, the parameters were 21 %, 66.7 ± 7.8 g and 1,176 kg/ha respectively and finally, the average survival rate, the final mean weight and the yield of prawn in treatment III of 29 %, 62.2 ± 9.4 g and 2,044 kg/ha respectively. The cost ratio profit in treatment I, II and III were average of 6 %, 19 % and 87 % respectively.

Finally, the model of rice-prawn rotation farming system could be considered sustainable development and improved productivity and profitability for farmers in relation to improvement of water quality in Tam Nong district Dong Thap province in the future.

## 2. メコンデルタの水産養殖と環境変化ーベトナム *Aquaculture and environmental changes in the Mekong Delta - Vietnam*

### ベンチェ省におけるハマグリ養殖の持続的発展に向けた統合的解決策 Integrated Solutions for Sustainable Development of Clam Cultivation in Ben Tre Province

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Southern Sub.Institute of Fisheries Planning

Fisheries resources in Ben Tre province are very abundant and diverse in three ecosystems (marine, brackish water and freshwater), with many highly-economic species. Particularly, Ben Tre has a large area of alluvial ground suitable for cultivation of bivalve species, mainly clam and cockle. In recent years, Ben Tre has developed clam cultivation in three coastal district: Binh Dai, Ba Tri and Thanh Phu. In total, there are 10 cooperatives with 8,744 members and 35 corporation which are involved in clam cultivation. Clam production varies from 12,000 to 37,000 tones annually, which contributes to the improvement of coastal community's life.

In order to sustainable develop clam cultivation in Ben Tre province, improving livelihood of coastal community, there are needs of integrated solutions in science, management and supporting policy, based on which clam cultivation in Ben Tre can develop sustainable in future.

## 2. メコンデルタの水産養殖と環境変化ーベトナム

*Aquaculture and environmental changes in the Mekong Delta - Vietnam*

### メコンデルタの干潟における貝類生産と地域開発 Regional development and mollusk production in the tidal flats of the Mekong delta.

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Fisheries resources of the tidal flats, such as hard clam (*Meretrix* spp.) and blood cockle (*Tegillarca granosa*) have declined in the coasts of Japan and Korea after the rapid economic growth. With this situation in background, the tidal flats of the Mekong delta have been growing recently as new supply areas for some resources. This paper attempts to describe recent trend of mollusk production and environmental change, with respect to its relationship with regional development in the Mekong delta. From the observation, I would like to suggest two issues which may benefit from comparative study of estuarine regions in Asia.

The first issue is how the delta has been designated as “rice production region” on one side and “estuarine fisheries region” on another. This issue was typically observed in production of blood cockle in the west coast. Faced to Thai gulf, the west coast possesses an extensive muddy tidal flat which supported production of blood cockle. However, production of blood cockle on the tidal flats was entirely abandoned in this area since 2000. Instead, production of another mollusk, *Potamocobula* sp., as bait for shrimp farm appeared in the provincial statistic since 2003. Blood cockle production was relocated into pond or shrimp farms in the mangrove area, where salinity control by pond gate was performed. Such change seemed to be related to irrigation canal development in wide area of the Mekong delta. Although the large-scale canal development started back in the 18th century, it was continued after introduction of market economy in the late 1980's. Funded by World Bank, the project aimed to eliminate poverty at the enclosed flood plain by improving acid sulfate soil for rice production.

The second issue is how the stakeholders emerge for sustainable estuarine environment. The market may help in some areas, but is not all-mighty. In the east coast of the Mekong delta, processing and export of hard clam have grown rapidly since 2000. The major end-consumers are in EU, Japan and South Korea. There were roughly two types of producers in the region; fisheries cooperative and individual fishermen. The cooperative conducted surveillance over the tidal flats, divided the profit into stockholders and labors, and assisted community infrastructure such as roads and a school. They even negotiated with the administrative office for research of environmental impact by construction of water sluice gate. On the other hand, the individual fishermen who did not organize the cooperative collected clam seeds. In the southern coasts, they were mostly Khumer ethnic groups. Although coastal fisheries were their only subsistence work, their activity was often regarded as over-exploitation by local officers and caused an ethnic conflict.



開発過程における人々の適応の意味－榮山河流域の歴史的事例  
Meaning of people's local adaptation in the dominant processes  
of development-Historical cases of Youngsan river basin-

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People's livelihoods in Youngsan river basin have been profoundly influenced by the interaction between the specific environmental conditions of this area and political economy of land use.

Hills and valleys along the river and tributaries, deep meanders, flooding and alluvial plains, influential penetration of tides up to the lower middle course of the river, tidal flats along the lower and lower-middle courses and topographical spectrum from river mouth to the coasts and islands, to the variety of environmental factors people have adapted their subsistence and the commercial economy. Different irrigation technologies from the upper course to the lower area influenced by tide, technical diversity from fresh water fishery to the complicated fishing technology in the tidal flats and river mouth of the river tell the people's micro adaptive advance in technology and indigenous knowledge sensitively reacting to the specific local environments. Just before the governmental reclamation of Youngsan river mouth area in 1982, there had been various village-scale embankment and landfill along the riverside. This pattern of reclamation with small scale and highly adaptive to the geographical settings had been found in the historical documents of the past dynasties, Japanese colonial periods and elders' memories on their life histories. These micro modifications also reflect people's specific technologies and indigenous knowledge sensitively reacting to the surrounding environmental conditions.

But Youngsan river and its basin also has been the place profoundly controlled or appropriated by state, upper social strata and colonial foreign forces. Archaeology tells the cases of human settlements, agricultural fields and burials in the chiefdom societies, mainly in the tributaries, including the hypothesis of local dominating social class. The studies of history and geography about the river and land use in past dynasties have concentrated on the embankment and reclamation mainly driven by local, provincial powers, on the transportation system for the supply to the central government. The studies on Japanese colonial years have been mainly on reclamation, appropriation of land by the colonial corporations, landowners and transportation of rice to Japan. The studies on recent, present Youngsan river basin are on geographical change and developmental process after the governmental reclamation which tremendously changed all physical, environmental, economic aspects of this area.

This presentation is a review of these previous studies. But from the ecological and cultural point of view, the meanings of local adaptations, indigenous knowledge of agriculture and fishery will be illuminated. And this will be linked to the study of interrelations between them and the developmental processes from upper levels.

### 3. 河口・沿岸域の地域開発と生態環境史－韓国

*Regional Development and Environmental History in in estuarine to coastal regions - Korea*

## 榮山河の景観と生態系の変化 Changes in Landscape and Ecosystem of Youngsan River Area

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#### Introduction

Youngsan River is the 4th largest and longest river in Republic of Korea. It is starting from Yongchubong of Damyang-gun, Jeonnam to West Sea through Hwangryong River, Jiseok Stream and Gomakwon Stream. Its length is 136.0km (main stream) and total watershed area is extend to 3,371.4km<sup>2</sup>. Although stream length of Youngsan River (136km) is rather shorter than Han River (482 km), Nakdong River (522km), and Keum River (396km), river had been important role of transportation system of south-western area. It was reason for tide of sea water that affected to river-bed of Youngsan River. The name of upper area located in Bongsan-Myeon, Damyang-Gun is Josu (潮水 in Chinese letter), and its meaning of name is closed to tide of sea water. Major 4 tributaries (Hwangryong River, Jiseok Stream, Gomakwon Stream, Hampyoung Stream) are effluent to main river, but there are small streams.

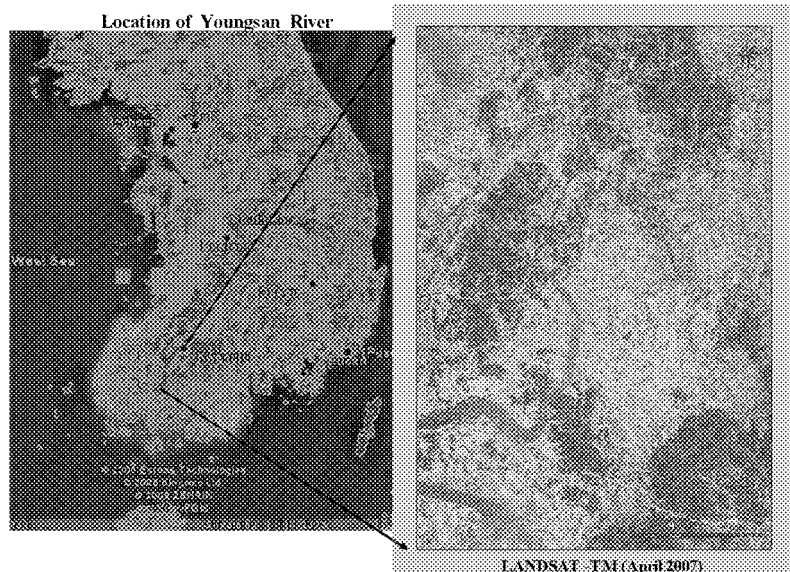


Figure 1. Location of Youngsan River and Satellite Image of LANDSAT-TM (April 2007)

Large flat area is composed of mainly alluvion and hilly area in Youngsan River. Therefore, the largest agricultural field was developed in Korea. Before the Japanese occupation, land fill and reclamation had been accomplished to secure the agricultural land. Several reports introduced the landscape change of Youngsan River and its surroundings. Although agricultural land was secured by reclamation project, most area of rural forest and river-bed having characteristic ecosystem was buried and disappeared. Especially, during the rapid economic development (1970-1990), landscape of those areas was converted to new town for industrial complex. Table 1 shows the current land use pattern of Youngsan River and its surrounding area.

#### Research Methods

In order to understand the landscape and ecosystem changes of Youngsan River, we applied two approaches to

### 3. 河口・沿岸域の地域開発と生態環境史－韓国

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research. One is quantitative landscape analysis of land use change using the satellite image of LANDSAT-TM (June 1997 and April 2007, Figure 1). We selected two areas (Upper-stream area and down-stream area) for landscape analysis. The other approach is statistical analysis of referenced data (biological data and pollution data) such as Annual Report and Statistical Data from Ministry of Environment (Youngsan River Branch, <http://yeongsan.me.go.kr/>).

#### Result and Discussion

Most drastically changed ecosystem is the estuary of Youngsan River during the last 10 years. According to completion of artificial bank near estuary of Youngsan River, Youngsan Lake as artificial lake is created near the Mokpo City. Riparian ecosystem of estuary landscape was simplified and polluted by surrounding non-pointed and pointed pollution source. Complicated and multi-sourced effects are influenced to coastal ecosystem and seascape of southwestern Korea. In this research, we can understand that current environmental problems and issues are not only one reason (one unit ecosystem) but multi-functioned. For that reasons, we sure that a logic of ecological network is most meaningful to understand the river-stream ecosystem and landscape pattern. For example, concept of blue-green network is one of network theory of landscape ecology.

Watershed	Area ( km <sup>2</sup> )						Area of Golf course
		Paddy field	Dry field	Forest land	Residential area	others	
Damyang Dam	113,868.60	4,755.80	7,695.00	89,648.50	963.7	10,805.60	0
Main Str. I	674,033.90	48,045.30	132,271.70	358,358.70	29,913.60	105,444.70	0
Kwangju Str.	170,383.70	12,067.30	13,869.50	83,022.70	31,008.30	30,415.90	0
Jangsung Dam	231,893.40	13,388.60	19,799.90	175,923.40	2,855.30	19,926.20	0
Hwangryong Riv	731,970.90	54,657.90	133,898.30	431,844.90	23,854.80	87,715.00	0
Jiseok Str.	920,998.10	69,445.30	123,399.10	617,355.10	17,163.40	93,635.30	775.7
Main Str. II	333,994.50	40,398.00	88,725.10	108,594.80	24,490.10	71,786.50	0
Gomakwon Str.	368,415.50	34,333.00	77,531.90	201,020.80	9,077.00	46,452.80	0
Hampyong Str.	353,809.70	48,626.70	69,347.00	185,339.90	9,029.80	41,466.40	0
Youngsan River Estuary	1,088,768.00	118,998.40	289,163.10	484,724.50	28,197.90	167,684.00	775.5

Table 1. Land use pattern of Youngsan River (<http://yeongsan.me.go.kr/>)

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### 3. 河口・沿岸域の地域開発と生態環境史－韓国

*Regional Development and Environmental History in in estuarine to coastal regions - Korea*

#### 榮山河流域の隣接する 3 村の形成と変貌 Formation and transformation of three Yeonsan River neighbored villages

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The formation and transformation of villages and cities along Yeonsan River( 榮山江 ) represents how humans have adjusted the nature. People along the river have historically expanded agricultural lands through land clearing and reclamation of flood plains, hill areas and tidal mud-flats. They have then formed villages on the agricultural lands, and developed a variety of irrigation facilities and systems to reserve water for the agriculture. This paper deals with the formation and transformation of three significant villages along the river : Naju, Yeongsapo and Illo. Firstly, Naju( 羅州 ) is a historical city. This city located along with the middle of Yeonsan River used to have the city hall as the capital of the province, Cholla( 全羅 ). Secondly, in comparison with the former city, Yeonsanpo( 榮山浦 ; the middle of river) and Illo( 一老 ; the end of river) are new towns which are formed in Japanese Colonization. They have developed while the majority of the residents are evolved with agriculture on the land reclamation and fishery along the river.

榮山河の環境保全運動史  
History of Yeonsan River environmental protection movement

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This paper deals with the history of environment movement around Yeongsan-gang (Yeonsan River). Yeongsan-gang neighbored areas have been developed to expand the agricultural fields and to protect from the floods. Protecting Yeonsan river Dam is the first step of the environmental movement in this area. It is the biggest reservoir in Asia built in 1982 with the length of 4,351m and the reservation of 25,300,000 tons. A Korean traditional wine company, Jinro, released the plan to plant alcohol spirit in the middle of the river in 1983. Great concerns about the potential pollution of the river raised a movement to keep the river, and eventually abandoned the plan.

Since then, the environment movement has continued. The contamination of the river proceeded for various reasons. They are: the increasing population along the river, the collection of sands, and the plan of waste dumping site. To stop the process, the river neighbored residents and the environment movement members have cooperated and devoted with the protection of the river through a variety of programs. For example, eco-environmental education programs take place, the daily collection of rubbish such as fish nets, environment campaigns like 'Yeongsan-gang saligi' (protect Yeongsan River) through some networks. The current issue that the movement focuses on is to connect the river to West Sea (Yeongsan River Dam Opening). It is likely to happen as the local administration office, Jollanamdo, participates.

### 3. 河口・沿岸域の地域開発と生態環境史－韓国

*Regional Development and Environmental History in in estuarine to coastal regions - Korea*

#### 内陸開発と干潟地域生態変化－南海岸泗川湾地域の事例をとおして Inland development and ecological changes in the tidal flat in Sachun bay

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The Nam River is about 186 km in length as the branch of the Nakdong River. The basin is formed as for the upriver district in the Nam River, and a local heartland develops. The aggraded valley plain is distributed in the downstream region of the river. There was a lot of damage caused by floods in the downstream region of the riverbasin. The flood has been, however, adjusted by the Nam River Dam construction in 1970, the Nam River and the Nakdong River downstream region are irrigated, and the electric power and water are supplied to the industrial areas.

The Sacheon Bay until 1990's was the spawning ground such as the Sea bass, the eel, gilthead, and conoshiro. Among them the clam and the oyster were important income resources of the fishermen. Annual capture of the clam was up to 3,000 t in 1970's. However, it decreased sharply to 2,000 t in 1980's, then down to 1000 t in 1990's, and only about 20 t were able to be captured in 2007. The current of the Sacheon Bay is slow because of the discharged water. Moreover, the bottom in the bay rises by the deposit that the discharged water has carried, and the function as the port has been lost as well. In addition, the discharge water was changed into the ecology condition of the bay. This is because food is not formed with the flow of a large amount of fresh water every year by the construction on the Dams and the life sewage.

If the discharge and the flood tide of the Dam come in succession, the flood damage is caused by the backflow of the river. The amount of discharge in the Dam is decreased to prevent the flood at the heavy rain by the typhoon. However, the low ground belt in the south inlet downstream is flooded when the amount of discharge is increased to the south inlet downstream region for the collapse danger prevention of the Dam and damage is caused. As a result, the dispute might deepen the problem of the discharge amount adjustment between the Nam River downstream bottom zone residents and the Sacheon Bay local populace.

黄海の干潟：危機に瀕した世界最大の沿岸景観  
The Yellow Sea Tidal Flat: The World's Largest Coastal  
Landscape in Peril

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The Yellow Sea is a part of North Pacific Ocean. Latitudinally, it extends to around 41°N to the north and joins the East China Sea near 31°N to the south. It covers an area of about 457,000 km<sup>2</sup>. The sediments of the Yellow Sea are mostly terrigenous, carried by rivers and winds from the surrounding Chinese and Korean lands. It receives annually more than 1.6 billion tons of sediments from China's major rivers such as the Yellow River and the Yangtze River, both of which have formed large deltas, and a considerable amount of fine and coarse-grained sediments comes from the rivers of the Korean Peninsula as well.

The Yellow Sea tidal flat covers an area of about 20,316 km<sup>2</sup>, and when treated as one complex, it rates as the largest intertidal area in the world. The Yellow Sea tidal flat hosts a vast diversity of flora and fauna that are critical to biogeochemical cycles and that serve not only as an important source of food in this region but also provide with the unique coastal landscape. However, recent serious changes in the biological resources along with the wetlands losses are largely due to effects of human activities. The Yellow Sea tidal flat is faced with four main challenges; (1) sharp decrease of sediment discharge into the sea by damming and diking of major rivers, (2) rapid increase of pollution matter into the sea due to the population expansion, (3) habitat loss due to the coastal wetlands reclamation, (4) fisheries operations. Many of these environmental problems are of a transboundary nature in this region, so that multi-national action plans to control these challenges are needed as in the European Wadden Sea Trilateral Co-operation Program.

河口地域の自然と社会の関わり合いーアジアの持続的資源利用モデルをめざしてー  
Dynamics of nature and society in estuarine to coastal regions- toward Asian sustainable resource-use model

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