

Aquaculture in Indonesia

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Abstract

Indonesia has a long tradition in aquaculture, particularly in fresh water and brackish water. Most aquaculture is still in extensive systems with low productivity. Mariculture only started in the 1980s and contributes yet little to the total national production. Aquaculture has become increasingly important, particularly in supporting rural economies. The development of shrimp and prawn culture became a Government priority after trawl fishing was banned in 1980-81. With its strategic geographic position and enormous inland and coastal resources, Indonesia has good prospects in aquaculture.

Introduction

Aquaculture in Indonesia is generally small-scale, with low technological inputs and high degree of dependence upon nature. Aquaculture covers freshwater, brackishwater, and marine culture. Freshwater and brackishwater culture have been practised for a long time, but mariculture or Seafarming just started in the early 1980s. More than 470,000 hectares of inland waters and 86,000 hectares of coastal waters are available for aquaculture. The total seed supply from open waters is estimated at 11.3 billion per year, consisting of 1.5 billion of milkfish, 800 million of shrimp, and 9 billion of freshwater fishes. Aquaculture has become important particularly in supporting the rural economy in Indonesia. In 1991, aquaculture made up 617,700 tons (Table 1) of the total fisheries production of 3,186,000 tons (FAO 1991, FAO 1993).

The development and management of fisheries, including aquaculture, are under the main auspices of the Directorate General of Fisheries, Ministry of Agriculture. Under PELITA V, the fifth Five-Year Plan (1989-1994), total fisheries production is projected to increase at 5.9% a year to reach 3,974,200 tons in 1993. Aquaculture in particular is expected to grow at a rate of 9.6% annually. In line with the government's current drive to promote non-oil exports, the development of fisheries is directed toward high-value seaweed, pearls, shrimps, crabs, and fishes such as tunas, sea bass, groupers, sharks, and ornamentals. The government encourages the private sector to invest in aquaculture and industrial fisheries; the industrial fisheries serve as development agents for small-scale fisheries. The objectives of fisheries development are:

- To increase production to meet domestic protein requirement, to provide raw materials for the processing industry, and to increase foreign exchange earnings through exports
- To increase the productivity of, and value-added products from, fisheries to improve the income of fishers and fishfarmers
- To expand employment and business opportunities
- To effectively improve the management of fisheries resources and the living environment

The national strategy for aquaculture development focuses on: (1) increasing the productivity of fishfarmers through improved technology, (2) increasing production through the intensification of culture in existing areas and expansion to new areas, and (3) diversifying towards species with high economic value. The aquaculture sector in Indonesia offers good prospects for investment. in coexistence with small-scale fisheries through the Nucleus Estate and Smallholder approach.

Table 1. Production from aquaculture in Indonesia in 1986 and 1991. Data from FAO (1993).

Species	Production (tons)	
	1986	1991
<i>Cyprinus carpio</i>	68,130	90,000
<i>Puntius javanicus</i>	22,877	28,000
<i>Osteochilus hasselti</i>	16,210	15,040
<i>Oreochromis mossambicus</i>	15,487	42,000
<i>Oreochromis niloticus</i>	8,487	12,200
<i>Osphronemus goramy</i>	3,938	4,130
<i>Trichogaster pectoralis</i>	1,414	2,500
<i>Helostoma temmincki</i>	4,988	5,800
<i>Clarias</i> spp.	886	4,000
<i>Anguilla</i> sp.	8	1,150
Other freshwater fishes	39,365	46,000
<i>Chanos chanos</i>	103,588	133,400
<i>Lates calcarifer</i>	798	2,000
Mugilidae	4,283	7,500
<i>Scylla serrata</i>	758	2,400
<i>Portunus</i> spp.	21	10
<i>Penaeus monodon</i>	15,424	70,560
<i>Penaeus merguensis</i>	13,575	18,000
<i>Metapenaeus</i> spp.	11,889	21,510
<i>Acetes japonicus</i>	929	1,500
Seaweeds	77,462	110,000
Total	410,554	617,700

Freshwater Culture

Aquaculture in ponds, rice fields, cages, pens or floating nets is done by many fishfarmers, and running-water ponds and integrated fish culture systems are in operation in some places. The cultured fishes include common carp *Cyprinus carpio*, tawes *Puntius javanicus*, tilapia *Oreochromis mossambicus*, Nile tilapia *O. niloticus*, gouramy *Osphronemus goramy*, spotted gouramy *Trichogaster pectoralis*, kissing gouramy *Helostoma temmincki*, and nilem *Osteochilus hasselti*. The government has also encouraged the culture of the lele catfish *Clarias batrachus* and the lele dumbo or African catfish *Clarias gariepinus* imported from Taiwan in 1985. The Thai catfish *Pangasius sutchi* was also introduced to Indonesia some years ago, but only a few people are interested in culturing this species. The culture of giant freshwater prawn *Macrobrachium rosenbergii* has been developed in some places, particularly in the provinces of West Java, Central Java, East Java, and Yogyakarta.

Ricefields are usually stocked with the carps *Cyprinus carpio* and *Puntius javanicus*. When the common carps are about 100 grams each, they are harvested and stocked in running-water ponds and in cages, pens or floating nets in rivers, lakes, irrigation canals, dams, or reservoirs. Other species cultured in cages are the common carp *Cyprinus carpio*, gabus or murrel *Ophiocephalus striatus*, toman or murrel *O. microleptis*, and jelawat or carp *Leptobarbus hoevenii*. Small-scale cage culture is done in the provinces of West Java, Jambi, South Sumatera and Kalimantan. In 1990, the average production from freshwater aquaculture was greater than 1 ton/ha (Table 2).

Table 2. Freshwater culture in Indonesia in 1990 (Directorate General of Fisheries, Ministry of Agriculture, Indonesia).

Freshwater culture systems	Area (ha)	Production (tons)
Ponds	84,441	125,176
Rice fields	114,106	100,086
Cages	21	7,392
Total	198,568	232,654

FAO (1993) records a production of 250,820 tons of freshwater fishes in 1991.

To maintain the seed supply, the Directorate General of Fisheries has established *Macrobrachium* and fish hatcheries in several provinces. There are five *Macrobrachium* hatcheries, one each in West Java, Central Java, East Java, Yogyakarta, and Bali. There are 354 fish hatcheries covering 446 hectares — 18 central units under the Provincial Fisheries Service and 336 local units under the District Fisheries Service. The silver carp or mola *Hypophthalmichthys molitrix* and the grass carp *Ctenopharyngodon idella* have been successfully propagated in a government hatchery in Central Java and some juveniles have been distributed to other places. Besides the government hatcheries, private hatcheries in the country numbered 7,649 in 1988, covered about 1,622 hectares, and produced about 2 million young juveniles each year.

To support the development of freshwater aquaculture, the Government has established the Freshwater Fisheries Development Center in Sukabumi, West Java.

Brackishwater Culture

In Indonesia, fish culture in brackishwater ponds, locally called *tambak*, started in the late 14th century. The existing *tambaks* as of 1990 total 276,442 hectares, 93% of these in Aceh, West Java, Central Java, East Java and South Sulawesi. From 1988 to 1990, the *tambak* area increased 3% annually. Until 1975, the main species cultured in the *tambak* was the milkfish *Chanos chanos*, and other species including penaeid shrimps were only by-products. Since 1975, the tiger shrimp *Penaeus monodon* and white shrimp *P. merguensis* have also become major crops, alone or in polyculture with milkfish. Fish farmers have adopted improved technology in the construction of their ponds. Water control structures such as sluice gates and irrigation canals are in place. Ponds are divided into several compartments depending on function and other requirements. Culture techniques have been improved as well. Ponds are prepared, pests are eradicated, manures and fertilizers are applied, young juveniles are stocked, and supplemental feeds are sometimes used.

The development of brackishwater culture is directed toward shrimp exports. The government prioritized the development of shrimp culture after shrimp catches declined due to the trawl ban in 1980 and the increasing population pressure in certain fishing areas. The total production from brackishwater ponds in 1990 was 272,000 tons, and about 30.3% were tiger and white shrimps (Directorate General of Fisheries, Ministry of Agriculture, Indonesia). Shrimps have become consistently the major source of foreign exchange — 30% in volume and 70% in value of the total fisheries export.

Based on the level of inputs and water management, extensive, semi-intensive, and intensive culture systems have been developed for shrimps. In the extensive system, the species under culture subsists on natural food grown with fertilizers. Pond water is changed with the tides. The stocking density is low and 1-2 crops are harvested per year depending on the condition of the site. The expected production is around 400-800 kg/ha-yr. In the semi-intensive system, higher stocking densities and supplemental feeds are used. Water pumps are used occasionally to increase oxygen levels. Two crops per year produce 1,000-2,000 kg/ha-yr. The intensive culture system is totally dependent on formulated feeds and on water pumps and paddle wheels. From two crops of shrimps a year, the total production is 5,000-8,000 kg/ha-yr.

The Brackishwater Aquaculture Development Centre in Jepara, Central Java was established to develop and support brackishwater aquaculture in the country.

The government strongly supports the development of *tambak*, particularly for small-scale aquaculture. The first Brackishwater Aquaculture Development Project, supported by the Asian Development Bank, includes the rehabilitation and construction of 280 km of primary and secondary canals serving 20,000 hectares of *tambak*. The project also provides credit to small-scale farmers. The Second Brackishwater Aquaculture Development Project established 10 Nucleus Estate and Smallholder *tambak* in Aceh, North Sumatera, South Kalimantan, East Kalimantan, and West Nusa Tenggara. Under the Fisheries Support Services Project supported by the World

Dank, about 600 kilometers of canals were rehabilitated to serve 18,000 hectares of *tambak* under intensive culture.

To support shrimp culture, the government will rehabilitate brackishwater canals, control the quality of fry and feed, control pests and diseases, develop post-harvest technology, improve the distribution and marketing mechanisms, and conduct training and extension in fisheries. These efforts will be supported by agro-industrial development (small-scale, medium, and rural industries).

Mariculture

Indonesia has vast potential for mariculture or Seafarming. Fish farmers cultivate different marine species at very small scales in several places in the country, but mariculture contributes yet little to the total national production.

Fishes are cultured in pens and floating net cages in Tanjung Pinang (Riau Province), Belitung Island (South Sumatera), Serang (West Java) and West Nusa Tenggara. The cultured species are the grouper *Epinephelus coioides*, rabbitfish *Siganus javus*, and sea bass *Lates calcarifer*. The seaweed *Eucheuma* has been cultured in several places, especially in Bali, West Nusa Tenggara and Lampung. Some 89,568 tons of seaweed were produced from 747 hectares in 1990. In South Sulawesi, some farmers culture *Gracilaria* in brackishwater ponds that are not productive for shrimp culture. Pearl oysters are cultured in some places. A few years ago, the government also encouraged the culture of green mussels in provinces such as Jakarta, Lampung and Kalimantan. However, marketing problems were encountered and mussel culture has slowed down.

The technical development of mariculture is supported by Seafarming Development Center in Lampung.

Research Needs in Aquaculture

Given the available resources, the level of technology applied, and the problems faced by the aquaculture industry, more research is needed in several problem areas.

Freshwater culture

- Seed production and rearing of selected ornamental fishes
- Seed production and rearing of the tawes *Puntius javanicus*, marble goby *Oxyeleotris marmorata*, carps *Labeobarbus douronensis* and *Leptobarbus hoevenni*, catfish *Pangasius pangasius*, freshwater eel *Anguilla bicolor*, and featherback *Notopterus chilate*

Brackishwater culture

- Seed production of milkfish
- Seed production and rearing of the white shrimp *Penaeus merguensis* and banana shrimp *P. indicus*

- Control of the pond environment
- Control and eradication of diseases and pests
- Land-use planning for *tambak* according to the technology level applied

Mariculture

- Seed production of sea bass *Lates calcarifer*, rabbitfish *Siganus javus*, and grouper *Epinephelus tauvina*
- Formulation of artificial feeds
- Culture techniques for fishes, seaweeds, sea cucumbers, and mollusks

Editors' Addendum

Among the papers that have been published during the past 20 years about Indonesian research and practices in aquaculture are listed below. Indonesian scientists write in Bahasa and there are not very many reports in English; those that are must be shared more widely.

Milkfish: Martosudarmo et al. (1976), Wiratno (1978), Padlan (1979), Poernomo and Singh (1982), Poernomo (1983), Chong et al. (1984), Prijono et al. (1988), Ahmad (1993)

Sea bass: Danakusumah and Ismail (1987), Kungvankij (1987), Martodusarmo (1987), Tiensongrusmee (1987)

Rabbitfishes: Ismael (1976), Ismael and Nuraini (1983), Waspada (1984), Diani et al. (1990), Kungvankij et al. (1990), Tacon et al. (1990)

Tilapia, carps, other freshwater fishes: Reksalegora (1979), Jangkaru and Djajadiredja (1979), Rifai (1979)

Seaweeds: Hatta and Purnomo (1994)

Integrated farming: Manik and Tiensongrusmee (1979), Sastroamidjojo (1993)

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