

Course of the Research for Sustainable Aquaculture in Japan

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Abstract : World aquaculture has grown dramatically in the last 50 years, mainly in Asia, and is expected to increase further. In the meantime, aquaculture production of Japan has stabilized and occupies an important position in the entire fishery, but the effects of that situation in Japan are in severe. The situation is due to increased costs of fuel oil, fish meal for feed, the high cost of quality fish for stocking and sluggish fish prices caused by the economic recession, along with losses caused by red tide and outbreaks of disease. Due to those factors, the aquaculture industry in Japan is faced with high production costs and low prices for its products.

To improve the management of aquaculture, it is necessary to shift to a sustainable and profitable structure through a review of the entire production process. We organized an overview of aquaculture production systems, and have discussed research problems and directions for solving them. To achieve sustainable aquaculture, the industry must reduce the environmental impacts, as well as need to be profitable. For low impact on the environment, research and technological innovation are needed on larvae and fry production that is independent on natural resources, improvement of culture methods and feed quality and so forth. To increase revenue, it is necessary to practice continual cost savings by analyzing each process of associated with aquaculture production and development of a way to add value to products. Thus, it is important that aquaculture becomes regarded as an integrated production system.

Keywords : sustainable aquaculture, profitability, aquaculture production systems

Production of aquaculture in the world has grown dramatically, and the increased rate since 1970 is much higher than that of world population growth during the same period according to the Food and Agriculture Organization (FAO) as can be found in The State of World Fisheries and Aquaculture (2008)¹⁾. Recently, aquaculture has been considered to be the answer for food security since the depletion of natural fisheries resources is concerned. While the aquaculture industry overall continues to grow, its status in Japan is not necessarily favorable. However, considering global food supply and food security, it is said that future continued expansion of the industry is strong. This paper introduces the current state of aquaculture in the world and Japan,

indicating the direction of research is heading in the Fisheries Research Agency.

Situation of aquaculture in the world

The global aquaculture industry continues unprecedented development. Over the past 20 years aquaculture production has increased rapidly, while capture fisheries production has not (Fig. 1). Aquaculture accounted for 47 percent of the global supply of edible fish and shellfish in 2006. Of that, 90 percent is produced in Asia (FAO Statistics, 2006). This dominance is mainly due to China's enormous production, most of which consists of freshwater fish. Looking at the top ten countries of aquaculture

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production, excluding seaweeds, Asian countries dominate, with Japan eighth on the list. Chile and

Norway, the world's leading producers of salmon, occupy the positions of seventh and ninth.

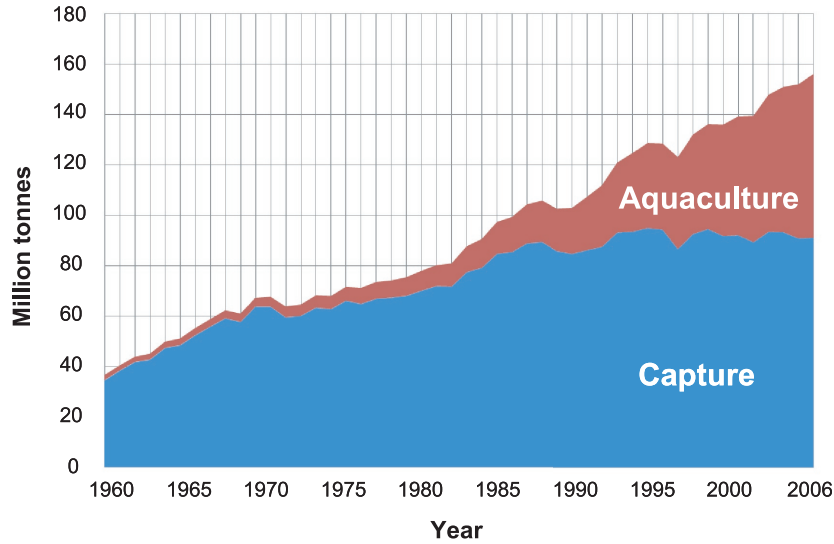


Fig. 1. Capture and aquaculture production in the world (The state of fisheries and aquaculture 2008¹⁾)

The aquaculture situation in Japan

Aquaculture production in Japan in 2008 was 1.19 million tons, with a value of 4,790 billion yen, accounting for 21% of domestic fisheries production.

Since the late 1980s, in the face of falling capture fisheries production, aquaculture production has been stable, and has increased its presence accounts for a relatively large proportion in the fishery (Fig. 2). However, Japan's aquaculture industry is in poor

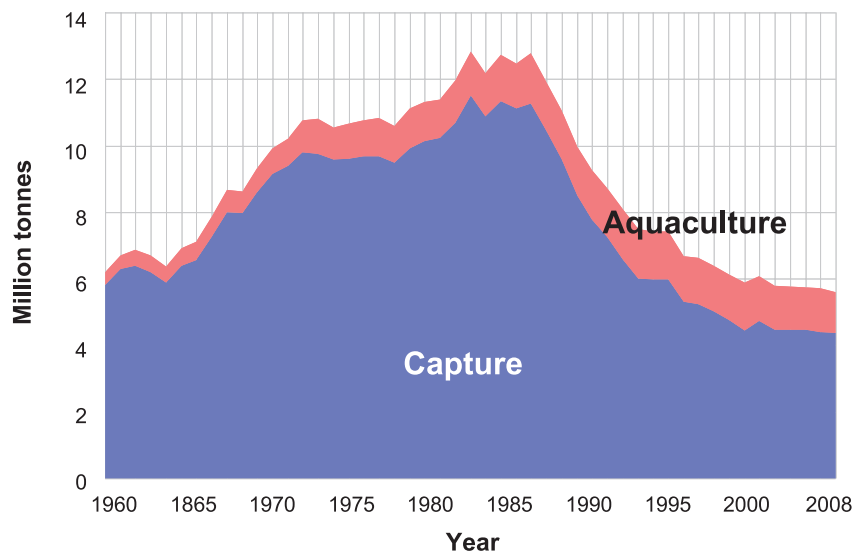


Fig. 2. Capture and aquaculture production in Japan (from the statistics of fisheries and aquaculture 2008²⁾)

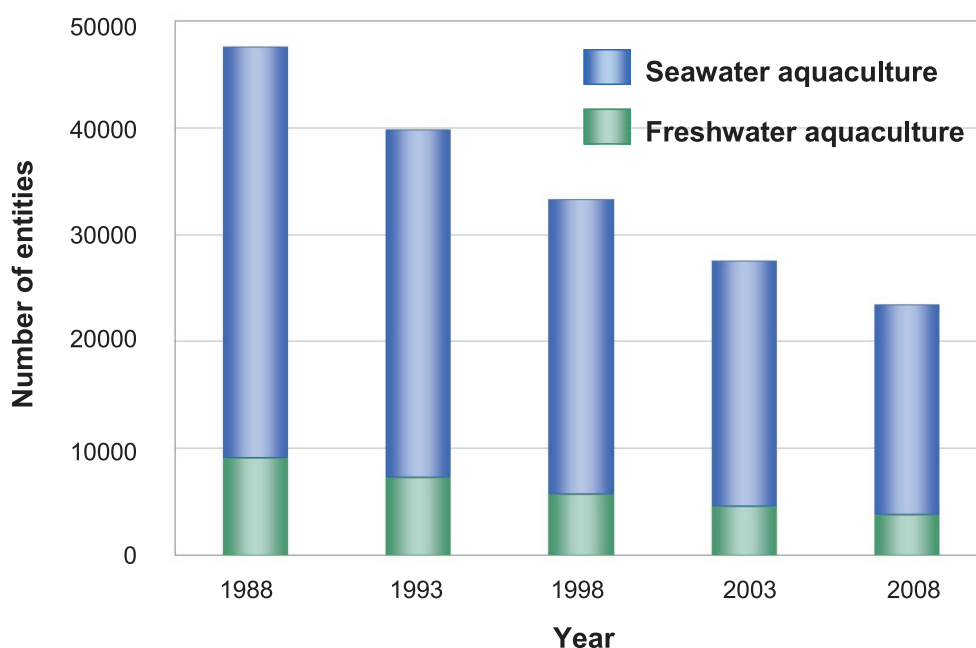


Fig. 3. Number of management entities in Japan (from the statistics of fisheries and aquaculture 2008²⁾)

shape because of increased production costs due to rising prices of fuel oil and fish meal, restrained purchasing of high quality fish and a decline of fish prices due to business recession. Other factors have been outbreaks of red tides and fish diseases. These circumstances have engendered the production structure with high production costs and low prices, and have given rise to problems such as a decrease in the number of management entities (Fig. 3), an aging work force and lack of successors.

In contrast, some new industries, as bluefin tuna aquaculture, have been developed in Japan. Aquaculture production of tuna is estimated to have reached 10,000 tons in 2010, up from less than 500 tons in 1999. The number of management entities entering tuna aquaculture has increased. That development still does not supply enough bluefin tuna to satisfy domestic demand. That is due to reduced production in world capture and aquaculture in the Mediterranean and by the regulation of tuna fisheries due to heightened international interest in the conservation of the resource.

In addition, hatchery production is one of the

Table 1. Number of production species in Japan (from seed production for stock enhancement, acquisition / plantation record 2007³⁾)

	Aquaculture	Plant
Fish	25	39
Crustacean	3	11
Shellfish	19	24
Others	4	7

(except for salmonids, eel and algae)

technologies for which the Japanese are proud. Table 1 shows hatchery production of various species in Japan. Many species are produced both for aquaculture and stock enhancement³⁾. Further, consumers in Japan ask for an abundance of seafoods that are rich in variety. Therefore, we think that Japanese aquaculture has the potential for further development.

Problems associated with sustainable aquaculture

Although the global aquaculture industry has made remarkable progress, it cannot be considered

that aquaculture will continue to grow within the level of current technology because fish aquaculture can result in pollution of the environment and the amount of feed available to be used in it is limited. Then, as mentioned above, the present situation with respect to the aquaculture industry in Japan is in a critical condition. A new perspective is needed for further development of the industry. Sustainability is an important consideration for regeneration of profitable aquaculture since industries cannot carry on if they operate at a loss. Research must be focused on not only sustainability but also profitability. It is necessary to first analyze the entire aquaculture enterprise. Fig. 4 shows an overview of aquaculture systems that was organized for digging out the problems. We are apt to think that only fish and shellfish production processes make up an aquaculture system. However, production needs support sections such as facilities and process management, along with post-harvest activities such as processing and distribution. Furthermore, management cannot be neglected, since aquaculture

is an economic activity. We have tried to distill problems from each of these categories through surveying the overall aquaculture system.

Research contents for sustainability and profitability are shown in Tables 2 and 3. In sustainability, issues including environmental improvement, appropriate amount of feeding, reduction of fish meal in feed, integrated multi-trophic aquaculture that combines species from different nutritional levels in the same system, and systems that include production of eggs spawned by fish reared from artificial fertilization, need to be addressed in order to reduce impacts on the environment. Complete aquaculture reduces the impact of fishing on native resources. Worker safety and reduction of labor are taken up for improvement of the work environment. Furthermore, mechanization, land-based aquaculture and offshore aquaculture require modernization. For profitability, it is important for management to realize the characteristics and trends of balance. Marketing is very important issue as well. There are

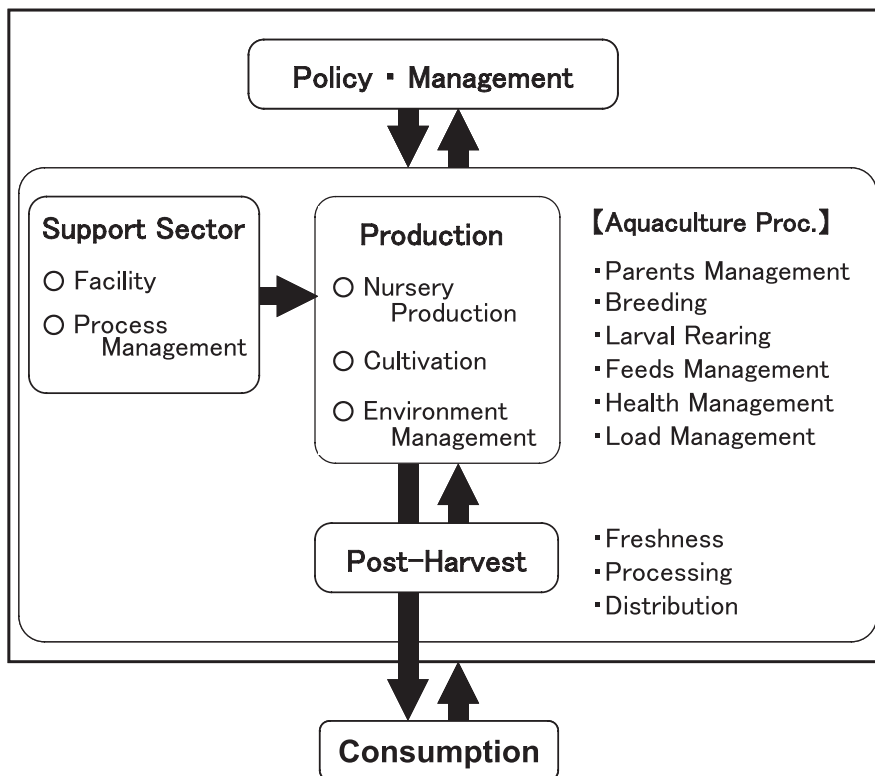


Fig. 4. Illustration of an aquaculture production system (fish aquaculture)

Table 2. Research contents in sustainable aquaculture

Sustainable Aquaculture
<ul style="list-style-type: none"> ◆ <u>Reduce impact on environment</u> <ul style="list-style-type: none"> • environmental improvement • appropriate amount of feeding • reduction of fish meal in feed • integrated multi-trophic aquaculture • complete aquaculture (reduces the impact of fishing on native resources) ◆ <u>Improvement of the work environment</u> <ul style="list-style-type: none"> • worker safety • reduction of labor (mechanization) ◆ <u>Modernization</u> <ul style="list-style-type: none"> • mechanization • land-based aquaculture • offshore aquaculture

Table 3. Research contents in profitable aquaculture

Profitable Aquaculture
<ul style="list-style-type: none"> ◆ <u>Management</u> <ul style="list-style-type: none"> • realize characteristics and trends of balance • marketing ◆ <u>Productivity improvement and cost savings</u> <ul style="list-style-type: none"> • maturation control • stable hatchery production • optimum rearing conditions • breeding (tolerance to disease, high growth rate, etc.) • prevention of disease • nutrient enrichment of live feed organisms • integrated multi-trophic aquaculture ◆ <u>Adding value</u> <ul style="list-style-type: none"> • food safety • quality control • product traceability

many specific problems in productivity improvement and cost savings. Maturation control, stable hatchery production, optimum rearing conditions, breeding, prevention of disease, nutrient enrichment of live feed organisms, and others need to be considered. Integrated multi-trophic aquaculture is important not only to reduce impacts on the environment but also for productivity improvement and cost savings. This practice is new and has attracted considerable attention since it promotes economic and environmental sustainability. Researches on food safety, quality control and product traceability are needed to add value to aquaculture products. Future research needs to take into account aquaculture as an integrated production system, recognize the relative importance of each of specific issue and how each affects the overall aquaculture system.

Future research with the aim of profitability and sustainability

This paper indicates that aquaculture has to

incorporate integrated production systems from production to distribution and consumption. We should address aquaculture research that includes management for producing a profit to post-harvest for selling the products at high prices, as well as production technology for improving productivity. The Fisheries Research Agency aims to help develop a sustainable aquaculture industry through research and technological innovation.

References

- 1) The state of world fisheries and aquaculture, 2008: Food and Agriculture Organization of the United Nations.
- 2) The statistics of fisheries and aquaculture, 2008: Statistical Yearbook of Ministry, Forestry and Fisheries.
- 3) Seed production for stock enhancement, acquisition / plantation record, 2007: National Center for Stock Enhancement, Fisheries Research Agency.