Aquaculture in the Philippines

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Abstract

Aquaculture is regarded as the most promising source of protein food in the years ahead. Milkfish and Nile tilapia are the major fishes now produced but groupers, sea bass, rabbitfish, red snappers, carps, and catfishes are grown by some farmers. The tiger shrimp is still the most important cultured crustacean, but white shrimps and mudcrabs also have great potential. Oysters and mussels are produced in considerable amounts. Mariculture of the seaweed *Eucheuma* is now a well established industry, and the pond culture of *Gracilaria* for agar extraction is beginning to take off.

Introduction

Aquaculture is an important sector in Philippine fisheries and the most dynamic since the decline of marine fisheries starting 1976. The total fish production in the Philippines in 1992 was 2,625,607 tons — 41.3% came from coastal or sustenance fishing, 30.7% from offshore or commercial fishing, and 28% from aquaculture (Table 1). Fish production from the coastal zone decreased and the fish caught were of lower commercial value. Commercial fishing increased in production but existing fishing boats are old and small and lack modern equipment to explore the exclusive economic zone.

Aquaculture is a more controllable and manageable production system. From this sector, a yearly increase in production has been achieved (Table 1). In terms of value, aquaculture products contributed nearly 40% of P65.443 billion in 1992 (Table 2). Production from brackishwater ponds, from freshwater ponds, pens and cages, and from mariculture in different regions in the Philippines are shown in Table 3. In the export markets, cultured shrimps and seaweeds have been major winners since 1987. In 1992, the shrimp export was worth US$211.448 million and the seaweed export $18.953 million (Table 4). Employment in the aquaculture sector is estimated at 258,480 people (BFAR 1992).

Table 1. Volume of the fishery production in the Philippines, by sector, 1983-92. Data from BFAR (1992).

Year	Production (tons)			
	Aquaculture	Municipal	Commercial	Total
1992	736,381	1,084,360	804,866	2,625,607
1991	692,401	1,146,765	759,815	2,598,981
1990	671,116	1,131,866	700,564	2,503,546
1989	629,345	1,104,626	637,138	2,371,109
1988	599,554	1,070,195	599,995	2,269,744
1987	560,970	1,060,878	591,192	2,089,484
1986	470,893	1,072,361	546,230	2,089,484
1985	494,893	1,045,382	511,987	2,052,111
1984	477,887	1,089,046	513,335	2,080,268
1983	445,073	1,145,841	519,316	2,110,230

Table 2. Value of the fishery production in the Philippines, by sector, 1983-1992. Data from BFAR (1992). US$1 = P25.

Year	Value of fish production (million pesos)			
	Aquaculture	Municipal	Commercial	Total
1992	25,986	22,656	16,801	65,443
1991	22,656	22,133	15,245	60,034
1990	20,467	19,300	12,411	52,178
1989	15,673	18,388	11,033	45,094
1988	15,213	16,633	10,272	42,118
1987	11,314	16,108	9,821	37,243
1986	10,832	17,251	9,248	37,331
1985	8,724	14,716	7,857	31,297
1984	7,266	11,863	6,521	25,650
1983	4,799	9,540	4,643	18,982

Table 3. Aquaculture production in the Philippines in 1992, by culture system, by region. Data from BFAR (1992).

Region	Aquaculture production (tons)					
	Total volume	Brackishwater ponds	Freshwater culture			Marine culture
			Ponds	Pens	Cages	
National Capital	7,041	1,345	-	3,607	375	1,714
Cordillera	513	-	412	-	101	-
Northwest Luzon	42,541	32,014	2,455	12	15	8,045
Northern Luzon	3,336	1,095	1,672	-	495	74
Central Luzon	112,927	78,418	33,220	50	629	610
Southern Luzon	81,155	27,205	865	24,014	18,320	10,751
Southeastern Luzon	15,660	6,816	207	-	8,427	210
Western Visayas	115,519	110,716	810	-	-	3,993
Central Visayas	30,980	11,495	-	-	-	19,485
Eastern Visayas	15,771	3,699	142	36	90	11,804
Western Mindanao	287,550	20,275	221	317	20	266,717
Central Mindanao	5,487	4,772	561	-	-	154
Eastern Mindanao	13,024	11,795	297	67	372	493
Southern Mindanao	4,877	4,698	165	-	14	-
Total	736,381	314,343	41,027	28,103	28,858	324,050

Table 4. Quantity and freight-on-board value of the major fishery exports of the Philippines, by country of destination, 1992. Data from BFAR (1992).

Commodity Country	Quantity (tons)	FOB value (×1,000 pesos)	FOB value ($ ×1,000)
Shrimp/prawns	23,623	5,347,417	211,448
Japan	17,897	4,068,924	161,056
USA	3,380	900,038	35,472
Korea	270	84,867	3,338
Others	1,626	293,588	11,582
Tunas	50,285	2,589,163	102,324
USA	10,944	494,019	19,512
Germany	9,967	483,540	19,059
Canada	6,492	363,462	14,395
Others	22,882	1,248,142	49,358
Seaweeds	22,756	480,398	18,953
United Kingdom	1,467	86,327	3,413
Denmark	3,663	67,370	2,673
France	3,724	61,380	2,416
Others	13,902	265,321	10,451

Developments in aquaculture in the Philippines, particularly environment-friendly mariculture and searanching, were reviewed by Aypa (1994), Delmendo (1994), Guerrero (1994), and Lopez (1994).

Brackishwater Aquaculture

Brackishwater ponds range from small and simple water impoundments to huge excavations of complex engineering design. Most ponds are built on what used to be mangrove swamps. Estimates of mangrove areas converted to fishponds during 1950-1973 range from 1,000 to 24,000 hectares per year. Some 227,907 hectares of brackishwater ponds are in existence as of 1992, about 176,000 hectares used for milkfish culture and 25,000 hectares for tiger shrimp. A total of 314,343 tons were produced from brackishwater ponds in 1992.— 228,358 tons milkfish, 59,657 tons shrimps, and 26,328 tons of other species (BFAR 1992).

Milkfish

Most milkfish are produced in western Visayas, central Luzon, northwestern Luzon, southern Luzon, and western Mindanao. Producers of milkfish generally use the extensive culture method, with stocking densities of 3,000-7,000/ha, and production of about 350-500 kg/ha-yr. The semi-intensive culture method is now gaining interest among milkfish farmers. Higher stocking densities of 9,000-10,000/ha and use of supplemental feeds allow relatively high

production of 900-1,200 kg/ha-yr in the straight-run system. The modular culture system introduced in the Philippines in the 1970s by Yun-An Tang has been adopted by some large-scale farmers.

The National Bangus Breeding Program has had difficulty maintaining the caged broodstocks in good health, and the government has offered them for privatization at the price of P1,000 per year of age per fish. Seven stations had more than 500 breeders and most of these will soon be in private hands. With breeders now available and the milkfish hatchery technology already transferred, the shortage of milkfish seed may be solved. Recently, one importation from Taiwan was made because of an acute shortage of milkfish larvae from the wild.

Tiger shrimp

In 1982, when there was demand for shrimps in the world market, many pond operators switched to shrimp production. Taiwanese feeds and shrimp farming technology and intense research in shrimp biology and hatchery techniques led to the rapid take-off of the shrimp industry. Milkfish ponds, sugarlands, ricelands, and coconut lands were converted into shrimp farms, many of them intensive systems. The use of feeds and pond aeration allowed high stocking densities. In areas where the Taiwanese method was not feasible, the extensive or semi-intensive systems were adopted for improved production. Thus, tiger shrimp production increased from 1,805 tons in 1982 to 59,657 tons in 1992 (BFAR 1992).

The reduction in the demand and price of shrimps in the world market in 1989 was a great blow to the farmers who had invested much in shrimp culture. Production capacity was reduced to half and this greatly affected the shrimp farmers and the allied industries, like the hatcheries, feed millers, processors and exporters. Many shrimp hatcheries closed due to lack of customers. Recently, shrimp prices in the world market have increased again. But the shrimp farmers are now plagued with serious environmental problems like self-pollution, which causes diseases, poor growth, and high mortality.

A policy study by the Auburn University Team (1992) has come up with concrete recommendations for the sustained development of shrimp culture in the Philippines. In areas affected by water pollution, existing facilities for shrimp production must be redesigned. Reservoir ponds, biofilters or other means of effluent treatment must be integrated in the pond culture system.

Groupers, mudcrabs, others

In 1992, some 26,328 tons of groupers, siganids, spadefish, sea bass, and mudcrabs were produced (BFAR 1992). Groupers have aroused the interest of fish fanners during the past two years. Grouper culture in ponds has been reported verbally at meetings, but documentation is lacking. One thing is clear — there is great demand for juvenile (seed) groupers in the export market. Studies on the breeding and larval rearing of groupers are being conducted, but successful hatchery production is still to be realized.

The mudcrab *Scylla serrata* is also in demand in the local and international markets. Small-scale fishfarmers buy or collect lean crabs and fatten them in cages or ponds divided into

compartments by nets or split bamboo. The crabs are fed 'trash' fish and harvested after 15 days or more.

Freshwater Aquaculture

Table 3 shows the production from freshwater ponds, pens and cages in 1992, totalling nearly 98,000 tons, mostly from central, southern, and southeastern Luzon.

Nile tilapia

Freshwater fish culture started in the Philippines in 1972 when the Nile tilapia was introduced. Now, the species is well established throughout the Philippines — in lakes, rivers and reservoirs, and fishponds. Nile tilapia is cultured in about 14,531 hectares of ponds and over 5,000 hectares of cages. Tilapia production in 1992 was 40,399 tons from ponds, 24,871 tons from cages, and 4,917 tons from pens (BFAR 1992). Tilapia cage culture is expanding to many lakes and reservoirs in the country and production is expected to increase.

As the tilapia industry grew, the demand for juveniles increased. Private hatcheries proliferated in addition to the government farms. In the absence of a broodstock development program, the genetic quality of Nile tilapia deteriorated and growth rates and fish sizes decreased.

The Bureau of Fisheries and Aquatic Resources (BFAR) collaborated with the International Center for Living Aquatic Resources Management and the Central Luzon State University Freshwater Aquaculture Center on a study funded by UNDP-FAO on tilapia genetic improvement in 1989-1992. Four tilapia strains from Ghana, Egypt, Senegal, and Kenya were imported and cross-bred with the existing cultured strains from Singapore, Thailand, Taiwan and Israel. After so many cross-breedings, a new strain has been produced, the so-called GIFT (genetically improved farm tilapia). Test culture of GIFT under different fanning systems showed that it grows 60% faster than the ordinary Nile tilapia used by farmers. The GIFT strain is expected to replace the existing inferior strains. BFAR's tilapia broodstock development program will expand the production of GIFT in different outreach stations of the Department of Agriculture to cater to the needs of the farmers.

In Sampaloc Lake, Laguna, intensive tilapia cage culture with heavy feeding has resulted in eutrophication, oxygen depletion, and mass kills of cultured stocks (Santiago and Arcilla 1993).

Milkfish, carps, catfishes

Milkfish is grown in about 18,000 hectares of pens in Laguna de Bay and 21,511 tons were produced in 1992 (BFAR 1992). Pollution, multi-use conflicts, and fish kills continue to be problems for the milkfish and tilapia industry in Laguna de Bay.

The production of carps, including the bighead carp *Aristichthys nobilis* and common carp *Cyprinus carpio,* from ponds and cages amounted to 4,615 tons in 1992 (BFAR 1992). The upgrading of carp species in the country is also being done by BFAR. Pure strains of common carps *Cyprinus carpio* were imported in May 1994 from Sukabumi (West Java) and from Madjalaya and are now being grown into breeders at BFAR in Tanay, Rizal.

The native catfish *Clarias macrocephalus* is becoming rare in the Philippines, probably due to loss of appropriate habitats and increasing pollution. Culture of the Thai catfish *C. batrachus* is well established in the country. In 1990-92, some farmers started the culture of the African giant catfish *C. gariepinus.* However, alarm was raised over the great likelihood that this carnivorous fish will escape into natural waters and decimate the local aquatic fauna. This alarm is justified. What is not justified is the fear that the African catfish will bite or eat people. Due to bad publicity, the catfish industry has suffered losses. But more and more farmers are growing African catfish.

Freshwater prawn

Larval production and pond culture techniques for the freshwater prawn *Macrobrachium rosenbergii* are also being worked out by BFAR. Larval production and pond culture techniques are being worked out at the National Freshwater Fisheries Technology and Research Center in Muñoz, Nueva Ecija.

Mariculture

Mollusks

The oysters *Crassostrea iredalei, C. malabonensis* and *C. cuculata* have been cultured for a long time and the green mussel *Perna viridis* since 1950. All the harvest, about 30,000 tons in 1992 (Table 5), are marketed locally.

In recent years, there have been problems with red tides, and oyster and mussel fanners have suffered heavy losses. In 1993 alone, about P1 million worth of oysters and mussels in Manila Bay and in Maqueda Bay, Samar were affected by toxic algae, and some people died of poisoning. As a safeguard, BFAR and the Department of Health continuously monitor the cell counts of toxic algae in Manila Bay and immediately warn the public of any abnormal increase.

Seaweeds

Mariculture of the seaweed *Eucheuma* is now a well established industry that produced 294,124 tons in 1992 (Table 5). Most *Eucheuma* farms are in central Visayas and Mindanao. Locally based seaweed processing plants are capable of producing refined and semi-refined forms of carageenan that are used in many commercial products. *Eucheuma* fanning and processing are a lucrative industry and *Eucheuma* ranks third among the country's fishery exports (Table 4).

The pond culture of *Gracilaria* for agar extraction is beginning to take off. BFAR is implementing a UNDP-FAO project to develop farming and processing technologies for *Gracilaria* species and to train government technicians and the families of coastal fishermen (Taw 1994). The project area covers coastal towns in eastern Sorsogon and Sorsogon Bay. Taxonomic studies identified 11 species of *Gracilaria* from Sorsogon, five of which have good potential for farming because of their fast growth rate and good-quality agar (Table 6).

Table 5. Production from mariculture in the Philippines, 1992. Data from BFAR (1992).

Region	Production (tons)			
	Total	Oyster	Mussels	Seaweeds
National Capital	1,714		1,714	
Cordillera	-	-	-	-
Northwestern Luzon	8,045	8,010	-	35
Northern Luzon	4	-	-	74
Central Luzon	610	507	103	-
Southern Luzon	10,751	892	5,418	4,441
Southeastern Luzon	210	134	53	23
Western Visayas	3,993	3,147	846	-
Central Visayas	19,485	-	-	19,485
Eastern Visayas	11,804	-	9,083	2,721
Western Mindanao	266,717	-	-	266,717
Central Mindanao	154	-	-	154
Eastern Mindanao	493	19	-	474
Southern Mindanao	-	-	-	-
Total	324,050	12,709	17,217	294,124

Table 6. *Gracilaria* species with good potential for farming and processing in the Philippines. Data from Taw (1994).

Species	Mean growth rate (%/day)	Mean gel strength (g/cm^2)
Gracilaria firma	8.7	765
G. fastigiata	9.0	890
G. changii	9.0	963
G. heteroclada	6.2	968
G. tenuistipitata var *lui*	6.2	433

Groupers

Grouper culture in floating net cages has been started in the recent years but juveniles are in short supply. Among the existing grouper cage culture projects are those of the Palawan National Agricultural College, the Philippine Human Resources Development Center in Lingayen, Pangasinan, and the Atlas Corporation in Bohol. Juvenile groupers are bought from fishermen and reared in net cages to marketable size or into breeders. Unless hatchery-reared juveniles become available, the grow-out culture of groupers will remain small-scale.

Constraints and Problems

The aquaculture industry is growing at a fast pace. The problems of the industry in the Philippines and the rest of southeast Asia have been addressed by many of the studies conducted by the SEAFDEC Aquaculture Department, as summarized by Bagarinao and Flores (1995). Still there are problems. Fish farmers commonly complain about the following:

- Poor quality larvae and juveniles of tilapia, carps, and tiger shrimp, and stocks of *Eucheuma*

  Continuous inbreeding of tilapias and carps has led to genetic deterioration and poor growth. Poor-quality shrimp larvae from infected broodstock (various diseases) die in large numbers. Genetic improvement of existing stocks of *Eucheuma* spp. is needed.

- Dwindling supply of tiger shrimp broodstock from the wild

  Pond-reared broodstock must be produced and shown to be disease-free and effective spawners.

- Lack of larvae and juveniles for grow-out culture of milkfish and grouper

  Production of larvae and juveniles in hatcheries is needed. Existing larval rearing techniques must be improved to increase survival. Larval nutrition must be studied.

- Low survival of grouper juveniles during transport

  Appropriate handling techniques before, during, and after transport of grouper seed must be developed.

- High incidence of abnormalities in hatchery-produced milkfish fry

  Milkfish culturists are biased against hatchery-bred milkfish with bent bodies and cleft gill covers. Such abnormalities must be reduced.

- High cost and poor quality of feeds for fishes and shrimps

  Feeds make up 60% of the cost of shrimp production. Unless the price of feeds is lowered, the Philippines can not compete in the shrimp export market. Poor quality feeds settle at the pond bottom, pollute the water and soil, and adversely affect the cultured stock.

- Outbreak of diseases in shrimp grow-out ponds

  Diseases such as luminous vibriosis and red spot disease, brought about by poor water quality, have become all too common. The occurrence and causative agents of shrimp diseases must be monitored in order to prevent and control them. Monitoring must be a continuous joint effort by the government, research institutions, and the industry.

- Lack of biodegradable pesticides to control snails in milkfish ponds

  Since the government banned the use of the organotin pesticides Aquatin and Brestan, snail infestation in milkfish ponds became a serious problem.

- Impact of aquaculture drugs and chemicals on the environment and public health

  Fish kills occur when toxic chemicals in sludge and effluents are released from culture ponds. Antibiotic-resistant bacteria pathogenic to people could develop as a result of the indiscriminate use of antibiotics in aquaculture.

- Lack of culture technologies for new species

  Appropriate and economical technologies must be developed for the grow-out culture of grouper, sea bass, snappers, siganids, mullets, mudcrab, and white shrimps.

- Effective quarantine measures for new aquaculture species brought into the country

  The introduction of exotic species into the country has been a problem and the government is now developing strict quarantine procedures.

- Pollution and environmental degradation

  Domestic agricultural, industrial and aquaculture wastes cause pollution problems in the Philippines and other southeast Asian countries. Pollution control measures must be strictly enforced, or the problem will get worse. Erosion and siltation due to deforestation, agriculture, and urbanization cause serious problems on coral reefs, seagrass beds, and other aquatic habitats.

- Technology for recycling wastewater from intensive and semi-intensive farms

  The use of biofilters like mussels, oysters, and seaweeds to cleanse aquaculture effluents must be further developed.

- Weak information exchange and networking in the marketing of aquaculture products

  Overproduction causes prices in the export market to go down. A strong network and linkage must be forged among countries producing the same commodities in order to prevent overproduction, oversupply, and low prices in the foreign market.

- Lack of appropriate policies in aquaculture

  A clearly defined legal framework for aquaculture is needed. Such policies and regulations must be based on thorough socioeconomic and technical studies.

Conclusion

The future of aquaculture industry is bright, particularly in the marine areas where water quality is not heavily affected by pollution. Many freshwater bodies in Mindanao can still be harnessed for aquaculture. Expansion of brackishwater ponds is unlikely except in some areas in southern Mindanao where land and labor are relatively inexpensive and pollution is not yet too much a problem. Conversion of mangrove forests and swamps into ponds and other uses is strictly prohibited by law. The thrust of government and industry must be to intensify production in existing ponds through adoption of improved culture technologies, particularly for milkfish. Further success in aquaculture in the Philippines can only be assured if the problems and constraints facing the industry are resolved by research and appropriate technologies.

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