



Land use management and cultural value of ecosystem services in Southwestern Korean islands

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Abstract There are widespread tidal flats along the southwestern coast of Korea. At the provincial level, Jeonnam region has the largest tidal flat area, of which the main part is located in Shinan-gun, a municipality consisting of only islands. This area, including its tidal flats, has a high species diversity as well as a high cultural. However, the various important ecological functions of tidal flats are not recognized, as in most cases the tidal flats are utilized simply as reclaimed land. During the period of Japanese colonialism in the 20th century large-scale reclamation of tidal flats took place in Shinan-gun, and rice was produced on the land that was reclaimed. From the standpoint of ecological services, tidal flats can be more than agricultural fields. Even though tidal flats have not yet been analyzed from the cultural perspective so much, their value can be expected to be very high. As an aggregation of a variety of ecological functions that occur by ecological processes, tidal flats have the better value in terms of ecological services than other land uses. This new, richer understanding of the value of tidal flats should be a stimulus to maximize its value by thoughtful landscape management and planning.

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Introduction

Nowadays the importance of islands is emphasized and exposed to the newspaper or television more often than in the past in Korea. Many countries are accelerating their efforts

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to solve the problem of island residents' survival in relation to climate change and take possession of marine resources around islands. In the meantime, many islands have also seen their economic value increase considerably due to tourist industry. People are trying to utilize island resources in many ways, and island landscape management plans are developed to ensure sustainable development (Pungetti, 2012).

Islands are much more vulnerable than the mainland in many ways (Hong, 2012). Because of their limited size, the resource supply of islands is more limited. Consequently, island ecological systems are more vulnerable than any other ecological systems in terms of resource utilization. Also, the sea-level rise due to global warming threatens the inhabitants of small, low-sea-level islands. Furthermore, often developments such as industrial facilities and tourist resorts occupy



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islands' coasts exploiting the available resources, but with the result that ecosystems are destroyed in many ways such as the erosion of beaches (Hong, 2009).

There are about 3400 islands in Korea, and 60% of them are located along the southwestern coast in the Jeonnam region. The Islands Development Promotion Act is enacted in Korea since 1986. This law initiated the start of a project run by seven government ministries including the Ministry of Public Administration and Security, the Ministry of Maritime Affairs and Fisheries and the Ministry of Construction and Transportation. The purpose of this project is to improve island residents' income and their welfare by establishing production base, cultural facilities and welfare facilities. The project started in 1988 on a ten-year cycle and first resulted in the publication of the Second Islands Integrated Development Plan in 2007. The second and current cycle started in 2008 and works towards the Third Islands Integrated Development Plan. The purpose of this plan is to create "Attractive Island" and develop islands by considering their characteristics. In addition, it aims to solve the isolation of islands by expanding bridge construction business with government involvement to ensure stable progress.

The tidal flats in Korea consist of about 6990 local tidal flats that measure a total area of 2489 km² (Ministry of Land, Transport and Maritime Affairs, 2008). Tidal flat area now occupies 2.5% of Korean territory, which is 60.8 km² less than in 2003, 5 years before. This reduction in tidal flat area is because of many types of development pressures, such as large-scale reclamations such as tidal flat reclamation, development of port hinterland, and construction of industrial complexes (Hong et al., 2010). Jeonnam region in the southwestern part of Korea has the largest tidal flat area in the country, measuring 1036.9 km² (41.7%). Within the Jeonnam region, Shinan-gun possesses 36% of the country's tidal flat area. Given the aforementioned pressure on tidal flat areas, the meaning of the tidal flats in Jeonnam region and especially Shinan-gun is becoming increasingly important and warrants efforts to make clear the full value of tidal flats to policy and decision makers. This article will examine the land use types related to the tidal flats in Shinan-gun and discuss the proper utilization of these tidal flats in terms of ecosystem services.

Natural resource and land use history

From 1981 to 2010, the annual average temperature in Jeonnam region has been measured to be about 12.6–14.3 °C, while the annual average precipitation has been 1107.3–1532.7 mm with peaks in summer (The Meteorological Administration, 2013). Because Jeonnam region is warmer than other inland areas during winter, it was also utilized for horse farming in the 15th Century Chosun Dynasty (Kim, 2004). However, frequent pirate attacks forced the people who lived in Jeonnam to move to inland areas, and as a result, the pastures in the area became abandoned and no longer managed.

Jeonnam region is located in the southwest of Korea (Fig. 1). There are mountainous areas to the east and north, and wide plains near the coast. Since long time ago, people have secured large farmlands through wide plains and tidal flat reclamation and usually have cultivated rice and barley and caught fish. Especially the farmlands in Shinan-gun, consisting of only islands, were formed through large-scale reclamation

during the Japanese colonial era (Oh, 2001; Kim, 2010). At that time, the total tidal flat area changed into farmland was about 55,951 ha. For comparison, the total area of the reclamation project performed from Korean independence in 1945 until 1992 was about 55,210 ha. Thus, the reclamation project during the Japanese colonial era was of a very large scale (Ryu and Lim, 2011). As this happened, it is perhaps not surprising that the nationwide tenant farmers' anti-Japanese movement started in Jeonnam. Given this course of history, many people in Shinan-gun have produced rice by reclaiming the wide tidal flats also in combination with working in the fishing industry. According to the island area land use in 2011, paddy fields and upland fields occupy the largest areas of non-forest land uses (Shinan-gun 2012) (Fig. 2).

From the 1960s to 1970s, Jeonnam saw widespread operation of Parsee,¹ markets on the sea selling seasonal fishes such as yellow corbina, shrimp, and croaker. As a market was formed on the sea near the islands, people began to trade local fish. This has had much influence on the regional economic vitalization. However, fish catches after 1980s have been smaller than before because of overfishing, changes in fishing ground environment and climate change. As a response to this situation, sea farming has become more popular lately (Kim, 2010). Fig. 3 shows the fish catches of fishery products, from 2003 to 2011.

Ecosystem services

The concept of ecosystem services discusses what and how much benefits the ecological function gives to human directly or indirectly through many complicated ecological processes. From 2001 to 2005 the United Nations performed "The Millennium Assessment" (MA), an international research project in which researchers around the world participated. About 1300 scientists from various fields participated in this international research program. The purpose of the MA project was to study the importance of ecosystem change considering policy decision makers and general scientific information, and to improve the quality of human life according to this change.

According to a study by Costanza et al. (1997), wetland provides the highest ecosystem service per unit area of all land use types including forest, agricultural fields, and grasslands. Though it is too much to say that the foregoing various values of tidal flats are directly reflected, it seems that wetland provides much higher values of service than other types of ecosystem. In this respect, it seems justified to say that the ecosystem services of Jeonnam's southwestern sea, and especially Shinan-gun's tidal flats, can have much influence on improving the quality of human life (Kim, 2011).

Shinan-gun consists of about 1000 islands, including 14 inhabited islands that almost all have wide tidal flats (Fig. 4). The value of tidal flats relates to the fact that they have multiple functions, especially a fish production function, a habitat function, a purification function, an aesthetic function and a natural disaster prevention function. Tidal flats have considerable potential as a source for the production of marine products. The productivity value of tidal flats is nine times higher than that of regular land. Some researches have

¹ Parsee: a fish market held on the sea in the season when fish is caught in large quantities. In a broad sense, this includes not only the fish market held on the sea but also the coastal markets.

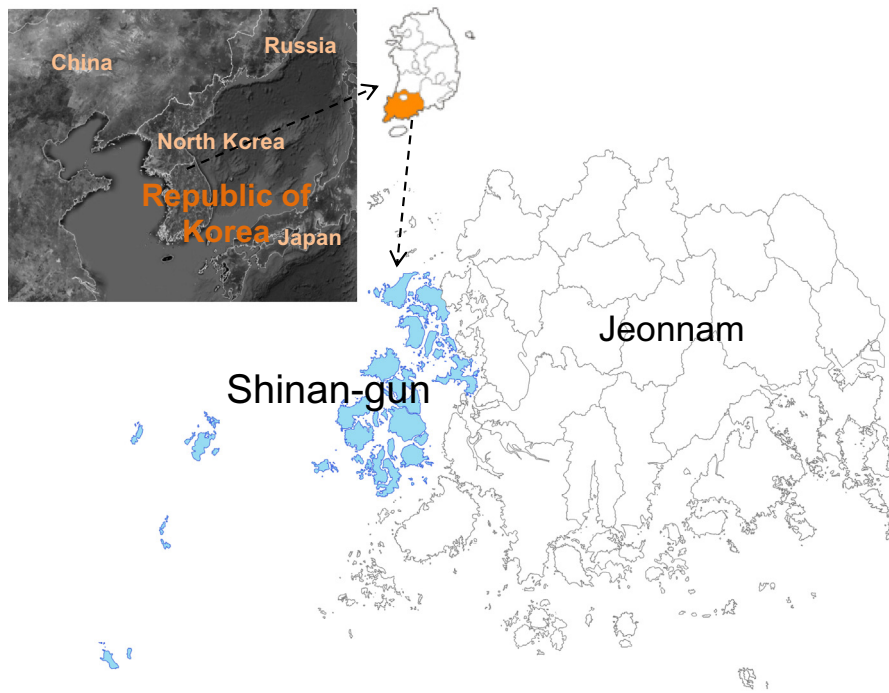


Fig. 1 Location of Shinan-gun and Jeonnam in Korea.

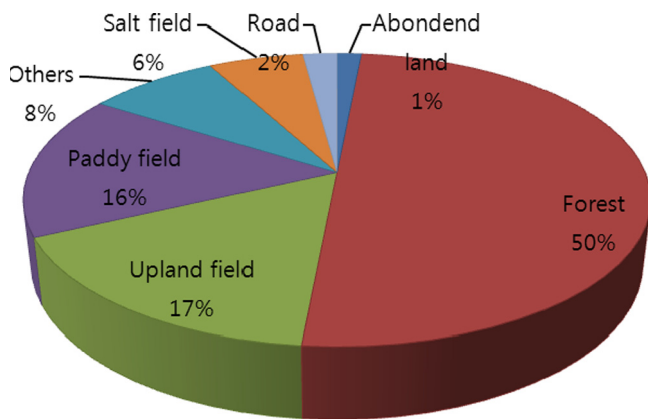


Fig. 2 Proportion of land use types in Shinan-gun (Data source: Shinan-gun, 2012).

shown that the annual fish productivity of tidal flats can reach 10 ton per acre (4047 m²). An analysis based on the market price according to fish catches and production shows that the annual marine product gross production in Yeongjongdo, an island located in Gyeonggi region, is 3 billion KRW (Lee, 1998). This means its production output per km² is almost 954 million KRW. The high productivity that can be established in tidal flats indicates they form a suitable habitat for creatures. In fact, tidal flats are used as spawning ground or growing place by many marine life species (Turner, 1991). As places that are both nutritious and turbid, tidal flats provide creatures with food and shelter that protects them against enemies. Moreover, tidal flats contribute to the stability of the entire ecosystem by enabling breeding up young creatures that will be the next members of the marine ecosystem. But, the habitat function of tidal flats not only concerns marine life. They also play a vital role as a way station for migratory birds that use them as a resting place or breeding area.

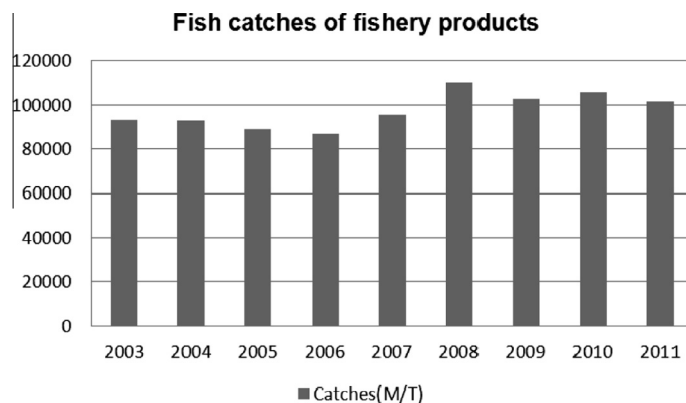


Fig. 3 Fish catches of fishery products in Shinan-gun, including aquaculture products (Data source: Shinan-gun 2012).



Fig. 4 Aerial photo of tidal flat areas in Shinan-gun islands: (a) Jido, (b) salt fields at Jeungdo, (c) salt fields at Bigeumdo, (d) tidal flat of Anjwado (source: Shinan-gun).

Tidal flats purify pollutants released from the land. In Korea there are many cities and industrial areas along the coast, and many pollutants are being released by them. Given this situation, it is reasonable to state that the tidal flats' value based on its purification function is considerably high. The biotic diversity of tidal flats provides high educational value and aesthetic value biologically, making it an environment that fulfills a role as laboratory, recreational space and cultural heritage. In particular, tidal flats serve an aesthetic purpose as a place where people can enjoy the beauty of nature in their leisure time. However, it is hard to measure the value of this aesthetic function because it has non-usable value and there is no market on its service. It is only lately that quantitative researches on the aesthetic value, cultural value and public service value are being conducted (Lee, 1998).

From a functional perspective, the economic value of tidal flats stems from their multitude of functions related to fish production, habitat, purification, culture, tourism resources, and natural disaster prevention Costanza et al. (2008). In 2006 the Ministry of Maritime Affairs and Fisheries announced a tidal flat conservation plan to address the contents above at a symposium on the conservation and sustainable use of the tidal flats in Korea. On the basis of the tidal flat ecosystem investigation conducted by the Korea Ocean Research and Development Institute over the preceding 6 years, the Ministry of Maritime Affairs and Fisheries estimated the annual economic value of the tidal flats at 3.9 billion KRW per km². In this estimation, the marine product production value accounts for 30.6% (1.2 billion KRW) of the whole value. The conservation value (1 billion KRW) and habitat value (0.9 billion KRW) have been

assigned similarly high percentages, too. The annual purification value is estimated at 0.4 billion KRW per km² and the disaster prevention value at 0.2 billion KRW (Ministry of Maritime Affairs and Fisheries, 2003). When this value is applied to the total of 2550 km² tidal flat area across the country, the value amounts to more than 10 trillion KRW each year. According to these figures, the economic value of the tidal flats in Jeonnam region, which account for 40% of the domestic tidal flat area, is more than 4 trillion KRW per year.

Cultural value

Local community

The tidal flats in Korea have not received much attention until recently. People are now starting to realize the importance of the tidal flats as an ecosystem given its species diversity and as a theme for eco-tourism. Most domestic tidal flats were owned not by individuals but by villages (fishing villages), so the Korean government adopted 'Self-managing fishery' as the fishery resources management system (Kim, 2010). This way of management is to prevent the overfishing of fishery resources and to establish a sustainable fish product base. This system is meant to utilize the tidal flats around villages in a sustainable way Kim et al., (2013). Since the aquaculture of laver, oyster, and Manila clam became possible, the tidal flats began to have more meaning as a property. But, the exclusive ownership of tidal flats was denied and the way of utilizing them was more systematized (Kim, 2005).

The products obtained from the tidal flats are preserved through communal regulations set by the members of the village. The products are mainly owned by the village members so that such resources can be utilized sustainably. This community spirit can play a role as a culture carrier and conservator to preserve resources and conserve traditional ecological knowledge.

Eco-tourism and education

The tidal flats in Korea are frequently used as a leisure space that provides opportunities for fishing, sea bathing, resting and sightseeing. Lately, the tidal flats are utilized not only as a general cultural space but also as an important place for eco-tourism. Especially, its value as a public property is increasingly recognized and highly regarded. The natural environment of the tidal flats with their large diversity of creatures is considered as something new that people have rarely experienced. The tidal flats also have a high value as spaces for the education about nature, with a lot of students visiting the tidal flats, to study the marine ecosystem and observe the creatures inhabiting the environment.

Quantitative studies on the ecosystem services of tidal flats from a cultural viewpoint are conducted regularly. Early studies found that tourists who visited the Louisiana tidal flats were willing to pay \$815 per ha on the 30,000 ha-tourist region (Farber, 1993), while the annual recreational value of tidal flats in Florida was estimated at \$198 per ha (1984). In Korea there has not yet been any research that evaluated the economic value of tidal flat landscapes using aesthetic criterions. A rare attempt was made by Lee (1998) who estimated the recreational

value of Korean tidal flats at about \$507 per ha, but this estimate is based on American data.

These days the tidal flats in Korea are recognized as both a leisure place and a production place, so people regard the value of the tidal flats higher than in the past when the tidal flats were only used under policies centered on development. Still, many people have not yet realized its value as a specific public property. The tidal flats need to be recognized as a place where the creatures, nature and human life are mixed harmoniously.

Cultural diversity

As the tidal flats have a high species diversity that causes local variations in the marine products that are caught or harvested, differences in food culture occur. There are wide tidal flats in Shinan-gun, making it the area with the largest production of bay salt in the country. With such salt production, Shinan-gun also produces many kinds of salted fish that are essential ingredients of kimchi, a traditional, basic Korean food. So, the tidal flats play an important role in keeping and conserving the traditional food culture, not only in Shinan-gun but also in Jeonnam and the rest of the country. Also, the common octopus (*Octopus minor*) is mainly produced in Shinan-gun and Muan-gun, which has made the Jeonnam tidal flat area famous in the country. About 14,000 tons of common octopus were produced in 1993 in Jeonnam. However, the production reduced steeply in 2005 and common octopus became one of the objects of a marine resource recovery project. The annual production of common octopus was about 5000–7000 tons from 2000 to 2005 (An et al., 2007). Nowadays, catching octopus during the breeding season from May to July is forbidden.



Fig. 5 Location of Gyeonggi Bay (image from google).

According to a study of Gyeonggi Bay in Gyeonggi region, many kinds of clams such as *Cyclina sinensis*, *Ruditapes philippinarum*, *Macra ueneriformis* were produced, and as a result, various local foods, including chopped noodles, using those clams as their ingredients appeared (Je, 2012). Various species produced in the tidal flats were recognized as representative local foods, and various local foods and cultures were formed based on the species. However, the production of clams rapidly reduced after the completion of the Sihwa Lake breakwater in 1994, and various foods using clams disappeared in the end. This example illustrates how large-scale projects such as breakwater construction and reclamation can threaten the diversity of species and regional culture (Fig. 5).

Conclusion

The tidal flats along the southwestern coast of Korea have high productivity and species diversity, and also a very high conservation value. The use of tidal flats in Shinan-gun is very important, not only to the Jeonnam region but also to the whole country. In general, according to Article 28 of the Public Waters Reclamation License in Paragraph 2 of the Public Waters Management and Reclamation Act, a project on less than 100,000 km² area only needs to get permission the cities and regions it affects. For this reason, small-scale reclamation projects are still taking place. In addition, the Public Waters Management and Reclamation Act gives preference to project operators on land acquisition and lease, so actually it cannot prevent reclamation effectively (Chun, 2001).

Shinan-gun has already expanded its land area through large-scale tidal flat reclamation since the late 19th century, and most of its non-forested land is now used as farmland. But in the case of rice farming, its competitiveness is lower than in the past as the competitive price of rice has dropped (Jeon et al., 2010). Rice production in the country is increasing every year due to the improvement of efficiency, while the rice consumption is decreasing. Moreover, transporting rice from islands to the mainland is more expensive, causing another disadvantage. Furthermore, even though reclaimed tidal flat areas are used as salt ponds and fish farms, the profit are limited due to the production cost and other costs. So, it is harder to make profit from tidal flats turned into farmlands than it was in the past (Kim, 2010).

The value of tidal flats was not fully recognized in the past. As the concept of ecosystem services has begun to receive attention lately, the true value of tidal flats is starting to become recognized from new and various angles. The value of tidal flats considering the services its ecosystem gives is directly linked with the functional purposes of tidal flats. According to Costanza et al. (1997), the ecological value of tidal flats is US\$ 9990 per ha (0.01 km²), which is more than 100 times the value of farmland (US\$ 92). In the case of Korea, the value of tidal flats as fish production and habitat sites is higher than in other countries. The economic value of tidal flats in Korea has been estimated at US\$ 27,316 per ha, although this figure is based on American data (Lee, 1998).

It is difficult to measure the aesthetic value of tidal flats that have cultural value. This is because every region differs in characteristics and culture. In Korea, there is a lack of studies quantifying the aesthetic value of tidal flats. According to Cherem & Traweek (1977)'s study, the most beautiful landscape to

Americans is wetland with inland waters. A wetland landscape mixed with wide tidal flats where birds and people are in harmony could have the best value in aesthetic terms.

Through various studies, the value of the tidal flat ecosystem has begun to be more highly regarded than in the past. But, the full value of tidal flats is often still not recognized as certain aspects tend to be overlooked. The tidal flats in Shinan-gun have various values due to their function regarding fish production, fish habitat and natural disaster prevention, and this is combined with great island landscape. Its cultural value is also very important, and therefore the eco-cultural values of tidal flats should be recognized as ecosystem services, and its economic value should be quantified and assessed so that the people and policy makers can easily understand the full value. But the economic value of tidal flats has in so many ways to do with human life ecologically and socioculturally, that it is hard to be all-inclusive, let alone express all aspects in monetary figures. Nonetheless, the tidal flats are public properties that we must share, and we can easily realize that preserving these areas as they are can generate much more economic and cultural values than transforming it into other types of land use.

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