2014 Annual Report on Aquaculture in Japan (Draft)

UJNR Japan Panel

1 Introduction

This report shows the latest topics, trends in production of major species and the policy of aquaculture in Japan.

2 Overview of aquaculture in Japan

2-1 History of aquaculture in Japan

In Japan, literatures on carp (*Cyprinus carpio*) culture, scallop (*Mizuhopecten yessoensis*) sowing culture and laver (*Porphyra* spp) culture date back to the early Edo period (1615 - 1624). In the Meiji period (1868 - 1912), inland water aquaculture and culture of pearls (*Pinctada fucata martensii*), oysters (*Crassostrea* spp), scallops and tiger shrimp (*Marsupenaeus japonicus*) were started. Japanese eel (*Anguilla japonica*) culture was started in Tokyo in 1879. After World War II, culture methods of wakame seaweed (*Undaria pinnatifida*), kelp (*Laminariaceae* spp) and laver spread widely in the country. Aquaculture of yellowtail (*Seriola* spp), horse mackerel (*Trachurus japonicus*), mackerel (*Scomber japonicus*) and red sea bream (*Pagrus major*) was started in Kagawa Prefecture in 1927, and developed significantly after World War II. Pacific bluefin tuna (*Thunnus orientalis*) culture began to be studied in around 1970, and full-scale aquaculture production has become possible since around 1990. In recent years, there have been efforts to improve aquaculture business by newly culturing high-priced species, such as sturgeon (*Acipenser* spp), longtooth grouper (*Epinephelus bruneus*) and threadsail filefish (*Stephanolepis cirrhifer*), through technology development.

2-2 Recent aquaculture production in Japan in volume and value

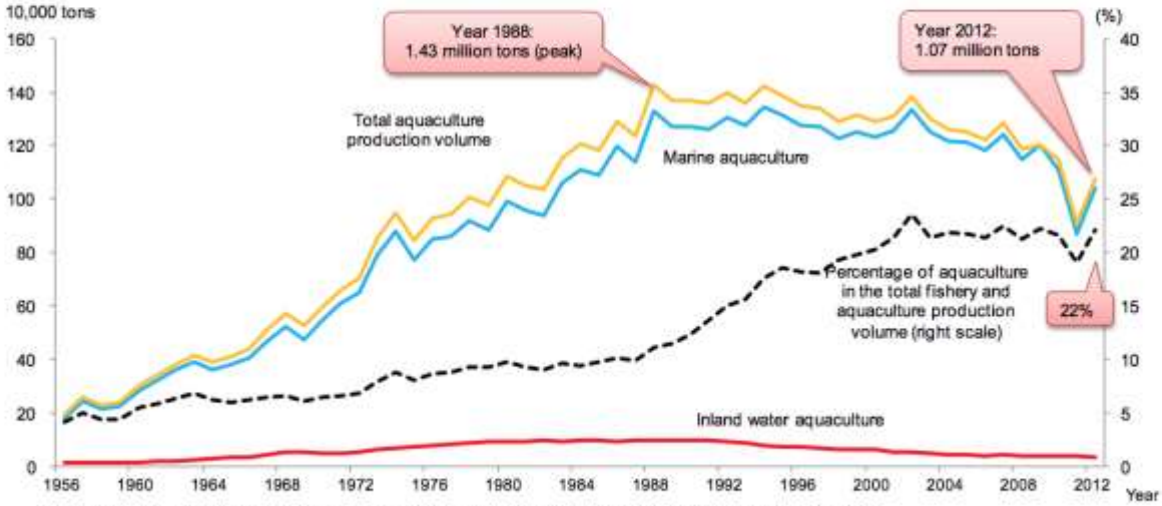
China ranked highest aquaculture production volume in the world at 53.9 million tons, accounting for 59.7% of the world total in 2012, with Indonesia ranking second at 9.6 million tons (10.6%), India ranking third at 4.2 million tons (4.7%), Vietnam ranking fourth at 3.3 million tons (3.7%), and the Philippines ranking fifth at 2.5 million tons (2.8%). Japan ranked 11th at 1.1 million tons (1.2%).

Aquaculture production volume accounts for 22% of the total fishery and aquaculture production volume in Japan. Japan's aquaculture production volume remained around 1.3 million tons after peaking at 1.43 million tons in 1988, and has been on a moderate decline since 1996. In 2011, the production dropped to 0.91 million tons due to the Great East Japan

Earthquake, and recovered to 1.07 million tons in 2012.

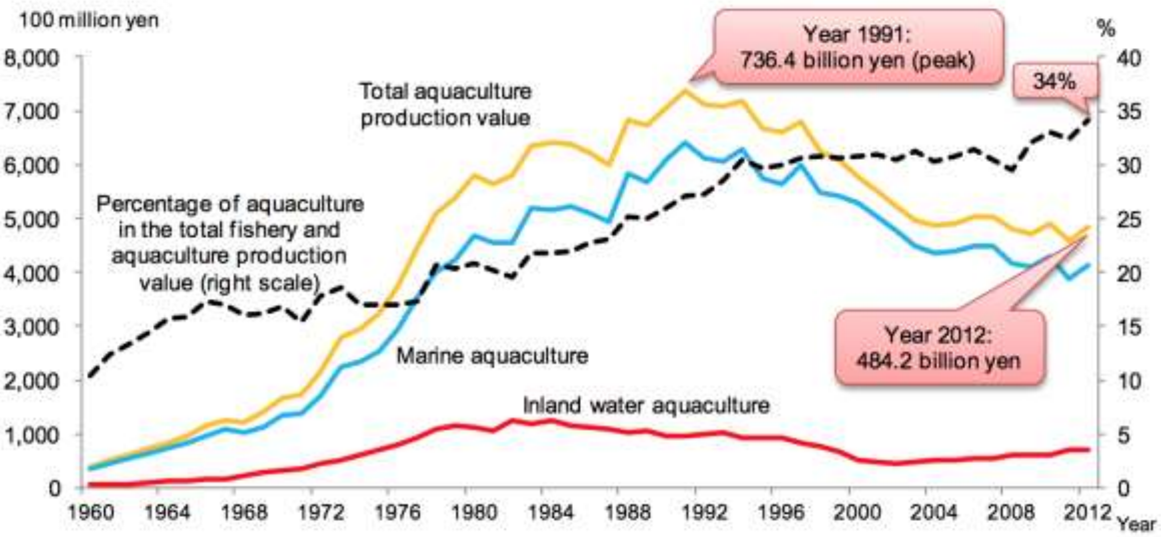
Marine finfish aquaculture production in 2012 (250,000 tons) was 90% of the maximum production observed in 1995 (280,000 tons). While red sea bream and Japanese flounder productions dropped during this period of time, yellowtail production was stable and Pacific bluefin tuna production increased. Shellfish culture production in 2012 (350,000 tons) was 30% less than the maximum production in 2002 (500,000 tons) partly owing to reduced production in Hokkaido and Tohoku area after the Great East Japan Earthquake. Algae culture in 2012 (440,000 tons;) was 31% less than the maximum production in 1994 (640,000 tons) due to decline in wakame and laver production. Tiger shrimp production peaked at 3000 tons in 1988, and it has decreased by 47% by 2012. The shrimp production was consistent around

[Changes in Japan's aquaculture production volume and its percentage in the total fishery and aquaculture production volume]



Source: Compiled by Fisheries Agency based on MAFF, *Annual Statistics on Fishery and Aquaculture Production*
Note: The survey results for year 2011 exclude data for some parts of Iwate, Miyagi and Fukushima Prefectures.

[Changes in the aquaculture production value and its percentage in the total fishery and aquaculture production value]



Source: Compiled by Fisheries Agency based on MAFF, *Annual Statistics on Fishery and Aquaculture Production*
Note: The survey results for year 2011 exclude data for some parts of Iwate, Miyagi and Fukushima Prefectures.

1600 tons in the past five years. Inland water aquaculture production (30,000 tons) has decreased to 34% of the maximum production in 1988 (100,000 tons). Production of almost all species has decreased, especially carp whose production was devastated by koi herpes virus disease.

Japan's aquaculture production value had declined after peaking at 736.4 billion yen in 1991. However, it began to show recovery from 471.8 billion yen in 2009, reaching 484.2 billion yen in 2012. In 2012, aquaculture accounted for 34% of the total fishery and aquaculture production value. While the production value of inland water aquaculture was below 50.0 billion yen from 2001 to 2003, it increased to 71.0 billion yen by 2012.

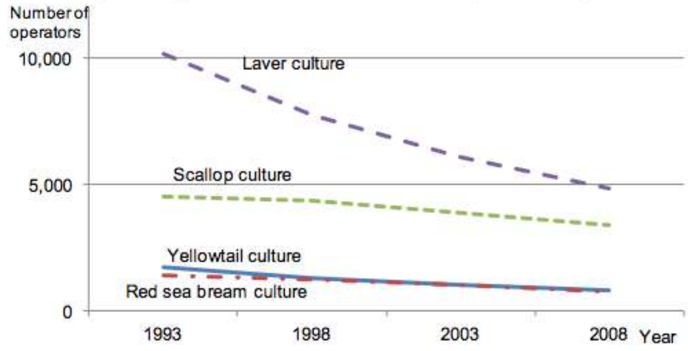
2-3 Laws concerning aquaculture in Japan

- Marine Resources Development Promotion Act: provisions on the general framework of aquaculture, such as species subject to promotion of aquaculture and the environment suitable for aquaculture.
- Fishery Act: provisions on the right to operate aquaculture in waters provided for use by the public (demarcated fishery right).
- Sustainable Aquaculture Production Assurance Act: improvement of aquaculture areas and prevention of the spread of specified diseases among farm-raised aquatic animals and plants.
- Act on the Protection of Fishery Resources: provisions on import quarantine on aquatic animals.
- Pharmaceutical Affairs Act: securing safety of aquatic animal medicines and regulation on the methods of use of such medicines at the site.
- Law Concerning Safety Assurance and Quality Improvement of Feeds: provisions on setting of standards and specifications, provision on testing regarding aquaculture feeds and feed additives.
- Act on Standardization and Proper Quality Labeling of Agricultural and Forestry Products: provisions on labeling of aquaculture products.

3 Aquaculture business management of major commodities

The number of aquaculture operators has declined or has been level for most types of aquaculture in Japan for the past 20 years. The decrease in the number of operators has been offset by the expansion of their business size, resulting in substantially increased production volume per operator. This, however, is not necessarily parallel to production value.

[Changes in the number of operators]



Source: MAFF, *Census of Fisheries*
Note: Number of operators for major types of fisheries.

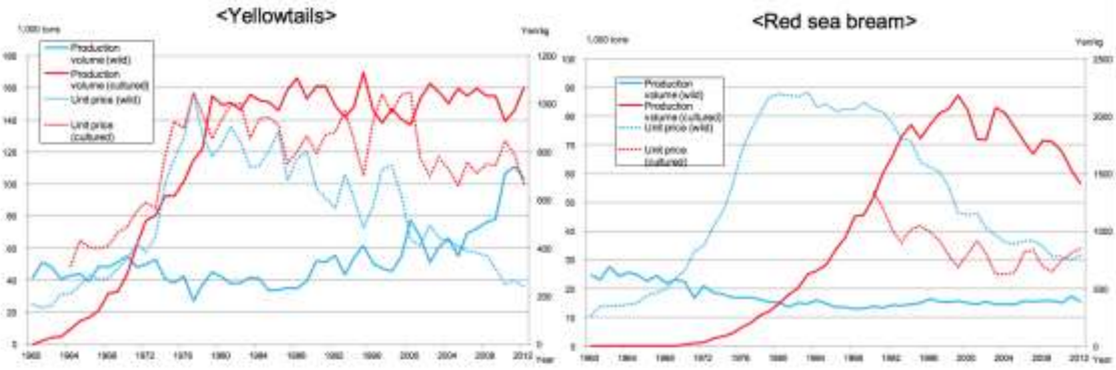
3-1 Yellowtail and red sea bream aquaculture

The business of yellowtail aquaculture (individual operator) has been in deficit since 2008. Corporate operators were in surplus in 2010 and 2011, but turned to record a deficit of 23.42 million yen in 2012. The yellowtail market is divided into cultured fish mainly consumed raw as sashimi and wild fish mainly consumed cooked due to the smaller size. The average unit price tends to be higher for cultured fish. The unit price of cultured fish tends to decline when its production volume increases. With fluctuating production volume, the price is unstable. The unit price tends to drop two years after stocking of a large amount of seeds, which is the time required from seed stocking to harvest. For well-planned business management of yellowtail aquaculture, it is necessary to decide the amount of seeds to be stocked with an eye to the demand two years later. The percentage of feed and seed costs in the total cost is high at around 80% for individual operators and more than 70% for corporate operators.

For red sea bream, the markets of cultured and wild fish overlap, and the unit price has converged to that of cultured fish that is supplied in larger volume. The unit price of cultured red sea bream has been rising in recent years in line with a decline in the production volume. Over the past five years, business management of red sea bream aquaculture was in deficit for both individual and corporate operators from 2008 until 2010, but moved into a surplus in 2011. For individual operators, fishery earnings in 2012 recorded a surplus of 10.9 million yen. Corporate operators also made a fishery profit of 2.4 million yen in 2012. The percentage of feed and seed costs in the total cost has been about or higher than 70% since 2006.

Both yellowtail and red sea bream have a cost structure where the feed and seed costs account for a large proportion of the total cost. The profit margin is structurally narrow, so a fall in the unit price directly leads to a price below cost. Meanwhile, the business management statuses of yellowtail aquaculture and red sea bream aquaculture have been contrastive in recent years. Yellowtail aquaculture has continued to be in the red due to a drop in the unit price associated with a large production volume, while red sea bream aquaculture has turned into the black due to a rise in the unit price associated with a decline in the production volume.

[Changes in the unit prices and production volumes of yellowtails and red sea bream]



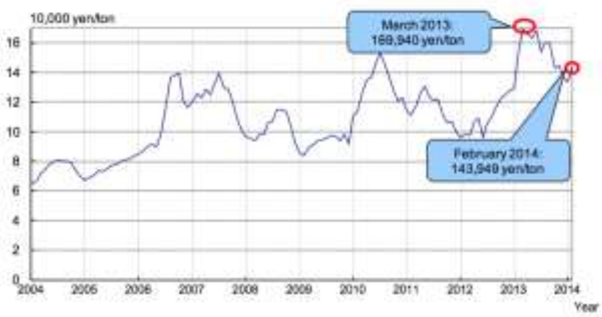
Source: Compiled by Fisheries Agency based on MAFF, *Annual Statistics on Fishery and Aquaculture Production*

3-2 Aquaculture feed

Fishmeal, the main ingredient of compound feed for aquaculture, is mostly imported from abroad. Since fishmeal is mainly made of mass-caught pelagic fish, such as anchovy and sardine, its production volume fluctuates considerably in line with the drastic changes in the wild stock level of these fishes. Fishmeal is not only used for fish aquaculture but also for pig farming and poultry farming, and its price has risen due to increased global demand in recent years.

Since 2010, a project to build a safety net for aquaculture business management has been implemented whereby aquaculture operators and the national government contribute funds at a fixed percentage, and when the price of compound feed rises beyond a certain level, a subsidy is provided to the operators from that reserve. The participation rate is 64% and the number of participants is 749 (as of the end of March 2014).

[Changes in the import price of fish meal]



Source: Compiled by the Fisheries Agency based on Ministry of Finance, Trade Statistics

[Changes in the total production volume of Peruvian anchoveta and Murphy's mackerel in Peru and Chile and the production volume of fish meal]

Source: FAO, *Fishstat (Capture production, Commodities production and trade)*

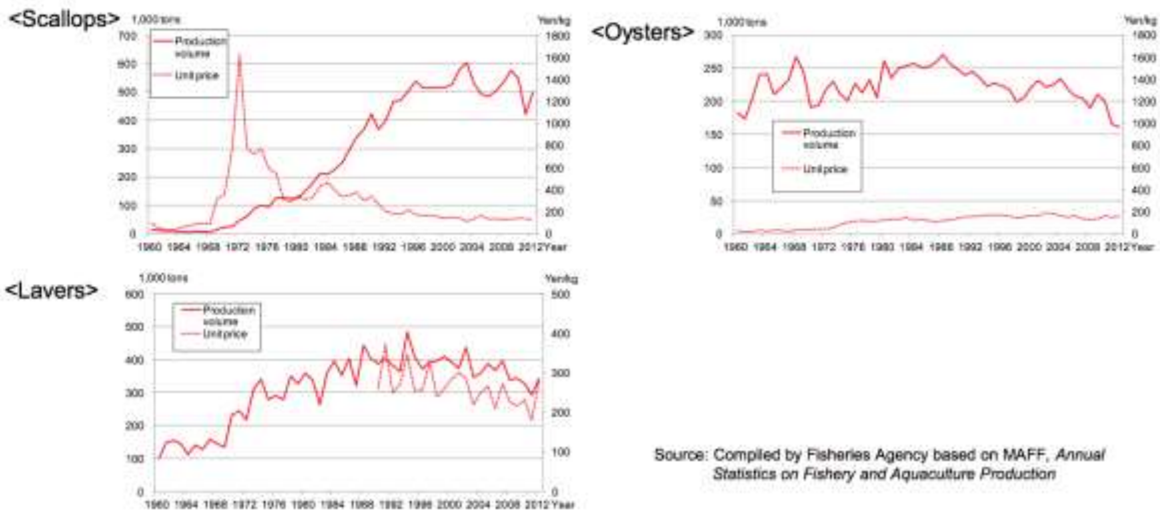
3-3 Scallop, oyster and laver aquaculture

Bivalve and seaweed aquacultures are non-feeding aquaculture, where wild plankton and dissolved nutrient are used as feeds. In scallops, oysters, and lavers, the price trends of cultured products decide the overall price trends. The unit prices of scallops and oysters have been stable at a low level. The unit price of lavers has been falling in spite of a declining trend in the production volume.

In scallop aquaculture (suspended culture), the labor cost for ear-hanging the scallops and detaching them from the lines and the machinery cost for hanging the scallops deep under the sea are large. The cost for labor and machines including fishing vessels (repair cost and depreciation cost) accounts for around 40% of the total operation cost. Although aquaculture earnings have remained in surplus, they have been declining every year.

In laver aquaculture, aquaculture operators process the harvested laver to a certain extent before selling them. Therefore, the fuel cost, maintenance cost and depreciation cost for machines, such as large drying machines required for processing, constitute 42% of the total cost. The repair cost has been on an increase, suggesting that operators are inclined to use existing machines for a long period of time while repairing them as needed. Aquaculture earnings are in the black.

[Changes in the unit prices and production volumes of scallops, oysters and lavers]



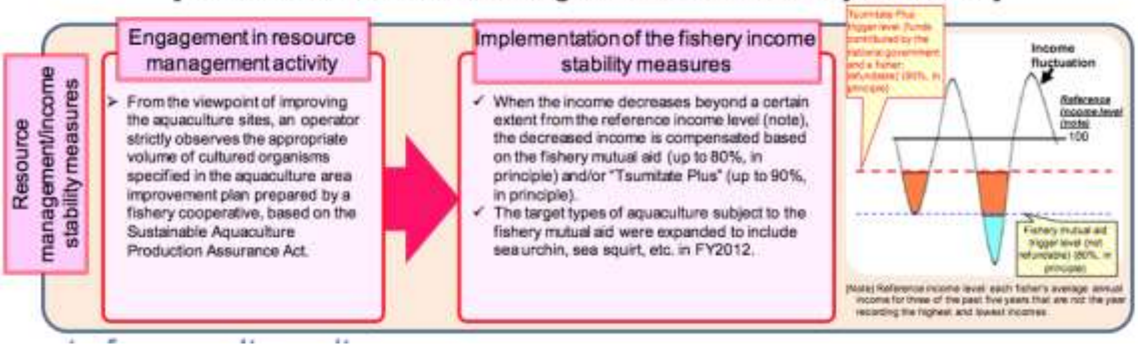
Source: Compiled by Fisheries Agency based on MAFF, *Annual Statistics on Fishery and Aquaculture Production*

3-4 Income stability measures for aquaculture business

In order to ensure appropriate management of aquaculture sites and stable aquaculture business, the national government of Japan has implemented a project for income stability measures using the fishery mutual aid system, targeting aquaculture operators to improve aquaculture environment by reducing the nutrient load to the sites, such as decreasing the aquaculture production volume by 5% or more from the past level, in accordance with the Sustainable Aquaculture Production Assurance Act.

Aquaculture operators and the national government contribute funds, and in the event of the operators' income falling below a certain level, the decreased income is compensated using the reserved fund. The compensation is limited to cover no more than the 10% portion between 90% to 80% of the reference production value. In 2014, a new system is introduced to provide support no more than the 15% portion between 95% to 80% of the reference production value when the operator reduces the production volume by 10% on average, so as to promote stronger efforts to improve the aquaculture sites.

[Outline of the resource management/income stability measures]



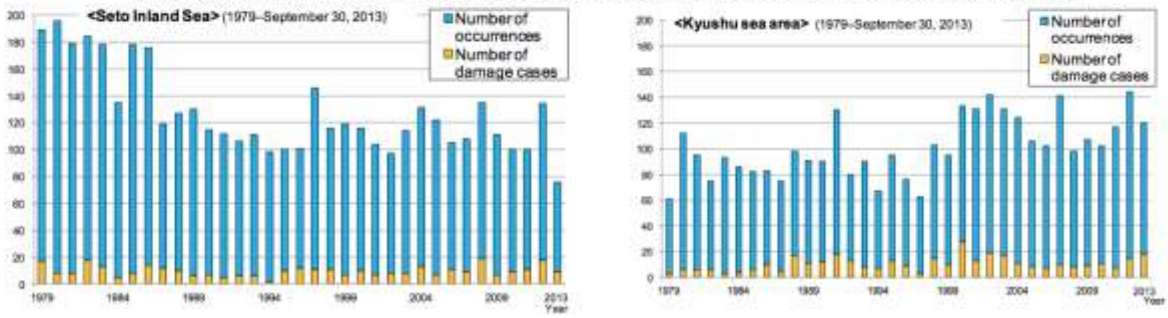
4 Aquaculture environments

4-1 Red tide

Aquaculture, particularly that of finfish and shellfish, has received serisous damage from red tide, which is caused by micro-algal bloom due to a complex effect of environmental eutrophication, temperature, salinity, sun light and competition amongst algae. One of the adverse effects of red tide is suffocation of fish due to the malfunction of the gills covered by algal mucus.

In Kyushu area, the occurrence of red tide has remained at a high level since 2000. In the Seto Inland Sea, the occurrence has been decreasing in the long term, but aquaculture damage persists. Prefectural governments of Japan regularly monitor level of red tide algae and dissolved nutrient to forecast occurrence of red tide.

[Changes in the number of red tide occurrences and the number of red tide damage cases]



4-2 Color loss of laver thallus

In recent years, there have been frequent occurrences of “color loss” where the color of cultured laver fails to grow dark. The factors causing the color loss are said to be depletion of dissolved nutrients due to consumption by propagated phytoplankton and the reduced amount of terrestrial nutrient load to the sea due to the development of sewage treatment facilities. In the Seto Inland Sea, measures are taken such as increasing the discharge of nitrogen from sewage treatment facilities within the limit of the discharge standard value and discharging river water containing nutrients from dams during the laver culturing season.

4-3 Global warming

High water temperature has caused incidences of sudden mass mortality of scallops in Mutsu Bay. In laver aquaculture, the red rot disease occurs due to fungal infection at high water temperature. Also, in recent years, damage has been reported in kelp aquaculture where second-year kelp close to harvest is withered and dies for an unknown reason possibly related to high water temperature.

4-4 Prevention of environmental deterioration due to aquaculture

In feeding aquaculture, feces and leftover feed accumulate in a large quantity in the sea sediment, and decomposition of such organic matter consumes a large amount of oxygen and sometimes produces toxic sulfides. Furthermore, eutrophication of the environment due to the excess organic matter can lead to the occurrence of red tide. Non-feeding intensive aquaculture of bivalves also produces a large amount of feces deposition to the sediment. In algal aquaculture, mass mortality can cause accumulation of debris to the sediment. As such, aquaculture operation can be detrimental to the environment.

Deterioration of the environment of aquaculture sites has been prevented as a result of aquaculture operators implementing the aquaculture area improvement plan formulated under the Sustainable Aquaculture Production Assurance Act. For example in feeding culture of finfish, stocking density is reduced by more than 5% as compared to conventional practice to reduce leftover feed and feces production. Use of formulated feed and vaccines are encouraged. For non-feeding aquaculture of bivalves and seaweed, prompt removal of dead organisms in the case of mass mortality and environmental monitoring are taken place to avoid exceeding of carrying capacity. For restoration of deteriorated sediment conditions, oxygen is introduced to the sediment by plowing and mixing. Lime is added to the sediment to prevent production of highly toxic hydrogen sulfide gas.

5 Hatchery produced and natural seed for aquaculture

In the past, all seeds for aquaculture had been acquired by catching wild young fish or juveniles. However, in order to acquire seeds in a stable manner, development of artificial seed production has made progress. Today, artificial seeds are produced not only for aquaculture of fish such as red sea bream, flounder (*Paralichthys olivaceus*), tiger puffer (*Takifugu rubripes*) and coho salmon (*Oncorhynchus keta*), but also for aquaculture of tiger shrimp and algae such as laver.

Some fish species, for which wild seeds are used in aquaculture, such as Japanese eel and Pacific bluefin tuna, are subject to calls for stricter fishery management due to deterioration and destabilization of wild resource conditions. Therefore, there is a challenge of using wild seeds and managing wild resources at the same time. To address this challenge, for Pacific bluefin tuna aquaculture, the Minister of Agriculture, Forestry and Fisheries issued an instruction on reinforcement of resource management. With regard to Japanese eel, discussions were advanced toward building a resource management framework in the East Asian region as an international resource management measure, while within Japan, resource management pertaining to the catching of glass eel, fishing of adult eel, and eel aquaculture was promoted in a combined manner.

Development of the production technology for artificial seeds of Pacific bluefin tuna was started by Kinki University in the 1970s. The university succeeded in full-cycle aquaculture for the first time in the world in 2002, and established the artificial seed production technology. Further technology development has been promoted mainly by the Fisheries Research Agency toward culturing tuna onshore which is less affected by the external environment.

Production technology for artificial seeds of Japanese eel have been studied by the University of Tokyo, Hokkaido University and other research institutes since the 1960s. The Fisheries Research Agency succeeded in full-cycle aquaculture in 2010. However, since many problems still remain for commercialization, such as the difficulty of acquiring the feed (shark eggs) and maintaining a suitable rearing environment, further technology development has been promoted.

[Changes in the stocking volume and the price of glass eel]

Source: Compiled by the Fisheries Agency based on Ministry of Finance, *Trade Statistics* (import volume) and industry survey (stocking volume and transaction prices)

Note: The catch volume is obtained by subtracting the import volume from the stocking volume.

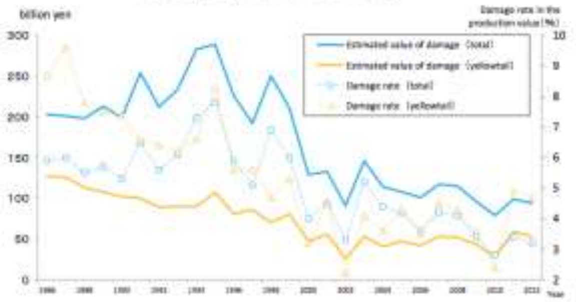
6 Fish disease

In marine fish aquaculture, diseases, such as streptococcosis and pseudotuberculosis became widespread in the past. Vaccines for major fish diseases have become available nowadays, and the occurrence of fish diseases and use of antibiotics have decreased dramatically.

In order to ensure that fishery medicines do not remain in food, the Pharmaceutical Affairs Act prohibits the use of medicines other than those approved by the national government and, with regard to antibacterial fishery medicines and vermifuges, specifies the types of aquatic animals for which they can be used, their dosage and administration, and the required interval period between the end of their use and harvest, and obligates compliance with these specifications. To ensure proper use of medicines, including vaccines, a framework has been established whereby the prefectural fisheries experimental stations instruct methods of use and other necessary information on medicines to aquaculture operators.

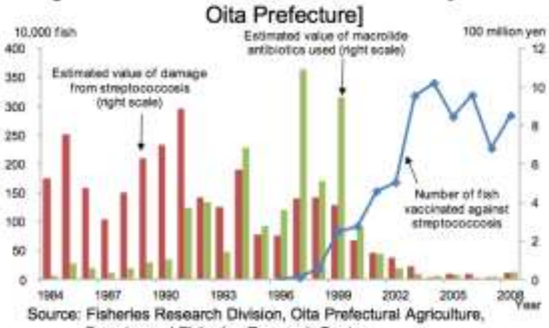
Import of foreign seeds that may hold pathogens that do not exist around Japan is regulated for some fish species under the Act on the Protection of Fishery Resources.

[Changes in the fish disease damage to feeding aquacultured fish]



Source: Fisheries Agency survey

[Changes in the number of vaccinated fish, the fish disease damage, and the value of antibiotics used for yellowtails in Oita Prefecture]



Source: Fisheries Research Division, Oita Prefectural Agriculture, Forestry and Fisheries Research Center

7 Sustainable development of aquaculture

7-1 Development of sustainable supply framework

Aquaculture businesses are facing difficulty acquiring sufficient capital recently, making the necessary investment difficult. It is difficult for individual operators to incorporate new technology and expand sales channels. In the short term, it is important to secure profit by enhancing business vitality by cutting down operational costs through rationalization. The operators should then strengthen the sales division through expansion of the sales channels including overseas channels and reduction of distribution costs.

The price of cultured fish greatly fluctuates as a result of an imbalance between the supply and demand of the commodity. It is important to develop a production framework that corresponds to the demand in and outside Japan. The Fisheries Agency of Japan established a production volume guideline for the 2014 fishing season in February 2014, presenting the target production volume.

7-2 Securing suitable aquaculture site environments

Aquaculture environment is important to prevent the occurrence of fish diseases and improve product quality. Suitable sites for aquaculture are decreasing in coastal areas due to the expansion of aquaculture businesses, coastal development and reclamation. As a countermeasure, it is essential to develop technology for offshore aquaculture and onshore aquaculture using a closed circulatory system to actively control water and sediment qualities.

7-3 Development of technologies to cope with environmental changes and maintain wild resources

For Japanese eel and Pacific bluefin tuna aquaculture, it is important to accelerate development of hatchery production technology, and to switch to full-cycle aquaculture as soon as possible. Although there is still an ample wild seed resource in yellowtails, switching to artificial seed is advantageous to cope with instability of wild resource availability and to harvest earlier than the high season for higher market price.

Since the demand for fishery products is growing worldwide, there is a need for technology to make use of low-use and unused resources in waters surrounding Japan for aquaculture feed. It is important to develop compound feed with less fishmeal content, which can be supplied at a stable price. It is also effective for business management and the management of wild resources to reduce the feed ration by creating a strain that grows well with a small amount of feed.

In order to deal with the rise in the seawater temperature, it is crucial to create a high water temperature resistant strain of broodstock to continue aquaculture at the existing aquaculture sites.

7-4 Promotion of safe and reliable aquaculture production

Consumers recognize that it is an obligation of producers to ensure the safety of their products. It is important to establish traceability of aquaculture commodities and build a framework to readily provide necessary information to consumers.

7-5 Contribution to food security

Aquaculture is expected to occupy a large proportion of fishery product supply in the future, responding to the growing demand for fishery products due to the world population increase. Japan should make contribution in advance in aquaculture productivity, making use of its abundant technology and knowledge of aquaculture.