

Open-water Fisheries in Bangladesh: A Critical Review

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1.0 Introduction

Fish resources play a very important role in the economy of Bangladesh accounting for about 5% of GDP. About 10% of annual export earning comes from the fisheries sector and it ranks 3rd among the export oriented industries. This sector provides employment to about 1.2 million full-time and 12 million part-time fishermen and workers (National Fish Policy, 1998).

The fisheries sector in Bangladesh can be broadly divided into four major sub-sectors: inland capture or open-water fisheries, inland culture or closed-water fisheries, marine industrial (trawling) fisheries and marine artisanal fisheries. The open-water fishery is a self-sustaining system although human interventions have significantly deteriorated its health and productivity in recent years. The culture fishery on the other hand is primarily an economic venture managed by private individuals and farms. The marine fishery is an open access resource, which has become a major source of economic return for the country. The inland fisheries contribute about 72% of the total catch and the remaining 28% comes from the marine fisheries. The relative contributions of these sub-sectors are shown in **Figure 1**. The average annual growth rate of the fisheries sector in the recent past has been about 6.5%, which is likely to increase due to the growing demand for fish and fish products.

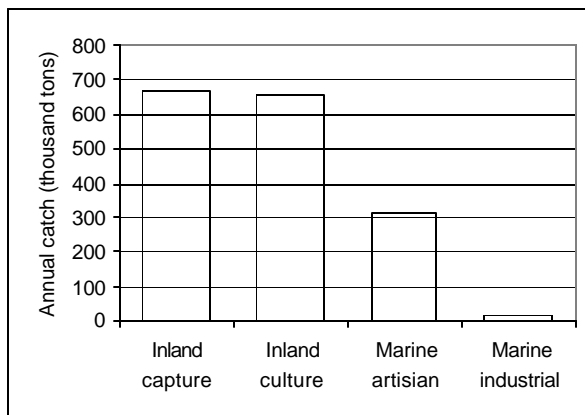


Figure 1 Fish catch in Bangladesh (BBS, 2000)

Historically, the fisheries sector in Bangladesh has been managed on ad-hoc basis. In case of managing the public water bodies, the main objective has been to maximize revenue through leasing these wetlands to the highest bidder. When it came to increasing the production of fish, the policy was biased towards promoting culture fisheries. Over the years, many exotic species such as silver carp, catfish, tilapia, pungas etc. have been introduced that practically eliminated local species from the fishponds. The saline/brackish water shrimp culture has been encouraged as it earns valuable foreign currency.

Meanwhile, aquatic habitats in both open and closed water bodies have been encroached upon and altered to reclaim more land for agriculture. Embankments and closures have been built to provide flood control and irrigation, which interfered with migration of brood fish and fish fry. The water quality has also been altered alarmingly due to indiscriminate disposal of industrial pollutants, agro-chemical residues and organic wastes into the open water system, making the open aquatic environment very hazardous for fish. As a result the open-water fish resource has significantly declined both in terms of catch as well as biodiversity.

Fisheries resources in Bangladesh has not been considered and managed as a “renewable natural resource.” Little attention has been given so far to the ecosystem aspect of the fisheries sector. A holistic view must, therefore, be incorporated to ensure that this resource is protected from irreversible damage and is managed on a sustainable basis.

2.0 Goal, objectives and scope

The goal of this paper is to present a critical review of the in-land fisheries in Bangladesh and provide recommendations for future course of action. Specific objectives include:

- i. Take an account of fish ecology and stock of open-water fisheries;
- ii. Identify the major fisheries issues;
- iii. Review current management practices
- iv. Review fisheries related national plan, acts, rules and policies;
- v. Review major fisheries projects; and,
- vi. Summarize key observations and make recommendations to be incorporated in future policies, guidelines and action plans.

This paper is based on information collected from official documents, papers, books and reports. Institutions that are actively involved with fisheries management and development in Bangladesh include the Department of Fisheries (DOF), World Bank (WB), Asian Development Bank (ADB), **DFID**, United States Agency for International Development (USAID), Bangladesh Center for Advanced Studies (BCAS), Center for Natural Resources Studies (CNRS) and the World Conservation Union (IUCN). A number of key informants have been interviewed from these organizations in order to assess the status quo and possible future direction of this important sector of the economy. In relation to major fisheries projects, the paper reviewed projects funded by WB/DFID (1st through 4th Fisheries) and ADB/IFAD (2nd Aquaculture Development) because these projects directly deal with inland open-water fisheries. A number of specialized projects - the Baor (oxbow lake) Development Project, Aquaculture Extension Project and Oxbow Lakes Small-scale Fisheries Development have not been reviewed in this paper as strictly speaking, these are not free flowing open water bodies. If incorporated in future studies, a more comprehensive picture of the sector would evolve.

3.0 Ecology of inland open-water fish

Fish habitat

Bangladesh is one of the world's largest deltas through which flow two of the world's largest rivers – the Ganges and the Brahmaputra. The country is literally crisscrossed by some 250 large and small rivers. The floodplains of these rivers and the natural depressions (haor – seasonal wetland, baor – oxbow lake, and beel – perennial water body) go under water during the monsoon and create a huge open water fish habitat. In an undisturbed floodplain, the productivity is as high as 693 kg/ha per year, which is the highest in the world. **Table 1** summarizes the areas of open water bodies in Bangladesh that serve as fish habitats.

Table 1 Inland water bodies (BBS, 2000)

Sector of Fisheries	Area (ha)
<i>Capture</i>	
1. Rivers & Estuaries	1031563
2. Sundarbans	-
3. Beels	114161
4. Kaptai lake	68800
5. Flood lands	2832792
Total	4047316
<i>Culture</i>	
1. Ponds	230000
2. Baors	5488
3. Shrimp farms	141353
Total	376841
Inland total	4424157

All the major rivers end at the Bay of Bengal. Near the confluence of the sea and the rivers, freshwater is replaced by a mix of saltwater and freshwater producing brackish water, and forming a distinct estuarine zone. A wide range of salinity gradients is encountered in the rivers up to a considerable distance upstream from the shoreline along the Bay of Bengal. Along the coast in the south, an estimated 2.5 million hectare of low-lying lands are subject to tidal inundation. In the past, these areas were used to provide, during high tides, temporary nursery and grazing

grounds for larvae, fry and juveniles of different fish shrimp species.

Fish ecology

Open-water fish are broadly categorized into two groups: white fish – that reside in flowing waters such as rivers; and black fish – that primarily reside in static water bodies such as ponds, lakes and beels. White fish typically migrate upstream or into floodplains and wetlands during spawning season. Black fish on the other hand spawn and reside in the same water body.

Daget (1960) described two types of river fish migrations in Bangladesh: (i) longitudinal migrations within the river channel and (ii) lateral migration to and from floodplains. Welcome (1975) states that each type of migration requires a different type of behavior and probably different sets of physical stimuli. A gradual rise in the river water in different areas of the country usually starts from late February or early March (pre-monsoon season). The process of sexual maturation and staging migration and movement for breeding activity occur in this pre-monsoon period when air and water temperatures rise. During the early monsoon (April-May), almost all species of fish are seen with ripe or ripening gonads. For the major carp species of Bangladesh, the upper reaches of the Brahmaputra in the Assam Hills, the Ganges below Farakka, the haor basins of Sylhet and the upper Barak region are the major spawning areas according to Tsai and Ali (1985) and Jhingran (1988).

Unlike the carps, many species of prawn and fish requiring brackish water and saline environment, and they migrate downstream to estuarine and coastal environments to breed. The juveniles then undertake upstream migration through the rivers to reach the food rich floodplains to feed and grow until recession of flood. The growing prawn, like the carps, move back into the flowing river habitats with the receding waters. The opposite of prawns is Hilsa, a fish that live in the marine environment in the Bay of Bengal but undertake migration into the fresh water habitats in the upstream of river systems to breed.

Floodplain fishes portray the complete coverage of trophic range from planktophagic to piscivorous habits. The young fish mainly feed on periphyton, detritus, zooplankton and small insects. Within-year changes in the growth rate have been noticed in floodplain fishes owing to expansion and contraction of aquatic body, seasonality of temperature and rainfall and flood-associated changes in food availability (Kapetsky, 1974). According to Dudley (1972), 75% of the expected first year growth of the juveniles occurs within six months after spawning. Slow growth has been observed during the dry season.

Mortality rates are higher in the dry season, especially when the water level is receding and fishes are more concentrated in the water body. In such a situation, they become more susceptible to attack by predators, disease and other environmental stresses. About 75% to 80% mortality has been recorded during this period in floodplain lagoons with an overall decrease of 40% in biomass within a three-month period. Differences in the amount of water remaining in the floodplains in the dry season, together with its duration, strongly influence survival from one year to the next (Welcomme, 1979).

Table 2 summarizes the status of inland fish species of Bangladesh according to IUCN (2000).

Table 2: Status of inland fish species in Bangladesh (IUCN, 2000)

Group	Total No. of Living Species	Extinct	Threatened			Total	Data Deficient (DD)	Not Threatened (NO)
			Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)			
Fishes (freshwater & brackish water)	266	0	12	28	14	54	66	146

4.0 Major open-water fisheries issues

Between 1994 and 2000, the inland fish catch has grown on average at 7.28% per year (BBS, 2000). This, however, gives a wrong impression about the health and sustainability of the capture fisheries in Bangladesh. This per annum growth is actually contributed by the growth of culture fisheries where only a few commercial varieties such as carp, punga, tilapia, catfish and shrimp are grown. A comparative picture of the growth of capture and culture fish catch is shown in **Figure 2**. It is evident that despite numerous projects undertaken by the government and the NGOs, the capture fish growth/catch has remained stagnant as it faces serious threats from

anthropogenic activities and mismanagement. Major factors contributing to the decline/lack of growth of capture fisheries are summarized below.

Structural interventions

Flood control and irrigation structures such as dams, barrages and embankments, serve as physical barriers to fish migration. According to the MPO (1987), over 0.81 million hectares of floodplain have been permanently removed from fish production by the year 1985, and another 2.0 million hectares of floodplain fish habitat will be lost by the year 2005. This will have drastic consequences on fish diversity as, 60% of the 251 fish species found in Bangladesh are floodplain dependent (Mincing, 1989). The Muhuri Closure in the Feni River has removed commercial Hilsha fishing from the Feni River above the dam. The dam has also destroyed the brackish water ecosystem. In addition to blocking fish migration, cross-dams and barrages slow down or stop the flow, turning the river water from lotic (flowing) to lentic (stagnant). This changes the species composition and diversity in the modified ecosystem and hydrologic regime.

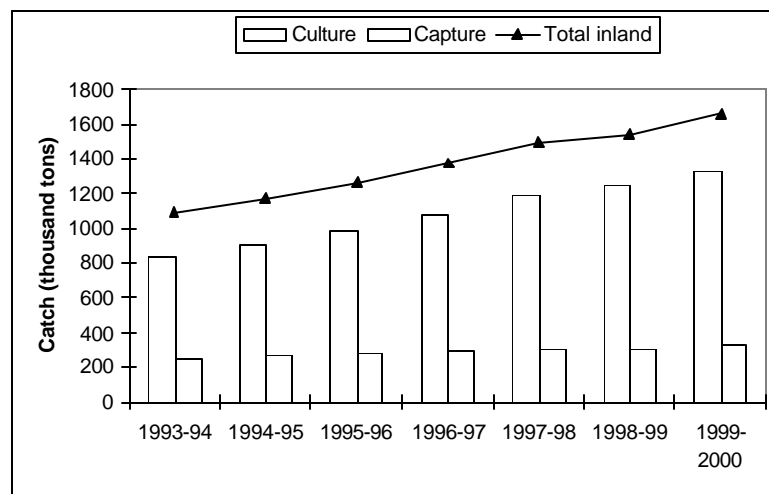


Figure 2 Annual inland fish catch (1994-1999)

Industrial pollution

According to a DOE report (Farooque, 1997), there are 425 major, 1175 moderate and 2200 minor polluting industries in Bangladesh. With a few exceptions, these dump their wastes in the nearby river without any treatment. According to Faisal et al. (2001), annual emission into water by the industrial sector alone is about 50,000 tons of BOD and 106,000 tons of TSS. The most polluted rivers flowing around major urban or industrial areas are the Buriganga, the Sitalakhya and the Karnafuli and the Rupsha. In addition, ports, shipyards and shipwrecking industries in Mongla and Chittagong cause significant oil pollution to local water bodies that eventual affect the coastal waters.

5.1.3 Agrochemicals

Farmers use fertilizer and pesticides to increase and protect agricultural yield. These chemicals contaminate soil and water, enter into the food web, and cause bioaccumulation of toxic substances. There are about 250 varieties of pesticides that are used in Bangladesh. Annually between 4000 to 5000 tons of pesticides are used in

the whole country and as much as 25% of this may end up in the water bodies eventually discharging into the Bay of Bengal. These chemical residues can kill fish at lethal dose. Even at sub-lethal dosage, other aquatic species may be harmed that are part of the food web of open water fish species.

Dry season irrigation

When irrigation water is taken from surface water sources such as beels, baors, canals and ponds, they shrink in size, or in some cases, completely dry out leaving no space for fish. This goes against the objective of maximizing fish productions from beels and baors. Excessive groundwater withdrawal can have similar effect.

Open access fishing and lack of proper institutions

Open-water fisheries are considered “public property” as per the State Acquisition and Tenancy Act of 1950. This has led to uncontrolled and indiscriminate fishing. State managed or leased water bodies are also managed with the sole objective of revenue generation. There is no post-lease monitoring to ensure that the leased out wetlands are managed according to the terms and conditions spelled out in the lease contract. This leasing agreement is managed by the Ministry of Land as opposed to the Ministry of Fisheries and Livestock, which is another reason for lack of fish friendly management of the wetlands.

Fishing practices

Using extra fine nets, bank to bank netting and illegal catching of brood fish and fish fry have serious adverse affect on open water fish. In the Padma and the Meghna, bank to bank fishing has all but blocked the movement of anadromuos fish like the Hilsa.

Degradation of wetlands

Due to sedimentation and encroachment, wetlands have lost both their productivity and biodiversity. In some coastal areas, people are deliberately trying to trap sediments within the coastal swamps for land reclamation. This is generating more employment and income for the local communities at the expense of fish resources. Wetlands are being encroached upon for agricultural, industrial and urban development. These activities are taking up wetlands on permanent basis and might have contributed to extinction of many indigenous varieties of fish.

Alien Invasive Species (AIS) and aquaculture

Since the late 1950s, about 15 different varies of AIS-type fish have been brought into the country to help boost the fish catch. During the major floods of 1987, 1988 and 1998, members of these species escaped out of the ponds into the open water. These AIS may cause outbreak of diseases that were previously non-existent. For example, According to Minkin (in Ali 1997), a deadly disease, Epizootic Ulcerative Syndrome, entered Bangladesh with the exotic fish *P. goniontus* that has affected numerous floodplain species. Moreover, most AIS are fierce competitors and they can significantly lower open water biodiversity in the long run.

5.0 Management of open-water fisheries

Management practices

The basic mechanism for managing fishery resources in inland open-waters of Bangladesh has been based on allocation of fishing rights through periodic leasing. The Ministry of Land directly owns the rivers, their tributaries and seasonal as well as perennial wetlands. For the sole purpose of revenue generation, the Ministry of Land leases out stretches of rivers and wetlands, called *jalmahals*, to intermediaries, called *Ijaradars*, i.e., lessees through auction. In the auction process, the lease is given to the highest bidder. The river fisheries and the seasonal beel fisheries are normally leased out for a term of one year while the permanent beels are leased out for a 3year term. The lease period commences on the first day of the Bengali Year and terminates on the last day of the same year. Some beel fisheries and group fisheries are leased out to the same lessee for 6 years and in rare cases, up to 9 years. Table 3 summarized the current lease schemes administered by various government agencies.

Table 3 Lease fees and sublease fishing rights of different area

Lease fees / Fishing rights	Taka	Area
Lease fees	500,000	Small beel next to the Manu River barrage;
	800,000	Futahawaboni beel in Hakaluki haor for 3 yrs;
	800,000	For a beel adjacent to the Gorautra River, near Patli (kishoreganj district);
	800,000	Bangla beel near Bajitpur. To maintain official formalities, fishermen took lease of the beel on behalf of one wealth men of Kuliarchar, who paid the lease fee, as a result fishermen did not have any right to harvest or take part in the management of the beel;
	50,000	Lease fee for a 13-ha stretch of the kushiyara River near Sherpur. The lease holder sold fishing right to genuine fishermen for a fee of Tk 1,000 per boat per year;
	68,000	Auction lease fee are paid by the lease holder for a 1.2 km stretch of Surma river;
Fishing rights	100-200	Fishing rights fee for fishermen to set up a katha in the Mogra River (at solisa, near Netrokona), payable to a middlemen who held the lease to that stretch of the river;
	100	For the right to use flanjal at Hail haor payable to a middlemen who held the beel lease;
	10,000-20,000	For using berjal at Hail haor payable to a middlemen who held the beel lease;
	1,000	Per net fee for fishing rights on a 8 km stretch of the Kushiyara River near Sherpur, payable to the leaseholder;
	3,000	For the right to set up a fish fence (duri) across the Surma River near Kanaighat during the dry season, payable to the leasee.

This pattern of dividing the rivers into segments and leasing them out to middlemen lease holders or *ijaradars* have encouraged over fishing of fish stocks. The situation in the seasonal beels is worse, where every year, during the dry season, the last fish is

taken out by draining the beels. The situation in permanent beels is not much different. In such beels, brush shelters are placed in deeper regions to create safe haven for mother fish stock. Unfortunately, fish taking shelter in these deeper pockets are caught annually even though this is not legally allowed. At the end of the lease, all fish are extracted and that leaves no room for survival of any fish – large or small.

Thus, the present scheme of wetland and river management is neither fair nor ecologically sustainable. The wetlands are leased out to influential village elites leaving the traditional fishermen trapped in the vicious circle of poverty. Also, due to unsustainable fishing practices, leased wetlands are being populated by mostly a few commercially important species through release of fries grown in hatcheries. Thus numerous species of native fish have become locally extinct all over the country.

Fisheries institutions

The Ministry of Fisheries and Livestock (MOFL) is the major public sector institutions in the fisheries sector. For the fisheries matters it includes the Department of Fisheries (DOF), the Fisheries Research Institute (FRI) and the Bangladesh Fisheries Development Corporation (BFDC). The Upazila administration contains a fisheries office technically guided by DOF. The administration of the sector comprises about 5,200 persons, including some 1,200 professionals. In addition several other government agencies such as the Ministry of Local Government, Rural Development and Cooperatives, Ministry of Lands and Ministry of Irrigation, Water Development and Flood Control, with the help of their affiliated institutions are actively involved in fisheries administration, management and development.

Non Government Organizations (NGO) and aid agencies

NGOs are becoming increasingly active in the fisheries sector. There are close to 300 NGOs in the country – about 30% of them are funded externally. NGOs involved in fisheries mainly work on promoting aquaculture, and to a lesser extent on community based management of wetlands. Only very recently, a few NGOs have become involved in cooperative based fish sanctuary management involving traditional fishermen.

External Influences in the Fisheries Sector

Donors like IDA (World Bank), ADB, UNDP, FAO, ODA, IFAD, DANIDA, CARE, EU, USAID, CIDA, IUCN, and Ford Foundation are involve in Bangladesh's fisheries sector with the aim of increasing the fish production and improving the fisheries management. These donors fund studies, research, institutional development, pilot activities, etc. They also show concern for the rights of the fishermen and their role in management. Among the donors the World Bank takes the leading role. These donor agencies have contributed significantly to increasing the culture fisheries yield.

6.0 National Plan, Acts, rules and policies related to fish

National Plans

National development strategies and programs for the fisheries sector are formulated in the context of the country's five-year development plans. The major objectives of fisheries sector development during the Fifth Five Year Plan (1996-2000) are to:

- ?? Generate additional employment opportunities in fisheries and ancillary industries to help poverty alleviation;
- ?? Increase fish production and improve nutritional level;
- ?? Improve socio-economic conditions of the fishermen, fish farmers and other engaged in the fishery sub-sector;
- ?? Increase export earnings from shrimp, fish and fish products;
- ?? Improve environmental conditions;
- ?? Improve the biological and institutional management mechanisms for judicious use on fisheries resources; and
- ?? Strengthening research, extension, management and co-ordination in order to transfer technology and encourage production activities in the private sector.

These objectives are broad based and specific details are often difficult to workout. Because past plans were over-optimistic, government spending has achieved only about 25% of the targets. This shortfall reflects the absence of consistent programs and the poor implementation capacity of the fisheries administration.

Regulations, Acts and Policies related to fisheries

Formal fisheries management in Bengal (part of which is now Bangladesh) has a long history. As early as 1793, the British rulers had given large tracks of lands to the landlords who were supposed to collect tax from the assigned estates. Since then many acts, rules, ordinances have been formulated, the chronology of which is shown

in **Box 1** (Parveen and Faisal, 2002). These efforts culminated by the formulation of the National Fish Policy in 1998. The important objectives of these amendments have been reflected in the last three items in Box 1: the national environmental, water and fish policies, implications of which on open water fisheries are briefly summarized below.

Box 1 Important acts, rules and policies related to fisheries

- ❧ *Permanent Settlement Regulation 1, 1793*
- ❧ *The Private Fisheries Protection Act, 1889*
- ❧ *State Acquisition and Tenancy Act, 1950*
- ❧ *The Protection and Conservation of Fish Act, 1950*
- ❧ *Bangladesh Fisheries Development Corporation Act, 1973*
- ❧ *The Marine Fisheries Ordinance, 1983*
- ❧ *The Fish and Fish Products (Inspection and Quality Control) Ordinance, 1983*
- ❧ *The Fisheries Research Institute Ordinance, 1984*
- ❧ *The Protection and Conservation of Fish Rules, 1985*
- ❧ *New Fisheries Management Policy of 1986*
- ❧ *National Environmental Policy of 1992*
- ❧ *National Water Policy, 1997*
- ❧ *National Fish Policy, 1998*

National Environmental Policy of 1992

The fisheries and livestock objectives in the National Environmental Policy 1992 are as follows:

- ❧ Ensure appropriate environment for the conservation and development of fisheries;
- ❧ Prevent activities, which diminish

the wetlands/natural habitats of fish and encourage rehabilitative measures in this area;

- Ensure that development activities in fisheries and livestock do not create any adverse impact on the mangrove forests and other ecosystems;
- Evaluate existing projects on water resources development, flood control and irrigation to determine their adverse impact on fisheries and adopt measures for alternate fish culture upon improvement of environmental conditions.

The Environmental Action Plan that was formulated to achieve the objectives of the National Environmental Policy, 1992 laid down the following provisions as shown in Table 4.

National Water Policy, 1997

Availability of water is essential for sustenance and growth of fisheries sector. Accordingly several provisions have been made on the National Water Policy that include the following: (i) fisheries will receive due emphasis in water resources planning when the anticipated social impact is high; (ii) attempt will be made to keep the impact on natural aquatic environment to a minimum; (iii) state owned swamps and marshes that are important for fish, waterfowl and other wild life will not be drained; (iv) water bodies such as haor, boar, beel, road-side ditch will be reserved for fish production and development to the extent possible; (v) perennial links of these water bodies with rivers will be properly maintained; (vi) water resources projects will not interrupt fish movement and adequate provisions in controlled structure will be made to allow fish migration and breeding; and (vii) brackish aquaculture will be confined to specific zones designated by the Government for this purpose.

Table 4 Provisions related to fisheries accordingly to NEP of 1992

Sector	Implementing Agencies
<i>Fish and Livestock Resources:</i>	
1. Steps will be taken to rehabilitate wetlands such as haors, baors, and beels and declare them as protected areas for pisciculture. Wetland areas will not be encroached upon.	a. Ministry of Fisheries and Livestock b. Haor Development Board c. Department of Fisheries
2. Pisciculture will be encouraged in all ponds and tanks. Over extraction of fish from ponds and wetlands will be prohibited. Similar prohibition will be effected for shrimp fry and other fish resources.	a. Ministry of Fisheries and Livestock b. Department of Fisheries c. Upazilas Administration
3. Ministry of Environment and Forest will advise on the environmental aspects of protection and augmentation of shrimp cultivation. The government will delineate appropriate coastal areas for.	a. Ministry of Fisheries and Livestock b. Ministry of Environment and Forest c. Department of Environ-shrimp cultivation d. Department of Fisheries
4. Necessary research and programs for prevention of fish disease and epidemics will be strengthened.	a. Ministry of Fisheries and Livestock b. Fish Research Institute c. Agriculture University
5. Regular monitoring and research will be conducted on the state of wetlands like haors, baors, and beels etc.	a. Ministry of Fisheries and Livestock b. Ministry of Defense c. SPARRSO d. Survey of Bangladesh

6.3.12 National Fish Policy, 1998

With the growing importance of the fisheries sector, Bangladesh Government formulated the National Fish Policy in 1998 for sustainable management of fisheries resources. The Policy has specific strategies for each of its components that can be translated into action plans by relevant agencies.

For open water fisheries, the policy calls for minimizing damage on fish and fish habitat during development activities. It aims for improving the current leasing system to ensure participation of real fishermen in fisheries management. The policy also calls for setting up fish sanctuary, open water stocking and integrated fish cum rice farming. The policy specifically prohibits draining out of natural open water bodies. It calls for protection and restocking of endangered and threatened fish species. Essential features of this policy have been summarized in **Box 2**.

7.0 Major Open-water Fisheries Projects

The Department of Fisheries has undertaken a number of major projects over the years with financial support of donor agencies WB, ADB, DFID and DANIDA. Initially, these projects had a few simple objectives and primarily aimed at increasing production of freshwater fisheries and shrimp culture. Only recently, a more integrated and eco-friendly approach has been incorporated in the project design.

Box 2 National Fish Policy 1998

Goals:

- i. Develop and increase the production of fish resources;
- ii. Poverty alleviation through creation of self-employment and improve their socio-economic condition;
- iii. Meet the demand of animal protein;
- iv. Promote economic growth and earn foreign currency through export of fish and fish products; and
- v. Preserve environmental balance, biodiversity and improve public health.

Scope:

- i. All government, autonomous, multinational organizations, NGOs and individuals involved with the fisheries sector will fall under the National Fish Policy.
- ii. All water bodies used for fisheries will fall under this policy.

Major policy components:

- i. Policy for conservation, management and harvesting of inland open water fish resources;
- ii. Policy for inland closed water fish culture and management;
- iii. Policy for coastal shrimp and fish culture;
- iv. Policy for conservation, management and harvesting of marine water fish resources;
- v. A set of supporting policies pertaining to: Hygienic unloading centres, transport and marketing, processing and quality control, export, education, training and extension, research, institutional framework, fish ecology, credit and cooperatives.

Of the major donor agencies, the World Bank is the largest financier of fisheries projects, which funded three national level projects – called the 1st, 2nd and 3rd fisheries projects. WB has also funded the the 4th fisheries project, which is still underway. These projects aimed at rehabilitation of depleted inland water stocks and enhancement of the productivity of floodplains through large-scale stocking programs and aquaculture development. DFID is involved in fisheries projects through providing technical assistance in training and sector development. DANIDA is financing activities to improve aquaculture development and small-scale lake fisheries development. **Table 5** gives an overview of some completed, ongoing and upcoming fisheries-related projects and their respective donors. Objectives, achievements and lessons learned from the 2nd and the 3rd Fisheries Projects are summarized in **Tables 6 and 7**.

Table 5 Important fisheries projects and donors

Project	Agency
Shrimp culture	World Bank
Oxbow Lakes Fishery	World Bank
1 st , 2 nd , 3 rd and upcoming 4 th Fisheries Projects	World Bank, DFID
Aquaculture Development Project	ADB, IFAD, LGED
Aquaculture Extension Project	DANIDA
Fisheries Training and Extension	DFID
Northwest Fisheries Development Project	DFID
Cage Culture Project	DFID
Oxbow Lakes Small Scale Fisheries Development	IFAD, DANIDA
Flood Action Plan (FAP)	DFID, CIDA, NEDA
Community based Fisheries Management	ICLARM, Ford Foundation

Table 6 Objectives, achievements and lessons learned from the 2nd Fisheries Projects

Objectives	Ways	Achievements	Lesson learned
1. Intensify the production of brackish water shrimp (mostly <i>P. Monodon</i>) in the coastal area of Bangladesh;	<p>?? Improve shrimp culture technology;</p> <p>?? Supply of high quality shrimp;</p> <p>?? Improve water management in 7000 hectares of polder area in Khulna and Coxes Bazaar through construction of embankment and controlled salt water intake;</p> <p>?? Development of 2500 hectares for shrimp culture through extension services;</p>	<p>?? Achievements was largely successful;</p> <p>?? 96% of the targeted area were developed for shrimp production;</p> <p>?? Production per hectare increased almost 4 times;</p>	<p>?? The fund was initially delayed for 8 months due to GOB's failure to meet 3 of the six-pre conditions. Bureaucratic inefficiency has always been a major hindrance in implementing development projects;</p> <p>?? Construction works in the polder took more than 4 yrs as opposed to 2 yrs as planned due to delay in release of fund, site selection and civil works procurement. Such delays can be minimized through inter agency coordination;</p>
2. Foreign exchange earnings;	<p>?? By export of shrimp;</p> <p>?? Capacity utilization of shrimp processing industry;</p> <p>?? Improved marketing of shrimp;</p>	<p>?? Increased production helped in boosting the quantity of exportable shrimps thus enhancing the foreign exchange earnings;</p>	<p>?? Shrimp culture is an important means of foreign exchange earnings</p>
3. Improved incomes, economic activity and nutrition in coastal areas;	<p>?? Through extension services, training, credits to shrimp farmers, traders and hatchery operators for on-farm works and awareness campaign;</p>	<p>?? The project attained an ERR of over 20% compare to the ERR of 27% as estimated in the appraisal;</p> <p>?? Mini hatcheries proved to be a success- <i>P. monodon</i> larvae were produced in a hatchery for the first time in Bangladesh;</p> <p>?? The project had significant impact on employment and extension of modern shrimp culture areas outside the project.</p>	<p>?? Hatchery based intensive shrimp culture is both economically and technologically feasible;</p> <p>?? Construction of hatchery was delayed. The quality of construction and design of hatcheries were poor. This shows lack of experience in design and construction of modern hatcheries</p>
4. Strengthen fisheries administration and extension services;	<p>?? Institutional support for the Project Implementation Unit (PIU) of DOF and BWDB;</p> <p>?? Modify public land lease policy;</p>	<p>?? Results of the two PIU – managed hatcheries were not satisfactory (these hatcheries could not produced 7 million post larvae per year as planned);</p>	<p>?? The performance of the international consulting firm in providing support to PIU in designing and implementing extension programs was satisfactory. But the farm support to the design and supervision hatcheries was poor. External consulting farms appointed by the donor agency may not be the best choice</p>

Table 7 Objectives, Achievements and Lessons learned from the 3rd Fisheries Project

Objectives	Ways	Achievements	Lesson learned
1. a. Increasing the income of fishing families, particularly of the poor;	?? Assist women and small farmers in shrimp farming;	??Achievement was mixed. Initially most of the benefits did not reached the targeted poor; ?? There has been an overall shift towards small landowners taking up shrimp farming; ?? NGO involvement, cancellation of leases to rural elites and taxation of 'Kuas' improved the distribution of the benefits;	??Involving NGOs rather than traditional leasing system can significantly reduce distributional inequity;
1.b. Producing fish and shrimp for domestic consumption and export;	?? Improved floodplain fisheries; ?? Promoting aquaculture; ?? Improved public infrastructure (polder, sluice, culvert) on polder land under shrimp culture; ?? Carry out fisheries development activities (studies, extension services) for fresh water shrimp and other fish species.	??Achievements were substantial; ??On average stocked fish species production increased 8 fold; ??Average Economic Rate of Return (ERR) was nearly 40% (was estimated to be 100% in SAR); ?? About 10,400 ha of shrimp/rice culture farms of planned 13,000 ha were brought under the projects; ?? The project has demonstrated that stocking of floodplain with fingerlings is technically, financially and economically feasible; ?? Other sub projects did not perform as well as shrimp farming.	??It may be difficult to estimate the net benefit of fisheries projects due to uncertain factors such as drought and flood and increase of fingerling price and other institutional costs; ??DOF lacks skill in dealing with the social complexities. DOF officials need training on involving the stakeholders during planning and implementation of projects.
2. Supporting the fisheries development with emphasis on private sector participation;	?? Involved private sector (NGO) in fingerling production; ?? Flood plain stocking.	??About 26,000 metric ton stocked fingerlings were supplied by private contractor; ??By 1995 the contractor were delivering about 95% of the contractual obligations; ??Fingerlings quality were inspected and assured by DOF.	?? Private sector fingerlings production is a commercially viable alternative;
3. a. Accelerating the expansion of fish production in the floodplains;	??Stocking of floodplains with fingerlings; ?? Carryout research regarding ecological assessment, fish food, fish disease etc.	??Achievements were substantially; ??A major activity included support to FRI to conduct targeted applied research; information disseminated through extension activities and circulation of simple booklets written in Bangla.	?? Availability of simple fish culture manual in Bangla benefits the fishermen.
3.b. Strengthening sectoral institutions;	?? Logistical support and technical assistance for capacity building of DOF, FRI and BWDB;	??Achievement was satisfactory; ??DOF officials were trained on procurement, contract management and intensive monitoring under ODA funded MTA component; ??DOF staff gained experienced in computerized stock management system.	??Overall capacity for coordination and information management at all level still requires strengthening.

The Fourth fisheries project

In order to increase environmentally friendly and sustainable fish and shrimp production, World Bank approved a grant for the Bangladesh Fourth Fisheries Project in July 20, 1999. Total project cost has been estimated to be US\$60.8 million to which the government of Bangladesh will contribute US\$9.3 million, the UK Department for International Development (DFID) will contribute US\$15.5 million, and the GEF will provide a US\$5 million. Important aspects of this project are shown in **Box 3**.

Box 3 Fourth Fisheries Project of Bangladesh

Objectives:

1. Improvement of inland open-water fisheries management;
2. Establishment of sustainable and equitable institutional arrangements for managing shrimp polders to help small holder shrimp production;
3. Improvement of sustainability of shrimp fry collection;
4. Development and applications of extension strategy for fresh water aquaculture;
5. Studies of key issues in aquatic resource and development and management and develop a sound management plan for conservation of *Hilsa* fish;
6. Strengthening the capacity of DOF to manage and support the fisheries sector plan for long term sustainability and implementing the National Fisheries Policy.

Components:

- ?? Development of sustainable, community-based institutions;
- ?? Support the fishermen is undertaking the program of adaptive management;
- ?? Use technical measures such as stock enhancement of floodplain fisheries, restoration of fisheries habitat, establishment of fish sanctuaries and construction of fish passes
- ?? Improvements in salt water inlets, flushing structures and channels;
- ?? Development and extensions of less destructive frycollection methods;
- ?? Improve the access of poor shrimp fry collectors to support and services of DOF;
- ?? Establish a network of institutions involved in fisheries management including DOF; donor agencies and relevant NGOs.

Problems facing open water inland fisheries will be addressed through different management measures with the direct involvement of beneficiaries and NGOs in the design, site selection, management, and monitoring of these interventions. The stocking of fingerlings of indigenous species in the floodplains is one such measure. To increase productivity and biodiversity, the project will also help reopen important canals and tributaries by which river fish breed and graze that are currently blocked due to sedimentation. Up to 10 pilot habitat restoration sub-projects are to be implemented by communities and NGOs that will allow for more effective fish migration are included under the project. The project also includes fish passes to allow passage of fish through flood control, drainage, and irrigation projects, which have blocked fish migration routes.

In order to protect the Ganges-Brahmaputra floodplain, a wetland of international importance, the project mainstreams aquatic biodiversity conservation within the day-to-day activities of fisheries and related sectors. Up to 50 pilot-scale community-managed aquatic sanctuaries will be established by the project in small rivers and channels with flowing waters and in areas where fishing rights are not leased out.

The project also aims to environment friendly aquaculture including shrimp culture in polder areas. The major thrust in 4th Fisheries is on beneficiary participation and capacity building at all levels.

Second Aquaculture Development Projects

The ADB-funded US \$ 48.41 million Second Aquaculture Development Project completed in 1996 is an example of how a project can be implemented with active participation of local communities. However, this project has risen some serious concerns right from the beginning. The third component of the project – floodplain fisheries enhancement involved six northeastern districts – Sylhet, Sumanganj, Moulavibazar, Habiganj, Netrokona and Kishorgonj where pesticides were used to kill fish and fries in haors and beels before stocking exotic fish varieties.

This project allegedly ignored environmental, cultural and socio-economic diversity. Technical review of the Environmental Impact Assessment (EIA) by the Asian Wetland Bureau suggested that the ADB EIA document did not address the potential social impacts of the projects. It also reported that the degree of modification of the natural functions of the Haor Basin by the introduction of high-input management techniques was a concern.

8. Key observations and concluding remarks

The fisheries sector of Bangladesh has a long history of management and regulation. In the last few centuries, it has evolved from a few privately owned wetlands and largely open access resource base to a fairly complex and market oriented sector of the economy. Information and analysis provided above highlights many shortcomings and issues pertaining to the continually evolving open-water management regime in Bangladesh. These are summarized as key observations below.

Observations in relation to fish ecology and diversity

The natural fish habitats are being encroached upon all over the country. Increased demand for food and protection of agricultural land through flood control measures has contributed to the loss of more than two and half million hectare of the active floodplain (MPO, 1987). These are very productive ecosystems and such encroachment has reduced both the total catch and diversity of fish in open waters.

The natural migration of fish in different seasons is not well understood. There is some information on the migration pattern of major carps and shrimp, but most other species need to be studied. In the past, dams, embankments, and regulators have been built without any regard to the impact of these structures on fish migration. The Fish Policy of 1998 now calls for mitigation measures such as fish pass. This provision should be sincerely implemented.

Fifteen alien species (Rahman, 1985) of fish have been introduced in Bangladesh in the last few decades. These have proven to be severe competitors and have driven out local species from their respective habitats. Some members of these species have escaped into open waters during major floods in the past. Long-term implication of such introduction of alien species is uncertain and may not be favorable.

Observations on major fisheries projects

In the past, fisheries projects were conceived with very narrow objectives and fragmented understanding of the complex fish ecosystem. The focus was to increase fish production and revenue. This objective was pursued through promoting aquaculture, fast growing alien species and revenue oriented management systems

leading to over-fishing. In case of the ADB funded Second Aquaculture Development Project, pesticide and herbicide were used to kill non-commercial varieties of fish, predators and aquatic weed. This was an environmental disaster and shows that even leading donor agencies lack knowledge and understanding of fish ecology and sustainable management of fisheries resources.

In addition, the common problems with the public sector in relation to fisheries management include bureaucracy and delayed implementation of projects with no follow up activities. This is partly due to the lack of DOF capability in designing and implementing large projects independently. Recent projects have focused on capacity building of DOF, which is certainly a step in the right direction.

However, there have been a number of encouraging developments - the concept of private sector hatchery and intensive shrimp culture has had a major beneficial impact on the coastal ecosystem. Another positive development was involving NGOs in leasing and managing the wetlands. For years, real fishermen had no say in managing the resource on which their livelihood depended. Now their representation is being gradually ascertained. The issue of equity and gender is also being incorporated in newer fisheries projects.

The 3rd and 4th Fisheries projects have introduced some innovative measures such as floodplain stocking and fish sanctuary. The basic idea is to enhance the overall productivity of open water fisheries and preserve biodiversity. Effectiveness of these measures has not been evaluated yet but such ecosystem-based approaches should be encouraged in future projects.

Observations on anthropogenic impacts

The extent of damage done by water pollution is unknown. It is possible that some toxic chemicals and heavy metals dumped by the industries in major rivers may be making their way into human food web through bioaccumulation in the bodies of freshwater and marine fish. Integrated pest management in agriculture can make a significant difference in reducing toxic chemicals in open water bodies.

The fishing practices are often very damaging to the fish population. Use of very fine net and destruction of non-commercial species during collection of shrimp fry are examples of self-destructive and unsustainable methods of fishing. Although there are regulations against such acts, it is virtually impossible to monitor these violations and sanction the violators. The best way to deal with this problem is to involve the fishermen community in the management process. Awareness, training and availability of easily usable documents written in Bangla have proven to be effective in some places. The basic idea here is to convert the violators into stakeholders so that they take care of the resource in their own interest.

Observations on the existing management system

The stocks and populations of fish and prawn in inland waters and in the sea are “common property renewable natural resources” (i.e. property belonging to all or none). As a result they are suffering from serious over-exploitation problem. Little can be done to directly control this activity. However, DOF can try to minimize the impact by designing practical property-right regimes appropriate for Bangladesh.

The current wetland leasing system has a number of flaws. It is a short-term arrangement and therefore the leaseholders try to maximize benefit by maximizing catch without any regard to the future potential of the wetland. This can be tackled by making the true fishermen the stakeholders in fisheries management through the supervision of NGOs. Also, the system is managed by the District Commissioner's Office, which does not have any specialized ability to manage fisheries. Some of the Key questions related to fisheries management are given in Box 8.1.

The official responsibility of managing the wetlands (which are used for revenue generation only) should be gradually transferred from the DC Office to the DOF. DOF must take an integrated view in managing the fish resources rather than focusing on short-term profit making. In this regard, DOF itself will need some internal restructuring and capacity building.

DOF must address its own institutional lacking: (a) lack of clear mandate; (b) structural weakness; (c) managerial constraints; and (d) insufficiently trained staff.

Currently, numerous government agencies such as DOF, BWDB, LGED, DOE etc are in charge of looking after various fish related issues. This multiplicity of institutions actively engaged in various aspects of fisheries management and administration has created compartmentalization of responsibilities and authorities with several overlapping functions among them. Thus, inter-agency co-ordination is an essential condition for effective fisheries management.

9.0 Concluding remarks

This document has reviewed the status, problems and prospects of the open-water fisheries sector of Bangladesh. The key observations made above and the corresponding recommendations can make a big difference in improving the current status of this sector.

The people of Bangladesh are known to have survived on "fish and rice." Fish supplies the main part of animal protein in their diet. This sector also employs some two and half million people directly. Its importance in the national economy has grown rapidly in the recent past through export of fish and shrimp to European and North American countries. Therefore, it is important to manage this valuable resource in a judicious way. Moreover, a healthy fresh and marine fisheries sector will also imply a healthy aquatic ecosystem in Bangladesh. Thus, managing the fisheries sectors in an efficient, equitable and sustainable manner will ensure the health and prosperity of the people and the environment of Bangladesh.

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