Status of aquaculture and fisheries in Bangladesh

M.E. Azim[1], M.A. Wahab[2] and M.C.J. Verdegem[1]

Since the 1970s, global aquaculture production has increased 10 percent annually and is now the fastest growing food production sector in many countries (FAO 2000). Today, Asia's share is about 92 percent of total aquaculture in the world. About 60 percent of the total production is produced in freshwater. Finfish accounts for approximately 98 percent of the freshwater aquaculture production. The production is dominated by Asian countries, particularly China, India, Indonesia and Bangladesh, which together account for 90 percent of the world aquaculture production of freshwater species. Bangladesh is very rich in inland fishery resources, with a tropical climate, heavy rainfall, fertile land and vast water resources. The country ranks fourth in respect to total freshwater aquaculture production although it is a very small country compared with the other three countries mentioned. On the other hand, the position of Bangladesh is third after China and India in inland fisheries production (FAO 2000). Fish and fisheries have always been an essential part of the life and culture of the people of Bangladesh. Bengali people were popularly referred to as *Macche-Bhate Bangali* (fish and rice make Bengali).

Resources

Bangladesh is the delta of three major river systems: Padma, Jamuna and Meghna and, thus, has vast inland waters. A total of 230 rivers with their tributaries and branches criss-cross the country, with extensive floodplains along their banks; about 36 percent of Bangladesh is occupied by inland waters. In addition, there is a 710 km long coastal belt, 12 nautical miles of marine territorial waters extending from the coast and 200 nautical miles Exclusive Economic Zone, covering much of the Bay of Bengal (Table 1).

Table 1. Different types of water bodies in Bangladesh with recent fish production (Department of Fisheries 2001)

Sources	Area in hectare	Fish production in metric ton ('99-'00)
A. Inland waters	**5,282,157**	**1,308,916**
1. Open waters	**4,920,316**	**659,824**
(i) River and estuary	1,031,563	167,478
(ii) Beel (depression)	114,161	81,866
(iii) Kaptai Lake	68,800	8,135
(iv) Floodplain	2,832,792	402,345
(v) Polder/Enclosure	873,000	unknown
2. Closed waters	**361,841**	**649,092**
(i) Pond and Ditch	215,000	547,677
(ii) Baor (Oxbow Lake)	5,488	4,940
(iii) Shrimp farm	141,353	96,475
B. Marine waters	**16,607,000**	**340,000**
Industrial		16,450
Artisanal		323,550
Grand total	**21,889,157**	**1,661,151**

Fisheries of this country are diverse. There are a total of 260 freshwater fish and 24 freshwater shrimp species, and 475 marine fish and 36 shrimp species. Besides fish and shrimp, there are 10 species of pearl bearing bivalves, 25 species of edible tortoises and turtles and seven species of edible marine oysters. Eleven species of marine and four species of freshwater crabs and three species of edible lobsters are also available in Bangladesh waters. In addition to the rich fishery resources of indigenous species, 15 exotic finfish species have been introduced for aquaculture.

Growth of Fish Production

Total fish production including shrimp in 1999-2000 was 1.66 million tons (Table 1). Inland fisheries contributed 1.31 million tons of which 49 percent come from aquaculture, especially from pond culture (Figure 1). Indigenous freshwater major carps and exotic carps from both culture and capture are the primary contributors (22 and 10 percent) to total fish production. Other inland fish are catfish, snakeheads and small indigenous species (SIS). From marine waters, hilsha fish (Bengal shad) alone contribute 14 percent to total fish production. Whereas, both freshwater and marine shrimps contribute nine percent of which 45 percent come from aquaculture and the remaining from capture.

The annual growth rate in aquaculture production is about 14 percent (Figure 2). The increased growth rate in production may be a result of the expansion of the pond culture area by using derelict ponds and excavating new ones, and increased productivity, based mainly on technologi-

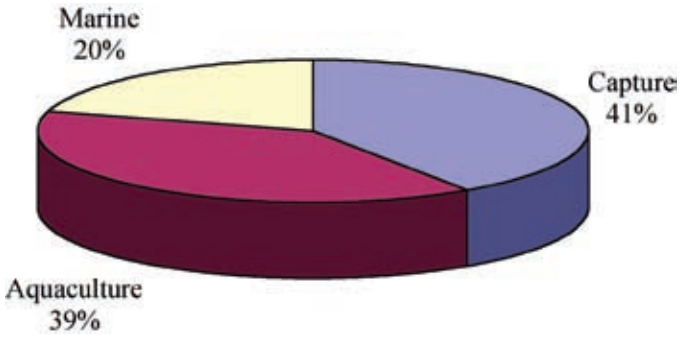

Fig. 1. Fish production in different types of water bodies.

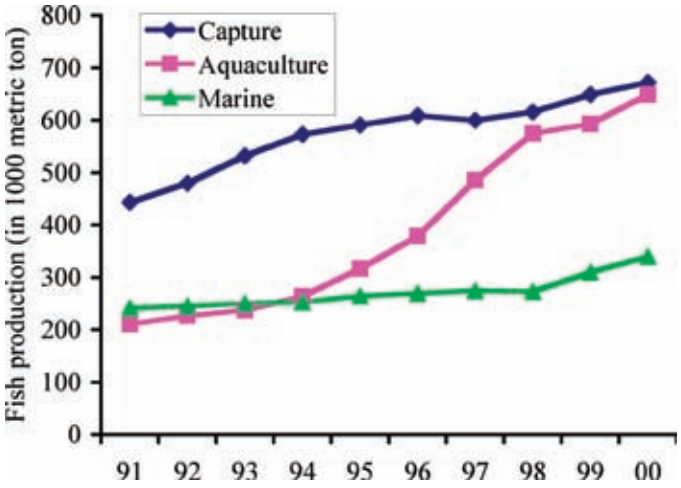

Fig. 2. Trends of fish production in different types of water bodies.

cal innovations made in the last decade in the research institutes, universities, and development agencies. On the other hand, the annual growth in inland fisheries production through capture fisheries in Bangladesh increased since 1991, but the rate of increase has declined gradually (Figure 2). This is mainly due to fish habitat degradation and overfishing.

The marine fisheries of Bangladesh contribute only 20 percent to total fish production and is not undergoing significant growth, although a vast area of marine water is available in the south of the country. The marine catch is comprised mainly of hilsa, Bombay duck, pomfrets and shrimp. Hilsa, a migratory fish, runs to the rivers for breeding and often is caught there.

Importance of Fish

The fisheries sub-sector plays an important role in alleviating protein deficiency and malnutrition, generating employment, reducing poverty and earning foreign exchange. Fish and fishery products are the third largest export commodity of the country contributing 3.4 percent to the GDP and 6.28 percent to the total export value. In 1999-2000, Bangladesh exported 39 tons of fishery products and earned US$320 million, of which shrimp alone contributed 72 percent by quantity and 89 percent by value. There are three million fish and shrimp farmers and 1.3 million fishermen engaged full time in Bangladesh. In addition, a large number of rural people, 73 percent, operate as part-time fishermen to obtain fish for family consumption and as a source of supplementary income. Fish is the major animal protein source contributing 63 percent of total animal protein intake. Annual per capita fish consumption is about 12 kg (Department of Fisheries 2001). Currently, fish prices are beyond the reach of poor people. Supplies lag severely behind the demand of the fast growing population, in spite of the recent growth in aquaculture production. Prospects for obtaining more animal protein from livestock are not bright, because there is increased competition for growing food grains for humans instead of producing food grains and leaving lands fallow to provide grazing lands for livestock. Therefore, dependence on fish as the main source of animal protein to meet requirements of the people in Bangladesh will continue to increase and, thus, demand for fish will also increase in the future (National Conservation Strategy 1996).

Aquaculture Practices

Based on the habitat, there are two types of aquaculture in Bangladesh, freshwater and coastal aquaculture; there is no marine aquaculture, so far. Freshwater aquaculture is comprised mainly of pond aquaculture, especially polyculture of carps of native and exotic origin. The major indigenous cultured species are Catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and kalbaush (*L. calbasu*). The exotic species in aquaculture are silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), pangas (*Pangasius sutchi*), Thai silver barb (*Barbodes gonionotus*), tilapia (*Oreochromis* sp.) and hybrid magur (native *Clarias batrachus* x African catfish *Clarias garipinus*). A number of technologies have been developed by universities, research institutes and non-government organizations (NGOs). The most important ones are:

- Carp (Indian and Chinese) polyculture
- Carp (Indian and Chinese) polyculture with freshwater shrimp
- Integrated fish (fish/duck/chicken) farming
- Pangas (*Pangasius sutchi*) culture
- Nile and red tilapia culture
- Raj punti (*Boarbodes gonionotus*) culture
- Cage and pen culture
- Culture-based fisheries in beels (depressions) and baors (oxbow lakes).

In earlier days, people depended mainly on natural waters for fish. But because of declining fish catch in nature as a result of increased fishing efforts related to a growing population and environmental degradation, people began culturing fish in closed waters. Therefore, pond production per hectare increased considerably from 800 kg in 1985 to 2,550 kg in 2000 (Figure 3). This is because of intensification of culture systems by applying fertilizer and supplemental feed and better management practices (Gupta *et al*. 1999).

Coastal aquaculture is comprised primarily of shrimp farming. With the lucrative international shrimp market, there has been a rapid expansion of shrimp culture in the coastal areas of both the southeast and southwest regions. The area of land for shrimp farming increased from 50,000 ha to 141,000 ha in the past two decades, but the production did not increase due to lack of technological knowledge. In fact, shrimp farming has mainly evolved through the individual efforts of farmers and commercial companies. Less attention has been paid by the relevant agencies

of the government and the scientific community (Hossain 2001). Brackishwater black tiger shrimp, *Penaeus monodon,* and Malaysian freshwater shrimp, *Macrobrachium rosenbergii,* are the cultured species in coastal aquaculture. Recently, crab fattening of *Scylla serrata* has begun. Based on intensity, shrimp culture practices can be divided into extensive and semi-intensive. Both marine and freshwater shrimp are traditionally cultured in ghers concurrently and or alternately with paddies. Marine shrimp are also cultured alternately with salt production in the southeast region of the country. Semi-intensive or improved extensive shrimp farming is practiced in ghers alternated with rice in the southwest region. This development of shrimp farms has taken place without thought having been given to the environmental consequences. As a result, environmental impacts have appeared which led to disease outbreaks, poor growth and low shrimp production.

Organizations for Fisheries Education, Research and Development

Since the country's independence in 1971, the Faculty of Fisheries of Bangladesh Agricultural University (BAU) was the sole institute for fisheries education. There are four academic departments including Fisheries Biology and Genetics, Aquaculture, Fisheries Management and Fisheries Technology with a teaching staff of 50. The University offers four year Bachelor, 1.5 year Master of Science and three year Ph.D. degree programs. The Faculty has earned a reputation for carrying out aquacultural research. Considering the importance of aquaculture and fisheries education to the country, some other universities have recently launched aquaculture and fisheries departments.

The Ministry of Fisheries and Livestock (MoFL) administers the fisheries sub-sector. Three government organizations are involved in fisheries research and development. Department of Fisheries (DoF) is the central organization for the government with a staff of 4,500. The DoF is responsible for extension of aquaculture technologies, management of open water bodies, creation and execution of fisheries legislation and organizing training for fish farmers. The Bangladesh Fisheries Research Institute (BFRI) is an autonomous national institute and is assigned to develop appropriate technologies for sustainable aquaculture development and management of fisheries resources. Since its establishment in 1984, the Institute has been conducting applied and adaptive research for overall development of fisheries resources. The Bangladesh Fisheries Development Corporation (BFDC) plays an important role in surveying the abundance of marine fish, identifying commercially important fish from the Bay of Bengal, fisheries exploitation and marketing. The BFRI and BFDC have 376 and 688 employees.

In addition to the government organizations, there are many national and international non-government organizations (NGOs) involved in aquaculture and aquatic resource management activities for reducing poverty and improving livelihoods. Some of those are the Bangladesh Rural Advancement Committee (BRAC), Grameen Bank, CARE Bangladesh, International Center for Living Aquatic Resources Management (ICLARM), Proshika, Department for International Development (DFID), CARITAS, MACCH, PRISM Bangladesh and the Intermediate Technology Development Group (ITDG).

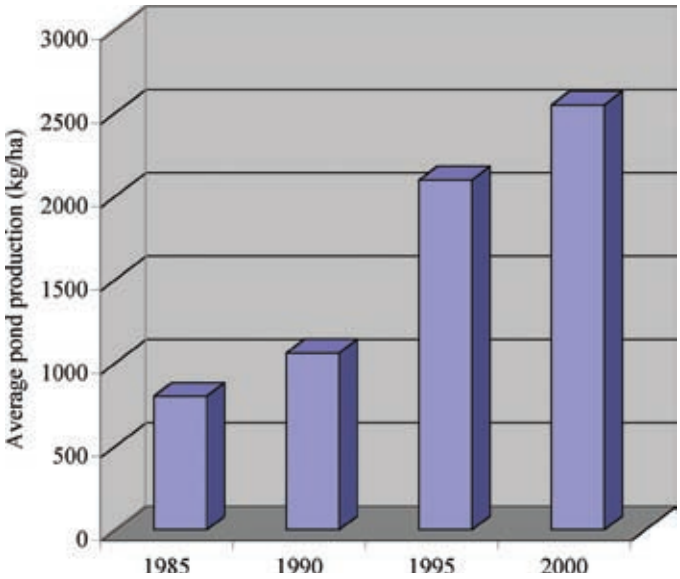

Fig. 3. Intensification of pond culture in time


Multi-use of pond: A villager is washing his cloth in the fish pond. (Photo by Dr. Azim)


Dr. Wahab and Dr. Verdegem are listening to the constraints of aquaculture from an old farmer. (Photo by Dr. Azim)

A fish farmer shows his farmed animal. (Photo by Dr. Azim)

Pond-dike integrated system: Fish ponds with papaya and vegetables on the dikes. (Photo by Dr. Azim)

Pond-dike integrated system: Water of fishpond is used for watering cabbage.

Environmental Impacts/Constraints for Aquaculture and Fisheries

Despite the vast potential of aquaculture in Bangladesh, there are some environmental, biological and social problems. Exotic fish species have been introduced without any comprehensive studies of their biology, ecology and compatibility with native species. Some of these exotics have been reported to have adverse effects on the native species, notably cross-breeding, which leads to sterility and slow growth of the native species (National Conservation Strategy 1996). Although many aquaculture technologies have been developed, very few have reached the farmers because of weaknesses in the technology and extension service. Some other important constraints, especially for aquaculture, are:

- Lack of user-friendly technologies for small-scale farmers
- Scarcity of good quality fish for stocking
- Cost of prepared feed for use in aquaculture
- Lack of access to ponds for poor farmers
- Multiple ownership of water bodies
- Lack of finance/credit available to fish farmers
- Farmers tend to overstock fry and fingerlings
- Multiple use of ponds inhibiting production
- Shortage of sufficient year round water supply
- Lack of fish and shellfish processing plants
- Lack of marketing and distribution systems
- High risks of poaching, sabotage and flooding
- Lack of inter-institutional co-operation.

As elsewhere in the region, Epizootic Ulcerative Syndrome (EUS) is a common problem for both farmed and wild fish species. Occurrence of white spot disease is a big threat to the shrimp industry. Because of a lack of appropriate guidelines for coastal land uses and resource utilization, conflicts between different land users occur in some parts of this area. Many other problems, such as loss of agricultural land resulting from salt intrusion, degradation of ground water sources, mangrove destruction, loss of natural spawning grounds, excessive nutrient enrichment, activation of mineral acidity in acid sulphate soils and eutrophication of coastal water are blamed on shrimp farming (National Conservation Strategy 1996, Chowdhury 2001). In addition, shrimp farming in Bangladesh is still dependent on the natural availability of shrimp fry, which can cause a loss of biodiversity. In a recent study it was reported that 551 postlarvae of other shrimps, 152 finfish fry and 1,636 other macro-zooplankters were wasted during the collection of a single *P. monodon* postlarva (Hoq *et al*. 2001).

Inland capture fisheries are affected by a number of natural and manmade interventions: (1) habitat destruction from the construction of flood control, drainage, irrigation embankments and barrages over the major rivers in the upstream areas, (2) overfishing, (3) water diversion for irrigation and (4) reclamation of land for human settlement. These problems have been aggravated further by the increased pollution from agricultural inputs, industrial wastes, sewage runoff, as well as municipal wastes dumped into the rivers near major cities (National Conservation Strategy 1996). Finally, pollutants carried from upstream countries are released into the Bay of Bengal, further deteriorating marine water

(Continued on page 67)

Bangladesh

(Continued from page 40)

quality. Detailed surveys on reliable fish stocks, fishing grounds and other potential resources, such as cephalopods, lobsters and flatfishes, have not been accomplished in marine waters (Hossain 2001). In addition, most of the Bangladeshi people do not like marine finfish because, culturally, they are habituated to eating freshwater fish.

Toward Sustainable Aquaculture

Bangladesh is a small country of 147,570 km^2, but it is densely populated with 130 million people. Inland capture fisheries could not be increased because of environmental degradation, over-fishing and increased pressure on wetlands for reclamation of arable land for producing cereal crops. Although there is room for increased exploitation of marine pelagic finfish, research on the Bay of Bengal and optimum exploitation of fish is expensive for countries like Bangladesh. Nevertheless, some initiatives can be taken at the sector/policy level by the government to overcome the prevailing problems in relation to inland and marine capture fisheries. For example, the government often releases fish fingerlings to open inland waters for stock enhancement. A decision could be made to not stock exotic fish species, thus avoiding the genetic degradation of a valuable native species.

Rural aquaculture in Bangladesh has been recognized increasingly as a way to improve the livelihood of the people. About 75 percent of Bangladesh households spend 90 percent of their income on basic needs. Most of the fish farmers cannot provide supplemental feeds to the fish ponds. A majority of aquaculture is still at a subsistence level, with the exception of a few commercial farms, especially pangas and shrimp. Irregular fertilization with cow manure and supplemental feeding with rice bran and oilcake are common in fish ponds. Pelleted feeds are available in the market, but the price is beyond the reach of the subsistence farmers. Developing cheaper or alternative food sources for carp culture is needed urgently. In fact, aquaculture technologies, so far developed in this country, are for more affluent farmers and are not appropriate for resource-poor and marginal farmers. Many of these technologies have also not been tested under farm conditions. A farmers' participatory approach is essential to develop sustainable low cost fish culture technologies. Recently, efforts have been directed toward developing some novel fish culture technologies for resource-poor farmers. These are:

- Rice-fish/shrimp culture (by BFRI, CARE Bangladesh)
- Culture of small fish (SIS) in seasonal ponds (by BFRI)
- Carp-SIS polyculture (by BAU, BFRI)
- Duckweed based aquaculture (by PRISM Bangladesh, BAU, BFRI)
- Hybrid and native catfish culture (by BAU, BFRI)
- Periphyton-based aquaculture (by BAU under an EC funded INCO-DC project).

There are about 570,000 ha of derelict and seasonal ponds, roadside ditches and borrow pits in the country, which can be used for fish culture. Inasmuch as fish culture is more profitable than other agricultural crop production, progressive farmers now excavate new ponds in their agricultural land that may have adverse environmental effects in the long term. To overcome this problem, pond-dike cropping is an alternative approach. In fact, farmers have started using their pond dikes to produce vegetables, fruit trees and nurseries.

It is good news for the country that some entrepreneurs have started commercial fish farming. They deserve proper technological and financial support from the government. Because there is a good future for exporting shrimp to earn foreign currency, the government should support this promising industry. Recent debate on the environmental effects of shrimp farming should be carefully assessed. Identification and allocation of coastal land among users are essential to minimize environmental impacts and social conflicts. As an alternative, freshwater shrimp could be cultured in ponds, floodplains and rice fields all over the country. Research and developmental plans are essential in this matter. Also, there is potential for the culture of new brackish and marine water species, especially shellfish, including crabs, oysters, lobsters and squid. These products are in great demand on the international market.

Notes

[1]M.E. Azim and M.C. J. Verdegem are affiliated with the Fish Culture and Fisheries Group, Wageningen University, Netherlands.

[2]M.A. Wahab is a Professor of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh.

Correspondence should be directed to Dr. M.E. Azim via e-mail (ekram.azim@wur.nl).

The contents of this article were presented at World Aquaculture 2002 in Beijing, China.

Acknowledgments

Dr. Azim is grateful to the European Commission for providing him a postdoctoral bursary within the Pond Live project (ICA4-2000-20034).

References

Chowdhury, M.A.K. 2001. Changes in mangrove forest soils: a comparison between cultured and naturally inundated conditions. Wetland Ecology and Management 9: 81-89.

Department of Fisheries. 2001. Fish Week Compendium. Bangladesh Fisheries Resources Survey System. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh.

FAO. 2000. The state of world fisheries and aquaculture 2000. Food and Agriculture Organizations of United Nations. www.fao.org

Gupta, M.V., M.A. Mazid, M.S. Islam, M. Rahman and M.G. Hussain. 1999. Integration of aquaculture into the farming system of the floodprone ecosystems of Bangladesh: an evaluation of adoption and impact. ICLARM Technical Paper 56, Manila.

Hoq, M.E., M.N. Islam, M. Kamal and M.A. Wahab. 2001. Abundance and seasonal distribution of Penaeus monodon postlarvae in the Sundarbans mangrove, Bangladesh. Hydrobiologia 457: 97-104.

Hossain, M.S. 2001. Biological aspects of the coastal and marine environment of Bangladesh. Ocean and Coastal Management 44: 261-282.

National Conservation Strategy (NCS). 1996. Towards sustainable development: The national conservation strategy of Bangladesh. Update of status, issues, strategies and recommendations for Fisheries Sub-sector. National Conservation Strategy (NCS) Implementation Project-1. Ministry of Environment and Forest, Bangladesh.