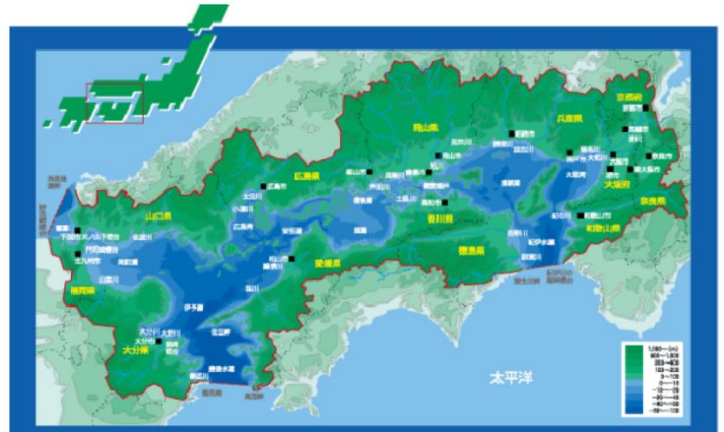


The Seto Inland Sea

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The Seto Inland Sea is surrounded by the Japanese islands of Honshu, Shikoku and Kyushu, and located in about midst of the islands constituting the nation's territory. Almost 1,000 large and small islands with intricate coastlines having total 7,230km in length, form the beautiful, distinct scenery of this region. Different 643 river water sources feed into the Sea from its surrounding watershed mountains with fifty billion cubic meters every year. Also, the region has a mild temperate climate and rather little rainfall through a year compared with other regions of Japan; typically average temperature 15-16°C and rainfall 1,000 - 1,900mm.



1. Major enclosed coastal sea in Japan

The Japanese Archipelago are composed of major four islands, Hokkaido, Honshu, Shikoku and Kyushu, accompanying with many small islands, and form intricate geography. In other words, there are many “enclosed coastal seas”, combined with inlets and bays. In Japan, there are 88 officially designated “enclosed coastal seas” defined as an enclosed geography encompassed more than 5km² area, such as Tokyo Bay, Ise Bay and Seto Inland Sea.

2. The Seto Inland Sea: an overview

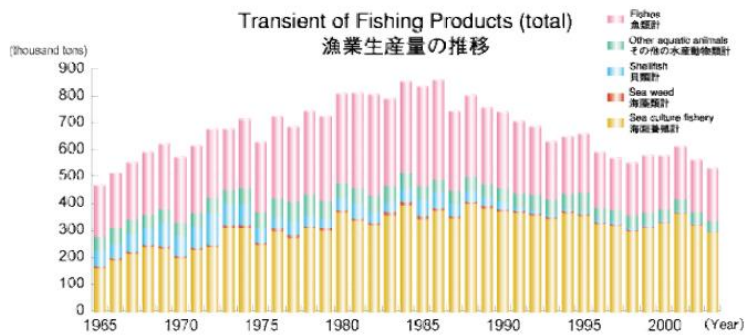
The Seto Inland Sea is the largest enclosed coastal sea in Japan and covers an area of 23,000km². It can hold 880 billion cubic meters of water and is a shallow sea with an average depth of 38 meters. The Seto Inland Sea is connected with outer ocean via the Kii Strait between Honshu and Shikoku, the Bungo Channel between Shikoku and Kyushu, and the Kanmon Strait between Honshu and Kyushu.

The coastal basin within its watershed covering the Seto Inland Sea are home to 30 million people, 24% of the total population of Japan (127 million). These people are crowded into an area of 47,000km² – a mere 12% of the entire land area of Japan (380,000km²). In terms of working resources, site climate and geographical conditions, the Seto Inland Sea is suitable as a location for heavy and chemical industries,

particularly steel and petrochemical industries, and the region played a leading role in Japan's period of explosive economic growth in the 1960s. Today's amount of products shipment from the area reaches 16 times compared with forty years ago. Even today, typical shares among the domestic products are 46% of steel industries, 35% of petrochemical industries, and 30% of pulp/paper industries, based in the coastal area of the Seto Inland Sea.

But in comparison of each composition ratio for industries, the primary industries (agriculture, forestry and fisheries) and the secondary industries (mining, construction and manufacturing business) retreat while the tertiary industries (transport/ communication, wholesale/retail, finance/insurance, service business etc.) are forwarding.

Since ancient age, the Seto Inland Sea has depended on maritime transport. Even now, about 43% of all goods shipped domestically pass through the Seto Inland Sea by cargo vessels, and it can be seen many of them passing to and from through the narrow sea route. The Seto Inland Sea is also a major fishing area, with a yearly catch of 233 thousand tons and a yearly aquaculture of 298 thousand tons. But, compared with the past 1980s, the amount of fishes is deceased about 30%. It should be also noted that, as reclamation for the construction of industrial lands has reduced the number of fishing areas, the quantity of clams and other marine products have fallen dramatically from its former levels.



3. Water Quality in the Seto Island Sea

Recent days, COD (Chemical Oxygen Demand) concentration as index of organic pollution is stopped rising at the specific level in each local sea though some degree improved comparing with past critical condition called as “dying sea” in about 1965.

Also, as cause of eutrophication, the concentration of nitrogen and phosphorus are in trends some more decreasing than COD, though differences between the local seas. It should be noted that occurrence of oxygen depleted bottom water is apt to destroy benthos ecosystem, particularly in summer.

4. Environmental problems in the Seto Inland Sea

During Japan’s period of rapid economic growth in the mid-1960s to mid-1970s, centralization of the population, increase of the number of factories and expansion of landfills in water front areas caused a rapid increase in water pollution with a reduction of shallow water area and destruction of the marine environment in the Seto Inland Sea. Actually, there are more frequently occurred “red tides” and, due to the depletion of oxygen, many fish and shellfish, particularly fish, were annihilated.

This dealt a serious blow to the fisheries industry. It was not only the industrial declination but also resulted rapid reduction of natural seashore area, especially sandy beaches, by landfills and water pollution, where local residents could come in contact with nature, for example by taking their families to the beach, swimming, basking in the sun, and digging for clams and so on.

Formerly, the sea was integral part of the lives of local residents. However, factories built on reclaimed land now are tightly each other and shut out the people from the sea, at present. Other concerns have been raised are sea sand mining from the bottom of the sea, marine litter due to disposal of garbage, and the problem of chemically harmful effluent from facilities.

(1) “Red tides”

The frequency of so-called “red tides” in the Seto Inland Sea became recently down to around 100 occurrences a year after reversed from the peak of around 300 in 1976.

Almost of the “red tides” occurrences are in the summertime, and have damaged endlessly to the fishing industries. Individually recording for enormous damages of cultured yellowtail, 14 million perished in July, 1972, resulting in loss of 7.1 billion yen; 3.3 million annihilated in August, 1977, resulting loss of 3 billion yen; 2.8 million annihilated in July, 1978, resulting 3.3 billion yen; and 1.35 million perished in August, 1987, resulting 16 billion yen.

Particularly, the fishery damages in 1965s were extended to major social problem, and the fishing cooperative eventually took the Government and the coastal companies to court. Subsequently, it was resulted an amicable settlement.

Also, very large damage annihilating cultured oyster occurred in August, 1998, resulted in loss of 3.9 billion yen.

(2) Reduction of shallow water area

a. Seaweed beds and tidal flats

Seaweed beds are generally important habitat for fish and other aquatic animals. Tidal flats are also important as habitat of aquatic animal, migratory birds and also play a leading role in purifying the water quality in the region. Both of these important areas has been disappearing. In the 12 years from 1978 to 1991, 800 hectares of seaweed beds and 800 hectares of tidal flats were lost. Of these, 40% of the seaweed beds and 70% of the tide flats were lost due to reclamation, dredging or modification of coastal area.

b. Natural coastlines

Since ancient ages, shallow area of the Seto Inland Sea has been changed from natural seashore to farmland and/or salt farm. From the middle of 1950s, expansion of urban area and/or industrial location are taken priority instead of natural environment, then it has become reduction of natural coast line, only remaining now 37%. In order to preserve natural seaside for recreation area such as bathing resorts, 91 points are designated by the each prefecture government under the municipal law.

5. Environment Conservation of the Seto Inland Sea

In the period between 1965 and 1975, water pollution of the Seto Inland Sea increased dramatically, and it was pushed to the brink of the becoming a dying sea. In order to conserve the environment of the region, in 1973

the Law on Temporary Measures for the Environment Conservation of the Seto Inland Sea was enacted. In 1978, this law was made permanent as the Law on Special Measures for the Environment Conservation of the Seto Inland Sea (“The Seto Inland Sea Law”), with new measures added to deal with the damage caused by "red tides" and the like, including measures to cope with eutrophication. The following measures have been taken based on these laws, etc.

(1) Basic Plan for Conservation of the Environment of the Seto Inland Sea

To promote long-term policies relating to environment management of the Seto Inland Sea in a comprehensive and systematic manner, the national government enacted the Basic Plan for Environment Management of the Seto Inland Sea based on “The Seto Inland Sea Law”. And the individual prefecture around the Sea established their own prefectural plans for environmental management of the Seto Inland Sea based on the Basic Plan of the government. In 2000, the Basic Plan established in 1978 was largely revised. The revised Plan established upgraded conservation policies as well as policies to restore lost environments and promote wide-ranging cooperation and participation among the national government, local public organizations, private citizens, companies and other entities.

(2) Policies to preserve water quality, protect natural scenery, etc.

To promote the conservation of water quality in the Seto Inland Sea, a variety of restrictions have been implemented based on the Water Pollution Control Law and “The Seto Inland Sea Law”. As the objectives of the water quality administration, environmental quality standards for chemical oxygen demand (COD), total nitrogen (TN) and total phosphorous (TP) concentration in sea water have been established as desirable standards needed to achieve and maintain the quality of water in public waters.

In addition, effluent standards have been established for waste water from factories and workplaces, and restrictions have been implemented prohibiting the discharge of specific pollutants into rivers and ocean. Moreover, in the Seto Inland Sea, permission from the prefectural governor, etc. is needed in order to set up specified facilities that discharge such polluted water. Total pollutant load control of COD, TN and TP have also been established for the Seto Inland Sea.

Measures have been taken to designate the core regions for natural scenery in the Seto Inland Sea as National Parks and the like, to ensure that their outstanding natural scenic beauty is not lost. Moreover,

as the greenery on islands and in coastal zones is a crucial component of the scenery in the Seto Inland Sea, an active effort is being made to protect and manage green spaces.

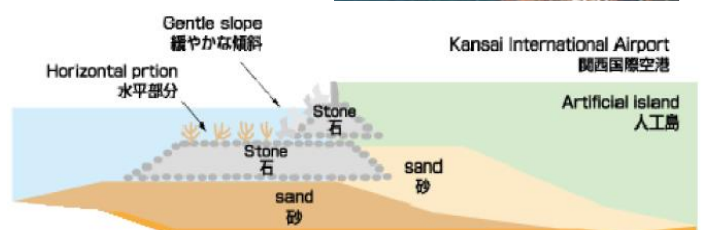
The basic policy for reclamation was established in accordance with “The Seto Inland Sea Law”, and reclamation has been strictly limited but not entirely banned. The sand mining from the sea floor, which has become an issue in the area, had also been subjected to prohibition measures and the like on the part of relevant prefectures, in order to reduce the environment impact of such activities.

(2) Policies contributing to recover sound environment

In case only depended on upgrading conservation policy leading by regulation, it will be difficult to restore, in both physical and ecological terms, the natural coasts, etc., comprising seaweed beds, tidal flats and other shallow water areas, already lost until now by developments and/or any other factors.

To secure various environment befitting the Seto Inland Sea to be deployed must be planned standing on the recovery of sound environment and succession to the next generation.

In the Seto Inland Sea, considering the past environment and its sound aquatic restoration in near future, the national government and local governments are leading it as projects by use of appropriate technologies with natural purifying capacity for seaweed bed, tidal flat, sandy shore, rocky beach, and inclined revetment, with the cooperation of relevant companies, local residents and private organization. For example, according with the Natural Recovery Promotion Law (enforced Jan. 2003), a local project is promoting to recover tidal flat in mouth of a river with a joint of participants including some experts.



6. New Direction of Management Policies

In recent years, 2013 saw the 40th anniversary of the enactment of “The Seto Inland Sea Law”, and 2014 saw the 80th anniversary of the designation of the Setonaikai National Park. Moreover, 2015 became the year for a particularly important change of direction for the Seto Inland Sea. At the end of February 2015, a major revision of the national government’s Basic Program for the Conservation of the Environment of the Seto Inland Sea was approved by the Cabinet. In addition, at the end of September, a revised version of “The Seto Inland Sea Law” was enacted to support the content of these major revisions. The combination of unparalleled major revisions to both the law and the Basic Program resulted in a major change to the management system for the Seto Inland Sea.

The Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea

<Key Points of the Amendment>

- Conservation/restoration of seaweed beds/tidal flats
- Adaptive management initiatives including efforts to conform with the act such as nutrient management at sewage facilities
- Investigation/research on appropriate management of nutritive
- Releasing aquatic animals’ seeds and seedlings
- Adopting eco-friendly structures, etc.

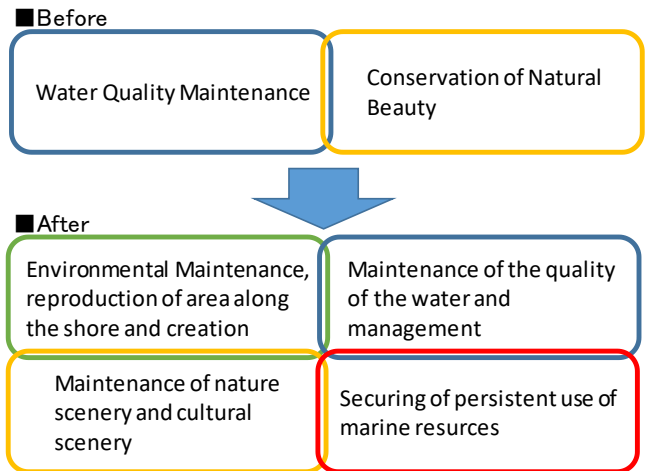
Concerned prefectures and cities will, by responding to the actual situation of their bays and seas, take on initiatives in a systematic manner.

If you wanted to sum up the changes to the system in a single phrase, it would be the major shift from working to achieve a “clean sea” to working to achieve an “abundant sea.” “The Seto Inland Sea Law” was enacted in the days of significant environmental pollution. Since that time, efforts over many years have been dedicated to cleaning up the polluted sea. As a result, the total pollutant load from land-based sources has been reduced, which, to a significant degree, achieved the goal of creating a “clean sea” in terms of water quality. Meanwhile, however, the natural beaches, seaweed beds and tidal flats have decreased, and the fish catch has also declined, and so the loss of the original abundance of the Seto Inland Sea remains unchanged. These revisions mark a major pivotal change from the previous focus on conserving water quality through restrictions to an active effort to secure fishery resources - and not only conserve but also restore the environment. This approach is clearly stated in the basic philosophy of the revised law: to turn the Seto Inland Sea into “a

sea of abundance whose multifaceted value and functions are maximized.”

Basic Program for the Conservation of the Environment of the Seto Inland Sea

< Concept of Revision >



Most of the areas in the Seto Inland Sea have already achieved their water quality environmental standards, and it is entering a “post-total pollutant load control age.” The Seto Inland Sea has also been called an “experimental area” for marine environmental management in Japan. From now on, it also needs to play the role of experimental area for the entire world as it deepens its exchanges with other enclosed coastal seas around the world.

References

- T. Okaichi and T. Yanagi ed. (1997), Sustainable Development in the Seto Inland Sea Japan-From the Viewpoint of Fisheries, 329pp., Tera Scientific Publishing Company.
- O. Matsuda (2008), Eutrophication and its Cause/Consequence: The Case of the Seto Inland Sea, p78-92, in Nobuo Mimura ed. “Asia-Pacific Coasts and Their Management”, Springer.
- O. Matsuda et al.(2012), Western Japan cluster: Seto Inland Sea as *satoumi*, p381-402, in Anantha Kumar Duraiappah et al. ed. “*Satoyama-Satoumi* Ecosystems and Human Well-Beings”, United Nations University Press.

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