

New direction of management policies in the Seto Inland Sea, Japan, in a changing environment

Osamu MATSUDA*

Abstract: The Seto Inland Sea, the largest enclosed coastal sea in Japan, covers an area of 23,000 km² and was originally renowned as a productive fishing and aquaculture ground with scenic beauty. However, since the coastal basin in the watershed around the sea is home to 30 million people, and impact of human activities on the sea has been very strong. During Japan's period of rapid economic growth in the mid-1960s to mid-1970s, industrialization of the coastal area, increase in the number of factories and expansion of landfills in waterfront areas caused a rapid increase in water pollution with a reduction in shallow water area and destruction of the marine environment. In order to conserve the environment of the region, the Law on Temporary Measures for the Environment Conservation of the Seto Inland Sea was enacted in 1973. This law was made permanent in 1978 as the Law on Special Measures for the Environment Conservation of the Seto Inland Sea ("The Seto Inland Sea Law"). More than 40 years have now passed since the enactment of the legal system. During the time, changes of both the natural and socio-economic environments around the sea were remarkable. And, recently, 2015 became the year for a particularly important change of direction for management because major revisions of both "The Seto Inland Sea Law" and the governmental Basic Program based on the Law were made. In the newly revised Basic Program, two major aims of the previous Basic Program (conservation of water quality and conservation of natural landscape) were reformed into four new major aims, including conservation and restoration of coastal environment, conservation and appropriate management of water quality, conservation of natural and cultural landscapes, and sustainable utilization of fish resources. These recent changes indicate that not only passive conservation but also positive conservation, such as restoration of coastal environment, became very important targets. The new direction of the management reflects the changing environment of the Seto Inland Sea. After WWII, the first major target was water pollution control, including toxic substances. Then, the target turned to red tides due to eutrophication. Recently, major targets are changing to lowered biological productivity and diversity due to oligotrophication and deteriorated habitat. Therefore, the main approaches of management also changed from water quality control by restrictive measures to restoration of habitat, such as tidal flats and sea grass beds, by promotion of participatory creative activities. New direction is also supported by the concept of *Satoumi*, which includes restoration of biodiversity, biological productivity, habitat and well balanced nutrient cycle by the intervention of positive human activities. These recent shifts of the management policies are expected to contribute to recovering productive fishing and aquaculture grounds in the Seto Inland Sea in the future.

Key words: coastal management, environmental conservation, Seto Inland Sea, *Satoumi*

Introduction

Brief History of the Seto Inland Sea

The Seto Inland Sea, the largest enclosed coastal sea in Japan (**Fig.1**), has long history in which plenty of ecosystem services have been provided. However, serious environmental changes due to land-based human activities occurred during the postwar reconstruction age after WWII. Rapid economic growth during 1960s to 70s was accompanied by serious water pollution, eutrophication and destruction of habitat, such as tidal flats and sea grass beds, in the shallow coastal areas. Among many countermeasures, the Seto Inland Sea Law (Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea), which was first enacted in 1973 and applied only to the Seto Inland Sea, played an important role. Major functions of “the special law” were area wide total pollution load control (TPLC) and suppression of land reclamation.

Brief Introduction to *Satoumi*

What does *Satoumi* mean? Why is so much attention paid to *Satoumi* nowadays? In Japanese, “*Sato*” means local village or community where people live their life and “*Umi*” means the sea. Therefore, the simple literal meaning of *Satoumi* is the sea associated with local village or community.



Fig. 1. Outline of the Seto Inland Sea, its watershed and location of 13 prefectures around the Sea. The applied area of “The Seto Inland Sea Law” is almost equal to the watershed area of all rivers flowing into the Sea, where ca. 30 million people live. (Source: The Association for the Environmental Conservation of the Seto Inland Sea)

In reality, *Satoumi* is a traditional Japanese coastal ecosystem and landscape management system that was found in many coastal areas throughout Japan in days gone by. Sustainable community-based management of the local sea areas has a long history in Japanese tradition.

However, during the nation’s high economic growth, this type of traditional coastal management has gradually deteriorated due to changes in the local community and life style of the people. As a result, social demand to create a new type of *Satoumi* defined as high biological productivity and high biological diversity in the coastal seas with positive human intervention has arisen and grown strong. In Japan, community-based habitat restoration activities have been gaining ground in recent years partly because the concept of *Satoumi* was incorporated into official institutional systems of national policy. Since *Satoumi* originated in Japan and is sometimes said to have grown up in the Seto Inland Sea, *Satoumi* exemplifies the close relationship between the deterioration of the sea and active conservation of the area by local people (**Fig.2**).

Recently, a new concept for coastal sea management called *Satoumi* has been noticed not only in its original place of Japan but also in many other countries, including both western and Asian. Multilingual editions of books on *Satoumi*

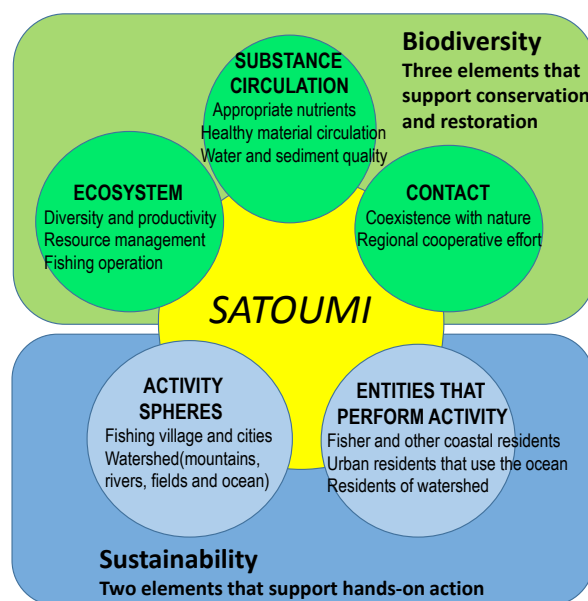


Fig. 2. Five important elements of *Satoumi* concept. Three objectives to be improved (upper) and two indicators on activities (lower). (Source: Sato-Umi net)

published by such international organizations as the United Nations University and the Secretariat of the Convention on Biological Diversity (CBD) also contribute to expanding *Satoumi* activities in the world.

Change of the Environment and Ecosystems

The TPLC system has significantly improved water quality in terms of COD, Total Nitrogen (TN) and Total Phosphorus (TP). For example, the number of the occurrences of red tide decreased from about 300 a year at the peak to about 100 a year recently. Concentration of TN and TP in sea water also decreased, and recently, it has cleared the legal environmental standard of Japan in many areas of the Seto Inland Sea. However, since suppression of land reclamation does not mean total ban of land reclamation, the effect of the policy was restricted. As a result, shallow areas -- in particular tidal flats and sea grass beds -- have been drastically lost during the last 50 years.

Changes in the pollutant load from land and

changes in water quality in the Seto Inland Sea due to the TPLC system is very clear. The load of COD, TN and TP decreased during the years of 1979 to 2014. Generally, concentration of TN and TP in sea water is proportional to the TN and TP load per unit area of the sea. This means that water quality in terms of TN and TP has been much improved in general. However, decreased nutrient concentrations in sea water has led to the new issue of artificial oligotrophication, which caused insufficient growth in *Nori* (laver) culture.

Meanwhile, changes in biodiversity in the Seto Inland Sea have not been systematically monitored. However, biodiversity seems to have decreased judging from the evidence that the number of observed sea shore animals of at various stations around Kure area that are members of long monitored species has decreased drastically from the mid-1960s. Tidal flats and sea grass beds around the Seto Inland Sea decreased mainly due to land reclamation and, therefore, natural coastlines disappeared (Fig.3). These events indicate that the habitat condition has deteriorated. Fish catch data indicate that fisheries

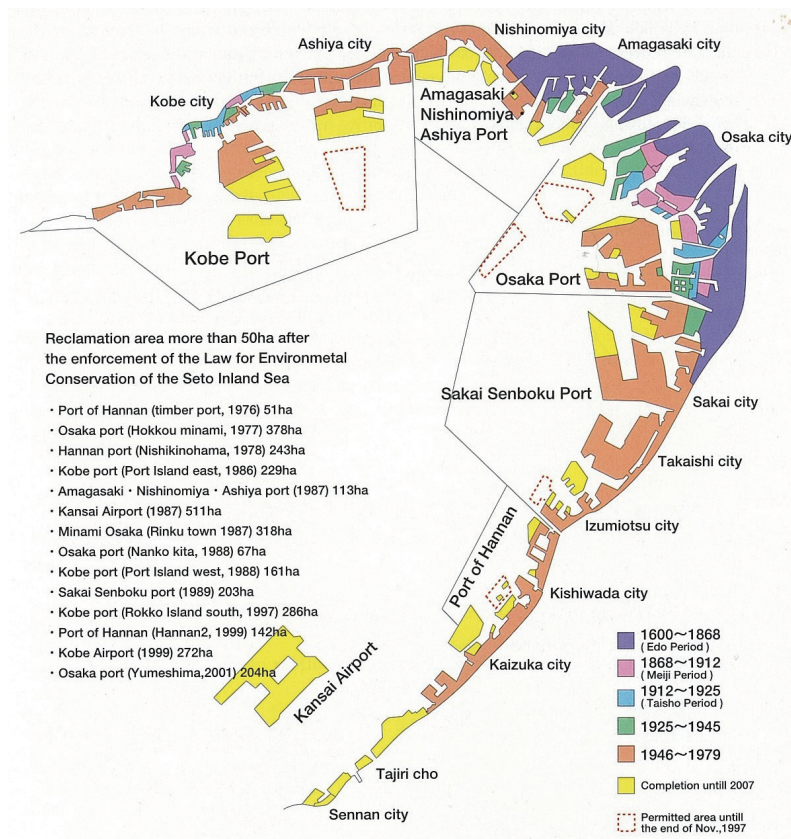


Fig. 3. Result of historical land reclamation in Osaka Bay. Natural shorelines and shallow areas, such as sea grass beds and tidal flats, disappeared. (Source: The Association for the Environmental Conservation of the Seto Inland Sea)

production is decreasing after a peak in the mid-1980s. From these results, it can be said that the ecosystem services available are decreasing in the Seto Inland Sea, although water quality has been improved to some extent.

Major environmental and related problems in the Seto Inland Sea in recent years can be summarized as following.

In broad sense:

- Deterioration of the ecosystem, natural resources and ecosystem services
- Decrease of biological diversity and biological productivity (fish catch)
- Weakened relationship between humans and the sea

In narrow sense:

- Occurrence of red tides and oxygen depletion in bottom waters
- Deterioration of the benthic environment and sediment quality
- Disappearance of biological habitat for spawning and as nursery grounds
- Insufficient nutrients for laver (*Nori*) culture ground in winter

Recent Shift of Management Policy in the Seto Inland Sea

Environmental conservation and management policy firstly made emphasis on water pollution control. However, this kind of passive conservation policy is gradually being shifted to active

conservation, such as *Satoumi*, which includes restoration of biodiversity, biological productivity, habitat and a well-balanced nutrient cycle between land and sea. Holistic approaches, such as ecosystem-based management (EBM) and integrated coastal management (ICM), are also being incorporated in new policy. In the recently revised governmental Basic Program for the Environmental Conservation of the Seto Inland Sea (2015), based on the revised Seto Inland Sea Law (2015), 2 major aims of the previous Basic Program (1. conservation of water quality, 2. conservation of natural landscape) are reformed into 4 major aims (1. conservation and restoration of coastal environment, 2. conservation and appropriate management of water quality, 3. conservation of natural and cultural landscapes, 4. sustainable utilization of fish resources) (Fig.4). Therefore, the simplified major change of the aim is from a focus on water quality control to more holistic restoration of environmental and fish resources, which can lead to abundant and bountiful coastal seas.

Present Status of *Satoumi*

Historically, *Satoumi* has evolved as the traditional Japanese way of coastal management in which local communities co-existed with nature. In the *Satoumi* concept, people's livelihoods and their culture are deeply involved, biological productivity is sustained, and biological diversity is protected and conserved, while ecosystems are able to be sustained and material cycling is maintained. These community efforts were undertaken in a comprehensive and integrated

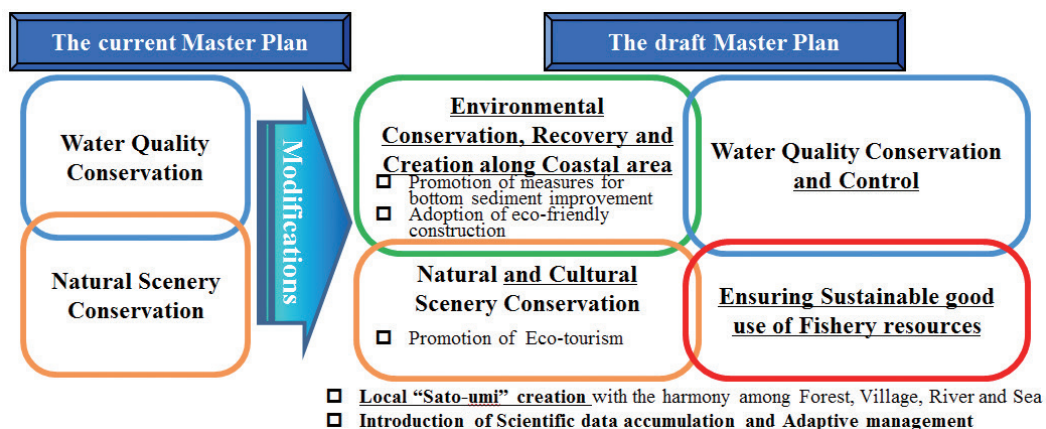


Fig. 4. Outline of recent revision of the governmental Basic Program, based on the revision of "The Seto Inland Sea Law" (2015). (Source: Ministry of the Environment)

manner from upland forest and rivers to coastal seas. Therefore, the concept of *Satoumi* primarily provides holistic management of watersheds, including forests, rivers, local communities and coastal environments. Combining *Satoyama*, focuses on forest and agricultural land, with *Satoumi* is also expected to help develop a Japanese model of integrated coastal management (ICM).

In many *Satoumi*-like coastal seas in Japan, sustainable community-based management of the sea has historically been conducted in a traditional manner. However, during the nation's high economic growth after World War II and due to social changes associated with the economic development of the nation, this type of traditional coastal management gradually declined because of the changes in local communities and life styles of the people. During the same period, coastal environments, habitats and living resources were also seriously damaged by water pollution, eutrophication and land development, as a result of urbanization and industrialization of coastal areas. Instead of obtaining efficiency and convenience due to industrial development, valuable capital, such as the natural environment, natural resources and natural landscape was lost. As a result, social demand to create and establish a new type of *Satoumi*, defined as high biological productivity and high biological diversity in the coastal seas with positive human intervention, has arisen and gradually gained ground. In other words, a "*Satoumi* Renaissance" is taking place in order to restore once lost rich and healthy coastal seas by community-based participatory activities. In seas where *Satoumi* activity is necessary, natural environmental conditions and the ecosystems are so deteriorated they cannot recover naturally without support by human behavior.

In Japan, community-based habitat restoration activities have also been gaining ground in recent years. This is partly because the concept of *Satoumi* was incorporated into official institutional systems of national policy, such as the Basic Ocean Plan (2008), based on Basic Ocean Act (2007), and some national environmental strategies.

The Governor's and Mayor's Conference for Environmental Conservation of the Seto Inland Sea has been seeking new policy, based on the concept of *Satoumi* since 2004. Some local governments out

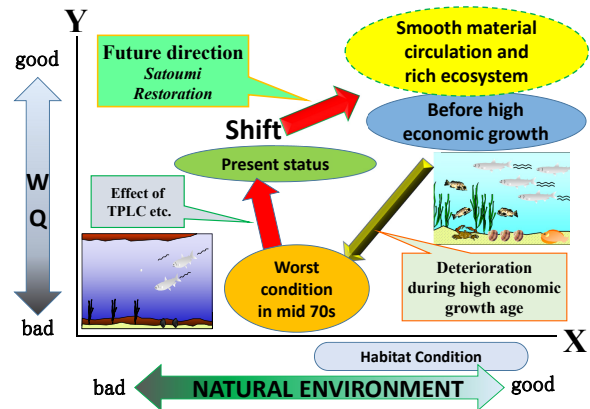


Fig. 5. Conceptual view of future directions and necessary shifts of environmental management in the Seto Inland Sea. (Reformed figure by the author based on Ministry of the Environment)

of Seto Inland Sea area also introduced the *Satoumi* concept as official policy. For example, Kagawa prefecture has always promoted *Satoumi* as an official policy. And, recently, based on the revised special Law and revised governmental Basic Program on the Seto Inland Sea, every local government of prefectures around the Seto Inland Sea revised the environmental management plan at the prefecture level by the end of 2016. This new management plan at each prefecture level reflected the shift toward the *Satoumi* concept directly and will promote *Satoumi* activities. The above mentioned *Satoumi* policy of Kagawa prefecture was incorporated into the revised prefecture plan. This kind of enhanced policy will promote local activities for the creation of *Satoumi* elsewhere in the near future.

Future Direction under New Policy

The conceptual view on future directions of environmental management in the Seto Inland Sea is presented in Fig.5. In this figure, past, present and future environmental conditions are indicated on an X-Y axis. The horizontal axis shows natural environmental conditions, such as habitat condition, and the vertical axis shows water quality. Recent shifts mean that not only is improvement of water quality needed but also more active conservation, such as restoration of deteriorated habitat and promotion of *Satoumi* activities, are necessary.

This shift of management policy may help local sea areas to realize smooth material circulation and rich ecosystems.

In close relation to *Satoumi*, ecosystem-based management (EBM), community-based management (CBM) and ICM are also very important concepts for coastal management in the near future. Since *Sato* means community and *Satoumi* also focuses on the relationship between humans and nature, *Satoumi* can be a type of diversified CBM. *Satoumi* is also focusing on biological diversity and biological productivity. Therefore, *Satoumi* can be a part of EBM. Besides, combination of *Satoyama* and *Satoumi* can be a type of ICM, including both land and sea. Similarities and differences among *Satoumi*, CBM, EBM and ICM should be made clearer and easier to understand in the near future.

The next possible step of coastal management under the new policy might be as follows. Integration of science into management decisions and managing habitats through application of biological information from all available data sources is necessary. Recognizing the importance of ecological networks from forests and rivers to the sea, including the human dimension, is also necessary. A comprehensive management of the material flow from hilltop to the coastal environment is essential for successful coastal management. Managing coastal habitats by participatory activities of people, based on increasing public awareness, adopting appropriate legislation and enforcement, is also essential. Coordination across sectors to improve governance and efficiency and addressing trans-boundary issues are most important in the future of coastal management. In order to restore once lost rich and healthy coastal seas in deteriorated areas, *Satoumi* can play a role in active conservation measures to restore deteriorated ecosystems. Valuable coastal areas, such as tidal flats and sea grass beds, which were already lost by land development, were historically a kind of commons or shared space for people. And, therefore, to take back these kinds of common spaces for people is also an important role of *Satoumi* in the future.

Annotated bibliography

(1) Matsuda O., 2008: Eutrophication and its Cause/

Consequence: The Case of the Seto Inland Sea, in "Asia-Pacific Coasts and Their Management" (ed. by Mimura N.), Springer, The Netherlands, pp. 78-92.

This is a case study on the management of the eutrophic Seto Inland Sea.

(2) Secretariat of the Convention on Biological Diversity (CBD) (2011), Biological and Cultural Diversity in Coastal Communities – Exploring the Potential of *Satoumi* for Implementing the Ecosystem Approach in the Japanese Archipelago, CBD Technical Series No. 61, Montreal, 118pp.

This volume provides relevance of *Satoumi* to biodiversity issue and case studies of *Satoumi* activities from Hokkaido northernmost area to Okinawa southernmost area of Japan.

(3) Okaichi T. and Yanagi T. (ed.) ,1997: Sustainable Development in the Seto Inland Sea Japan-From the Viewpoint of Fisheries, Tera Scientific Publishing Company, Tokyo, 329pp.

This book provides valuable information on the Seto Inland Sea until 1990s.

(4) Stickney R. R. and McVey, J. P. (ed.) ,2002: Responsible Marine Aquaculture, CABI Publishing, Maryland, 391pp.

This is a milestone work on the development of sustainable and responsible marine aquaculture.

(5) Okaichi, T. (ed.) ,2003: Red Tides, Tera Scientific Publishing Company, Tokyo, 439pp.

This book provides comprehensive aspects of red tides such as phenomena, organism, ecological problems, environmental relevance and mechanism of outbreaks.

(6) Yanagi T., 2007: Sato-Umi: A New Concept for Coastal Sea Management, Terra Scientific Publishing Company, Tokyo, 94pp.

This book was written by the first proposer of the concept of Sato-Umi (*Satoumi*).

(7) Matsuda O., 2012: Western Japan cluster: Seto Inland Sea as *Satoumi*, in "*Satoyama-Satoumi* Ecosystems and Human Well-Beings" (ed. by Duraiappah A. K., Nakamura K., Takeuchi K.,

Watanabe M., and Nishi M.), United Nations University Press, Tokyo, pp. 381-402.

This is a comprehensive reference of the Seto Inland Sea and also a part of the result of Sub-Global Assessment on Japanese Satoyama and *Satoumi*.

(8) Matsuda O., 2012: Combining Activities of *Sato-Umi* and *Sato-Yama* in Japan: Towards a New Type of Integrated Coastal and Watershed Management, in "The Dilemma of Boundaries-Toward a New Concept of Catchment" (ed. by Taniguchi M. and Shiraiwa T.), Springer, The Netherland, pp. 221-234.

This paper describes the possibility of integrated coastal management by connecting *Sato-Umi* and *Sato-Yama*.

(9) Berque J. and Matsuda O., 2013: Coastal Biodiversity Management in Japanese *Satoumi*. *Mar. Pol.*, **39**, 191-200.

This paper refers to relevance of *Satoumi* to biodiversity management.

(10) Matsuda O., 2014: Predicting and promoting the future state of coastal seas with special emphasis on *Satoumi*, in "Connectivity of Hills, Humans and Oceans, Challenge to Improvement of Watershed and Coastal Environments" (ed. by Shimizu N., Tateno R., Kasai A., Mukai H., and Yamashita H.), Kyoto University Press, Kyoto, pp.209-221.

Some aspects of future perspective of *Satoumi* were described in this paper.