6

BIMSTEC-Japan Cooperation in Fisheries Sector: Bangladesh Perspectives

Md. Liaquat Ali

6.1. INTRODUCTION

BIMSTEC is a sub-regional initiative of seven countries, namely, Bangladesh, India, Myanmar, Sri Lanka, Thailand, Nepal and Bhutan, in South and South East Asia for enhancing economic and technological cooperation (Sen et. al. 2006). The idea of this regional cooperation was first mooted by Bangladesh, India, Sri-Lanka and Thailand at a meeting in Bangkok in June 1997 for enhancing economic and technological cooperation and it was named as BIST-EC (Bangladesh, India, Myanmar, Sri Lanka, Thailand Economic Cooperation). Then in December 1997, Myanmar was included and it was renamed as BIMST-EC (Bangladesh, India, Myanmar, Sri Lanka, and Thailand-Economic Cooperation). Following the decision of the ministerial meeting held on 22 December 2006, Nepal and Bhutan were included in the group. To make it more generic and flexible BIMSTEC was freshly renamed as Bay of Bengal Initiative for Multi-sectoral Technical and Economic Cooperation (BIMSTEC). BIMSTEC covers cooperation in six major areas viz (i) Trade and Investment (ii) Technology (iii)
Transportation and Communication (iv) Energy (v) Tourism and (vi) Fisheries (Kularatne, 2004).

BIMSTEC members are all developing countries and not economically or technologically advanced. BIMSTEC is looking for suitable partner which is economically and technologically advanced and also a good capital exporters, particularly in this region. Japan is the 2nd largest economy and stock market capitalization in the world, after USA, and a significant investor in the world (Sen et al 2006). Japan is also one of the largest bilateral and multilateral donors in the world. Japan is a major trading and investment partner of most of the BIMSTEC countries. BIMSTEC partnership with Japan is thus likely to strengthen the economic and technical cooperation and thereby, benefit each other.

Of the six areas of cooperation, fisheries sector plays a significant role in development of economy, employment generation, foreign exchange earning and nutrition in the BIMSTEC countries (except Nepal and Bhutan). BIMSTEC countries contribute about 10 per cent of world fisheries production and about 10.8 per cent of export earning (trade value). BIMSTEC countries’ contribution in the world shrimp aquaculture production is about 43 per cent. BIMSTEC countries generate over 6.3 billion foreign exchange earning from fisheries trade (Table 6.1).

BIMSTEC countries, except Nepal and Bhutan, are more or less rich in fisheries resources - both in capture and culture fisheries. Some of them are technologically quite developed in some disciplines of fisheries (Table 6.2) which could be shared among BIMSTEC countries where needed. The BIMSTEC fisheries sectoral committee identified the following five key area for cooperation (Kularatne, 2004).

(i) Fisheries research and development
(ii) Promotion of technical cooperation in fisheries
(iii) Promotion of investment including joint ventures for fishing, processing, quality control and marketing of fish and fish products.
(iv) Promotion of trade in fish and fish products
(v) Other area of mutual interest.

Research, development and promotion of technical cooperation among BIMSTEC countries are largely associated with financial implication rather than technical issues only. Japan’s role
<table>
<thead>
<tr>
<th>Country</th>
<th>Capture Fisheries Production (000' m.ton)</th>
<th>Aquaculture production (000' m.ton)</th>
<th>All Total (000' m.ton)</th>
<th>Contribution to GDP (%)</th>
<th>Export US$ million</th>
<th>Fish Consumption (kg/person/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inland Capture</td>
<td>Marine Capture</td>
<td>Total Fish &amp; others</td>
<td>Shrimp</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>732</td>
<td>455</td>
<td>1187</td>
<td>840</td>
<td>75</td>
<td>915</td>
</tr>
<tr>
<td>India</td>
<td>805</td>
<td>2811</td>
<td>3616</td>
<td>2316</td>
<td>156</td>
<td>2472</td>
</tr>
<tr>
<td>Myanmar</td>
<td>455</td>
<td>1132</td>
<td>1587</td>
<td>370</td>
<td>30</td>
<td>400</td>
</tr>
<tr>
<td>Sri-Lanka</td>
<td>30</td>
<td>254</td>
<td>284</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Thailand</td>
<td>200</td>
<td>2655</td>
<td>2845</td>
<td>873</td>
<td>300</td>
<td>1173</td>
</tr>
<tr>
<td>Nepal</td>
<td>20</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.3</td>
<td>-</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BIMSTEC Total</td>
<td>2241</td>
<td>7298</td>
<td>9541</td>
<td>4422</td>
<td>568</td>
<td>4990</td>
</tr>
<tr>
<td>Japan</td>
<td>60</td>
<td>4341</td>
<td>4401</td>
<td>-</td>
<td>-</td>
<td>776</td>
</tr>
<tr>
<td>World</td>
<td>9219</td>
<td>85788</td>
<td>95007</td>
<td>44148</td>
<td>1320</td>
<td>45468</td>
</tr>
</tbody>
</table>

Table 6.2: Fisheries Resource Potential and Development Status in BIMSTEC Countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>Freshwater Aquaculture</th>
<th>Brackish water Aquaculture</th>
<th>Marine culture</th>
<th>Inland capture fisheries</th>
<th>Marine capture fisheries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>D</td>
<td>MD</td>
<td>ND</td>
<td>D</td>
<td>MD</td>
</tr>
<tr>
<td>India</td>
<td>HD</td>
<td>D</td>
<td>DL</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Myanmar</td>
<td>MD</td>
<td>DL</td>
<td>ND</td>
<td>DL</td>
<td>MD</td>
</tr>
<tr>
<td>Sri-Lanka</td>
<td>DL</td>
<td>MD</td>
<td>DL</td>
<td>MD</td>
<td>D</td>
</tr>
<tr>
<td>Thailand</td>
<td>D</td>
<td>HD</td>
<td>DL</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Nepal</td>
<td>DL</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Bhutan</td>
<td>ND</td>
<td>NS</td>
<td>NS</td>
<td>ND</td>
<td>NS</td>
</tr>
<tr>
<td>Japan</td>
<td>MD</td>
<td>D</td>
<td>DL</td>
<td>HD</td>
<td></td>
</tr>
</tbody>
</table>

(a) Highly developed = HD, (b) Developed = D, (c) Moderately developed = MD, (d) Developing = DL, (e) Poorly developed = PD, (f) No development = ND, (g) No scope = NS.
as one of the largest bilateral donor in the world may be of great advantages for BIMSTEC countries.

Bangladesh is naturally rich in fisheries resources in its inland and marine waters. Fisheries is an important sector of Bangladesh providing significant impetus to the country’s economy, employment generation and nutrition. The fisheries sector as a whole has been developed significantly during the last two and half decades with huge development initiatives of the Government, supported both technically and financially by international and bilateral development partners/donors including Japan. Exception to the sectoral development is the decline of inland capture fisheries due to over exploitation with increase of population and loss/ degradation of fish habitats. However, some successful management tools have been developed and tested for inland capture fisheries management.

However, the fisheries sector of Bangladesh is facing management and development problems in some specific fields where both technical and financial assistance and cooperation from external sources are needed. Japan being fish eating and producing country has much interest in fisheries. Japan is also technically advanced in fisheries particularly, in marine fisheries, and is a potential donor.

Japan’s cooperation in the field of fisheries of Bangladesh is quite long. Since 1950s Japan’s cooperation and assistance in fisheries sector of Bangladesh has been quite significant. Under the BIMSTEC-Japan cooperation, this will further be strengthened for development and management of the fisheries of Bangladesh.

Given above, this chapter highlights the status, trend, constraints/problems, challenges and opportunities of the fisheries sector of Bangladesh and identifies areas/fields of cooperation and assistance where Japan can cooperate and also where cooperation among BIMSTEC countries are needed and possible.

6.2. FISHERIES OF BANGLADESH

6.2.1. Importance of Fisheries

The Fisheries sector of Bangladesh plays a vital role in the economy, employment generation, nutrition supply and poverty alleviation.
The sector contributes about 5 per cent to the country’s GDP and 4.7 per cent of the total export earning of the country. Fish provides more than 60 per cent of animal protein and 6 per cent of the total protein intake in the diet of the people of Bangladesh (DOF, 2005). Fisheries sector provide employment of about 1.2 million of full time fishers and 11.00 million of part time/artisanal fishers, fish/shrimp farmers, fish traders and processors, labourers, input suppliers etc. About 60-70 per cent of the rural people undertake some sort of fishing in a year for own consumption as well as for income (Ali, 1997, 2005).

6.2.2. Fisheries Resources and Trend

By virtue of geo-physical location and environmental condition, Bangladesh has been very rich in fisheries resources since time immemorial. The country has about 4.00 million ha inland open waters in the forms of rivers, canals, beels and haors (depressions), seasonal flooded land, reservoir/lake etc.; 0.40 million ha. of closed waters in man made ponds, impoundment/ditches and burrow pit and 166000 km2 marine water along 710 k.m. coast line extending upto 200 nautical miles in the EEZ in Bay of Bengal with high potential of fish production (DOF; 1985, 1997). The inland water is inhabited by 260 species of indigenous fin fishes, 14 species of exotic fishes and 25 species of shrimp, while the marine water is inhabited by 475 species of fishes, 36 species of shrimp, 21 species of sharks, rays and skates, 6 species of lobsters, 16 species of crabs, 3 species of turtle, 7 species of squid and cuttle fish, 3 species of crocodiles, 350 species of mussels and snails and 165 species of sea weeds (Khan, 2005).

Based on the production system and environmental consideration, the fisheries of Bangladesh is broadly categorized as (i) inland open water fisheries (inland capture fisheries), (ii) culture fishers (freshwater and brackish water aquaculture) and (iii) marine fisheries (industrial and artisanal fisheries). An account of water resources as categorized according to fisheries types along with present fish production (2004-05) is furnished in Table 6.3 (DOF; 1985, 2006).

Major sources of fish production in the past was the inland capture fisheries which even during 1960s would contribute more
### Table 6.3: Fisheries Types with Area and Fish Production (2004-05)

<table>
<thead>
<tr>
<th>A.</th>
<th>Inland Fisheries</th>
<th>Area in Hectare</th>
<th>Production (m. ton)</th>
<th>% of Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Inland Capture Fisheries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Rivers and canals and estuaries</td>
<td>1,031,563</td>
<td>155,522</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>Haors and beels (depression-deeper area)</td>
<td>114,161</td>
<td>74,925</td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td>Reservoir</td>
<td>68,800</td>
<td>7,379</td>
<td></td>
</tr>
<tr>
<td>(iv)</td>
<td>Seasonal Flooded area</td>
<td>2,832,792</td>
<td>621,443</td>
<td></td>
</tr>
<tr>
<td>Sub-Total (Inland capture)</td>
<td>4,047,316</td>
<td>859,269</td>
<td>38.8</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Culture Fishery (closed water)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Man made pond including ditches and burrow pits</td>
<td>305,025</td>
<td>756,993</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>Oxbow lakes</td>
<td>5,488</td>
<td>4,388</td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td>Shrimp farm (coastal and freshwater)</td>
<td>203,071</td>
<td>120,710</td>
<td></td>
</tr>
<tr>
<td>Sub-Total (Culture)</td>
<td>513,584</td>
<td>882,091</td>
<td>39.8</td>
<td></td>
</tr>
<tr>
<td>Inland Total</td>
<td>4,560,900</td>
<td>1,741,360</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| B. | Marine waters upto 200 m. miles in the EEZ in Bay of Bengal | | | |
|----|-------------------------------------------------------------|-----------------|-----------------|
| (i) | Industrial | | 34.114 | |
| (ii) | Artisanal | | 440.483 | |
| Marine Total | 166,000 km² | 474,597 | 21.4 | |
| Country Total | | 2,215,957 | 100 | |
than 90 per cent of the country's fish production, but it has declined significantly during the last 4 decades mainly due to over exploitation and loss/degradation of fish habitats. On the other hand, aquaculture and marine fisheries have developed steadily during the last two and half decades. The overall fish production has increased three folds during last 20 years (Figure 6.1) with annual growth rate of the sector varying from 5 per cent to 8 per cent during the same period. Per capita fish consumption dropped significantly from 32 gm/day in 1960 to 20 gm/ha during 1980s, after which it has increased to a level of around 38-40 gram/day during recent years.

![Figure 6.1: Fish Production Trend of Bangladesh](image)

6.2.3. Inland Capture Fisheries

Situated in deltaic plains of the three mighty rivers - the Ganges, the Brahmaputra and the Meghna - Bangladesh has vast inland water area in rivers and canals, haors and beels, floodplains, lakes etc. measuring about 4.0 million ha. (Table 6.3). The inland capture fishery is one of the richest in the world after that of China and India. Inland capture fisheries of Bangladesh is vast and wide spread but complex in nature with multi-species and multi-gear fisheries. It is the major source of employment, livelihoods and animal protein of the rural people of Bangladesh. About 0.77 million full time fishers are directly dependent on inland capture fisheries for their livelihoods (DOF, 2004). Thousands of people are engaged in
related activities such as fish trade, transportation, processing, making fishing equipment and boats etc. Besides, most of the rural people (amounting to about 70 per cent) depend on subsistence fishing in inland waters for their own consumption and income (Ali, 1987).

In the past it was the major source of fish production providing more than 90 per cent of the country's total fish production. But it has declined significantly over the last half of a century due to (i) over exploitation as a result of rapid population growth, (ii) loss and degradation of fish habitats by flood control, drainage, irrigation (FCD/FCDI) projects, siltation, agro-chemical and industrial pollution, diversion of the Ganges water flow at Farakka in India and (iii) lack of proper management policy, etc. Due to construction of flood control embankment and structure under the FCD/FCDI projects for augmenting rice production and for protecting lives and properties of the people, the migration routes of fishes between the rivers and the most productive floodplain ecosystem which is the breeding and feeding grounds of many fishes and other aquatic organisms, have been disrupted and thereby, the production in floodplain as well as in the river system has been affected. Due to drainage programme many water bodies have been lost. So far 5.5 million ha. floodplain area has been brought under FCD/FCDI projects and in the process, about 1.1 million ha. of water area in the floodplain ecosystem has been lost, in addition to the loss of water area by siltation (MPO, 1987). As a result of implementation of FCD/FCDI projects along with introduction of HYV rice, agriculture production has increased significantly and the agri-farmers have been benefited. The country has reached to almost self sufficiency in food grain production.

The important valued major carp (Rui, Catla, Mrigala, Kaliboush etc.) which would constitute more than 30 per cent in the past has drastically declined to a level of 3 per cent in the inland capture fisheries. The most favoured fish- Hilsa - (Tenualosa ilisha) known as Indian shad, a single species fishery, has declined significantly in the riverine waters of Bangladesh due to mainly the effect of diversion of water flow of the Ganges at Farakka. Prior to the Farakka Barage, the Hilsa as a single species fishery would contribute more than 30 per cent of the total production, which in the post Farakka period has dropped to around 7 per cent to 8 per
cent in the river systems (Ali, 2005). The niches of those commercially important fishes have been occupied by less important fishes.

Biodiversity has been affected in the inland capture fishery. According to a study by IUCN, some 54 species of fishes are endangered, of which 12 species are either critically endangered or extinct (IUCN, 2000).

As a result of the decline of the inland capture fisheries, the livelihoods of those dependent on it have been affected.

### Inland Capture Fisheries Production and Trend

There was no systematic method of collecting fisheries statistics until 1983 when a statistical system was developed under a FAO/UNDP supported project for collecting fisheries statistics including estimate of fish production for different production systems. Prior to 1983, fish production of the country was estimated by using the population number and per capita annual fish consumption obtained through national nutrition survey conducted for the first time in 1964, then in 1975 and 1980 by the Biochemistry Department/Institute of Food and Nutrition of Dhaka University. However, the marine wing of DOF had a system of collecting marine fisheries data including catch. According to those estimates, fish production in 1965 was 801,000 m. tons (Inland 717,000 m. ton and marine 81,000 m. ton) which increased with the growth of population till 1975 when the second nutrition survey was conducted. According to the second nutrition survey, the per capita fish consumption came down to 7 kg/person/year from 12 kg/person/year in 1965 and accordingly the estimate of fish production also came down to 640,000 m. ton (Inland 545,000 m. ton and marine 95,000 m. ton). The estimated fish production at 5 years interval is shown in Table 6.4.

It appears from the data that the inland capture fisheries production decreased gradually up to the end of 1980s, after which it showed gradual upward trend and reached the production level of 1960s. It contradicts the perception of declining the inland capture fisheries production. The present estimate of fish production made by DOF has been questionable as the estimate is made based on the old frame (area of water bodies, fishing units/fishing efforts)
<table>
<thead>
<tr>
<th>Type of water/ fisheries</th>
<th>Fish production in '000 m. ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inland capture fisheries</td>
<td></td>
</tr>
<tr>
<td>a) Rivers, Canals</td>
<td>676</td>
</tr>
<tr>
<td>b) Beels &amp; Haors</td>
<td></td>
</tr>
<tr>
<td>c) Reservoir</td>
<td></td>
</tr>
<tr>
<td>d) Flood lands</td>
<td></td>
</tr>
<tr>
<td>2. Aquaculture</td>
<td></td>
</tr>
<tr>
<td>a) Freshwater on culture</td>
<td>44</td>
</tr>
<tr>
<td>b) Shrimp culture</td>
<td></td>
</tr>
<tr>
<td>3. Marine Fisheries</td>
<td></td>
</tr>
<tr>
<td>a) Industrial (Trawlers)</td>
<td>81</td>
</tr>
<tr>
<td>b) Artisanal</td>
<td></td>
</tr>
<tr>
<td>COUNTRY TOTAL</td>
<td>801</td>
</tr>
</tbody>
</table>

* Data of 2005-06 not available.
developed in 1983, which by now have obviously changed significantly. The frame need to be updated and a sound statistical system for monitoring/estimating the fish production is to be developed.

**Management Measures and Development Interventions in Inland Capture Fisheries**

Inland water bodies are owned by the government except seasonal flood lands which are mostly privately owned rice fields. For administrative convenience a river is divided into several sections, each section being called a *jalmohal* (fishery water bodies). An individual *beel* or a group of *beels*, an oxbow lake, a government owned pond is also called a jalmohal. government water bodies are under the control of the Ministry of Land (MoL) who collects Government revenue by leasing out the water bodies for fishing. However the flowing rivers have been declared as open and free access for fishing since 1995 without any control over fishing effort and as such rivers are being over exploited. The Ministry of Fisheries and Livestock (MOFL) and its relevant organizations – Department of Fisheries (DoF) is responsible for management of fisheries resources for sustainable production.

Government water bodies (jalmohal) measuring upto 3 acre are managed by local Government (the Union Parishad) and all closed water bodies (jalmohal) upto 20 acres are managed by the Ministry of Youth and Sports who leases them to unemployed youth for fish production while the jalmohals above 20 acres are controlled by MoL for collecting revenues. Thus, multiple organizations are involved in managing inland water bodies for fisheries.

In order to ensure sustainable production in inland waters, the first regulatory interventions was the promulgation of Fish Protection and Conservation Act 1950 and the related rulers formulated time to time. The Act envisages restriction on fish size and mesh size of fishing nets, and fishing by destructive gears, dewatering and poisoning, etc. Primary responsibility of implementing this law is with DOF, but due to lack of sufficient manpower and logistic supports, the laws cannot be enforced properly. The interventions for development and management of inland capture fisheries undertaken under different development
projects and programmes include new fisheries management policy (licensing the fishing rights directly to the fishers), community based co-management of fisheries, establishment of fish sanctuary, enhancing fisheries through stocking of fish fry in seasonal floodplain, fisheries village approach of extension of fisheries, community based floodplain aquaculture (Doudkandi model) and fish habitat improvement through excavation of link canal and beels. The community based floodplain aquaculture (Doudkandi model), community based co-management of fisheries and fisheries village approach of extension have been proved to be successful and effective for enhancing fish production as well as improving the socioeconomic condition of the fishing community.

Problems and Constraints, Opportunities and Challenges

The inland capture fisheries have faced various problem and constraints that have led the inland fishery depleted during the last few decades and affected the people dependent on it. Over exploitation and loss and degradation of fish habitats are the major problems in the inland capture fisheries followed by lack of proper policy and policy implementation. The water bodies (Jalmohals) are leased out by MOL to earn revenue without considering the biological management of fisheries resources for sustainable production. Competitiveness in leasing and short term leasing period, indulge over exploitation/destructive fishing leading to depletion of the fisheries resources. Lack of coordination among the Land Ministry who controls the water bodies including leasing out and MOFL which is responsible for management of the fisheries resources for sustainable production has been found as a major policy weakness for proper management and development of inland capture fisheries. Thus, the revenue oriented short term leasing system of water bodies/fisheries and dual administration over the same resource are the major problem/constraints of the management policy of inland fisheries. Free and open access to the fisheries in the flowing rivers without any control of fishing efforts is another major weakness in the management. Shortage of manpower and logistics in DOF/MOFL is one of the major constraints for enforcement of fisheries regulations. Reliable information/data of the fisheries resources are the pre-requisite for formulating and
implementing development and management policy and program for sustainable fish production, but there is major lacking in reliable information/data in the fisheries sector.

6.2.4. Marine Fisheries

Along 714 km coast line, Bangladesh has about 166,000 km2 marine water in the Bay of Bengal with the EEZ extending upto 200 nautical miles from the baseline (10 fathom depth line). The country has extensive continental shelf of about 85,000 Km2, the most productive zone for fish/shrimp and other aquatic fauna (Table 6.5 and Figure 6.2).

<table>
<thead>
<tr>
<th>Table 6.5: Marine Waters of Bangladesh in the Bay of Bengal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coast line of Bangladesh in the Bay of Bengal = 710 Km</td>
</tr>
<tr>
<td>Internal water upto 10 fathom depth (baseline) from coast line = 25,151 km2</td>
</tr>
<tr>
<td>Territorial water upto 12 nautical mile from base line = 9,065 km2</td>
</tr>
<tr>
<td>Continental shelf (upto 40 fathom depth) excluding internal and territorial water = 85,156 km2</td>
</tr>
<tr>
<td>Exclusive Economic Zone (EEZ) upto 200 n. miles from baseline including territorial water = 140,915 km2</td>
</tr>
<tr>
<td>Total marine water (internal + EEZ) = 166,000 km2</td>
</tr>
</tbody>
</table>


With marine waters in the Bay of Bengal receiving nutrient rich run off from numerous mighty rivers from Bangladesh, India and Myanmar are rich in fisheries resources. The Bangladesh part of marine waters in its EEZ is inhabited by some 475 fish species, 36 shrimp species, 21 species of shark, rays, skates and dolphins, 6 species of lobsters, 16 species of crabs, 3 species of turtles, 7 species of squid and cuttle fish, 3 species of brackish water crocodiles, 350 species of mussels and snails and 165 species seaweeds (Khan Gias, 2005). Of the 375 fish species, some 90 species are commercially important, which fall under the common groups of hilsa, silver pomfret, Chinese pomfret, white gunter, red snapper, moon fish,
Figure 6.2: Marine Waters of Bangladesh

Source: Adopted from DOF's report of coastal and marine fisheries resource development and management, Bangladesh
Indian salmon, hairtail, catfish, croaker, thread fin bream, goat fish, lizard, big eye ilish, herring, barrendy, pike, congur and ancovey. Almost all shrimp species are commercially important but most important of them are the black tiger shrimp – Penaeus monodon – followed by P. indicus, P. monoceros, P. semisulcatus and P. merguiensis.

Because of sufficient availability of fresh water fishes, marine fisheries were almost unknown to the majority of the people in the past, even upto 1960s, when marine fishes were exploited in the near shore area by small scale non-mechanized/sail boat. With increasing demand of fish for the rapidly growing population, attention was drawn towards marine fisheries through public sector interventions. Marine fisheries have developed steadily since 1960s, but intensively after the liberation of the country in 1971. The scope of marine fisheries was further widened with declaration of EEZ upto 200 n. miles in the Bay of Bengal during 1970s. With a nominal marine catch of 33000 m. ton in 1960, it has reached to a level of 474,597 m. ton in 2004-05 (Table 6.3). Marine fish production has increased at an average annual rate of 8 per cent over the last 20 years since 1983-84 (Figure 6.3). Presently, marine fisheries contribute about 22 per cent in the country’s total fish production.

Figure 6.3: Marine Fisheries Catch
Development and Management of Marine Fisheries

Since late 1950s marine fisheries of Bangladesh received attention for its development and management through the public sector interventions. The development interventions undertaken so far since that time include (i) exploratory survey to know the stock of marine fishes for commercial exploitation including identifying fishing grounds in the Bay of Bengal, (ii) establishing an autonomous organization namely “Fisheries Development Corporation” for marine fisheries development, (iii) improvement of fishing technology through mechanization of fishing boats and use of nylon twine nets, (iv) introduction of industrial fishing by trawlers in offshore deep sea area, (v) establishing a marine fisheries training academy for development of manpower for fishing vessels and (vi) promulgating marine fisheries ordinance and rules and their implementations to regulate fishing for MSY, (vii) establishing marine fisheries monitoring and surveillance system, (viii) guarding unauthorized fishing/poaching by foreign vassals and (ix) infrastructure development (fish harbour and landing centre). Recently a marine reserve measuring an area of 698 km2 in the Bay of Bengal for conservation of marine fisheries resources has been established. Resource conservation measures also include a closure of industrial fishing during peak breeding season of shrimp from 15 January to 15 February every year.

Table 6.6: Standing Stock of Fish in the Bay of Bengal

<table>
<thead>
<tr>
<th>Type of fish</th>
<th>Standing Stock (m. ton)</th>
<th>Exploitable amount (m. ton)</th>
<th>Present level of exploitation as in 2003-04(m. ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp</td>
<td>4000</td>
<td>6,500-7,000</td>
<td>36,488</td>
</tr>
<tr>
<td>Demersal Fish</td>
<td>150,000-160,000</td>
<td>50,000-85,000</td>
<td>172,276</td>
</tr>
<tr>
<td>Pelagic Fish</td>
<td>90,000-120,000</td>
<td>Not determined</td>
<td>246,443 (Hilsa – 184,000)</td>
</tr>
</tbody>
</table>

Fish Stock in the Bay of Bengal

Through exploratory survey studies, stock of marine fisher resources have been assessed time to time for judicious exploitation and proper management of the resources. The latest assessments that have been made on the basis of exploratory survey and catch and effort study of commercial fishing and experimental fishing (1986) are presented below.

It appears from the above table that the exploitations have far exceeded the estimated exploitable stock, which poses question about the reliability of the assessment. A fresh survey is essential for assessment of the stock for judicious exploitation of the marine resources including deep sea pelagic fish resources. Off Shore/deep Sea pelagic resources like tuna, mackerel, shark etc. are not exploited due to lack of knowledge of the stock and harvesting mechanism. The deep-sea resources are yet to be assessed through exploratory survey. Japan may cooperate for conducting exploratory survey for assessment of pelagic resources in the offshore/deep seawater of Bangladesh.

Monitoring of the marine fisheries resource had been continued till mid 1990s through experimental fishing by the only research vessel – “Anusandhani” donated by Japan during early 1980s, and by using the commercial catch data. But the research vessel is now out of order and the repairing of the vessel is not economically viable and as such it has been abandoned. So the monitoring activities have been affected. In order to continue the monitoring of the marine fisheries resource for proper management, research vessels are essentially required. External assistance for procurement of research vessel will be of great help for management of the marine fisheries resources in Bangladesh.

Development of Fishing Technology

Since 1960s, government took up some projects/programmes for development of marine fisheries, which include mechanization of fishing boats, introduction of nylon twine nets and introduction of industrial fishing by trawlers. Though people were initially reluctant towards mechanization, it was gradually popularized and after liberation of the country mechanization of fishing boats expanded
rapidly with more people coming in marine fisheries. Presently about 21,000 mechanized and about 22,500 non-mechanized boats with some 0.5 million fishers are engaged in coastal water upto 40 metre depth (DOF, 2005).

Having indication of sizable stock of demarsal fishes in Bay of Bengal industrial fishing by trawlers was initiated in 1972 by BFDC with 10 trawlers as grant donated by the then USSR Government. Subsequently private sectors, in some cases with foreign collaboration became encouraged in industrial fishing by imported trawlers in the Bay of Bengal. It grew rapidly because of high demand and price of shrimp in foreign markets. Presently 46 shrimp trawlers 56 fish trawlers are engaged in the marine waters of Bangladesh.

**Resource Allocation and Exploitation Status**

Towards the policy objectives of marine fisheries for economic growth, poverty reduction and social development, the strategy in marine fisheries are primarily to protect, conserve and exploit the resource at MSY level as well as to protect the interest of poor through allocation of resources for industrial fishing by the rich and small scale artisanal fishing by the poor. The policy strategies have been reflected in the marine fisheries laws/regulations.

As per regulation of the country the trawlers are to operate beyond 40 m. depth while the coastal water up-to 40 m depth is allocated for small scale fishing by mechanized and non-mechanized sail/boats (MOFL, 1983). The industrial fishing vessels are bottom trawlers harvesting the demersal fishes/shrimp upto 100m. depth. But the trawlers are reported to have encroached this boundary below 40 m. depth zone assigned for artisanal fisheries for better catch of shrimp which are not much exploited by artisanal fishing. Some species of shrimp such as brown shrimp is reported to be under exploited in the below 40 m. depth zone.

The industrial fishery contributes only 7.0 per cent while artisanal contributes about 93 per cent of the marine catch (DOF, 2006a).

Small scale artisanal fishery constitutes mostly gill net fishery, set bag net fishery and long line fishery. Gill nets operated by mechanized boats constitutes the major fishery contributing about 58 per cent of total artisanal catch and 54 per cent of the total marine
catch followed by set bag net fishery mainly operated by non-mechanized boats contributing 32 per cent of total artisanal and 30 per cent of the total marine catch. Long line fishery operated by both mechanized and non-mechanized boat contributes 5.9 per cent of the total artisanal and 5.5 per cent total marine catch. Estuarine set Bag Nets (ESBN) and push net used for catching shrimp fry are very harmful as of the use of those gears destroys huge quantity of larvae, fry and juveniles of many fishes, shrimp and other aquatic fauna.

**Problems and Constraints**

Increasing fishing pressure in the artisanal fishery is the major problem and challenge that have already indicated signs of over exploitation and stock depletion of some species in the marine water. Destructive fishing gears particularly estuarine set bag nets (ESBN), that mainly harvest small fries and juveniles of almost all fishes, shrimp and other agnatic organizations. Though the resource boundary is demarked for industrial fishery beyond 40m depth zone, but there is frequent encroachment of the boundary by industrial fishing vessels into the zone (upto 40 m) assigned for artisanal fishing by the poor. Quite a good quantity of trash fish (less valued fish) is discarded by mainly shrimp trawlers as carrying trash fish is not economically viable compared to carrying valued fish and shrimp. Against a total landing around 30,000 m. ton of fish and shrimp, about 30,000-40,000 m.ton trash fish is discarded every year, which is great loss of resources (Khan, Gias, 2005). Mechanism/technology needs to be developed to make the use of trash fish economically viable.

Major constraint in the marine sector is the lack of reliable information on the fish stock particularly of the deep-sea pelagic stock for judicial exploitation and management of the resources. Due to institutional weakness particularly shortage of the manpower, lack of funds and other logistics, the marine fisheries regulations cannot be enforced properly for protection and conservation of the resources. Monitoring and surveillance programme could not be performed efficiently because of the shortage of manpower and logistic support including a research vessel. Poaching/unauthorized fishing by foreign vassals, marine pollutions by oil spill from ships,
dumping waste, exploratory activities for oil/minerals etc are the major threats to the marine resources. Lack of coordination among different Government agencies is a hindrance in the management of the marine fisheries. Because of lack of awareness of the fishers about the need of conservation and management of fisheries resources, the illiterate, unorganized and poor fishers indulge in destructive fishing and over fishing and tendency of violating regulation. Besides the fishers' lives and properties are very much vulnerable to risk by piracy and natural calamities such as cyclones, tidal surge etc. There is no provision of insurance of lives and properties of the marine fishers though they are exposed to risk and hazards in the sea.

In view of the above, the immediate needs for development and management of the marine resources include (i) assessment of fish stock in all area including deep sea pelagic resource in particular, (ii) determination of exploitable stock at optimum level, (iii) control fishing pressure (fishing effort) through licensing/registration of artisanal fishing boats, (iv) gradual elimination of harmful gears like set bagnet through rehabilitation of set bagnet fishers in other type of fishing or in other occupation, (v) developing mechanism/device (gear) for exploitation of under exploited resource such as white shrimp within 40 m depth zone, (vi) strengthening enforcement of marine fisheries law and regulations, and (vii) strengthening surveillance of marine fisheries.

Japan's cooperation may be very useful to meet many of the present needs of marine fisheries of Bangladesh particularly assessment of deep sea pelagic resource through exploratory survey.

6.2.5. Aquaculture

Aquaculture in man-made freshwater domestic ponds with Indian major carp is an age old practice of fish production for artisanal and recreational purpose. With increase of demand by the rapidly growing population and stagnation or decrease in inland capture fisheries, aquaculture received much attentions for its development since 1960s. Shrimp farming by trapping shrimp juveniles in earthen dyked tidal inundated area in coastal region in the grater district of Khulna was also in practice in Bangladesh. This type of shrimp
culture was called as “Bheri” culture. By now aquaculture both in fresh water the ponds and brackish water area have developed significantly during the last two and a half decades. The country has great potentials of aquaculture for increasing fish production for the country’s economic and nutritional development and poverty alleviation. Presently, both freshwater aquaculture in manmade ponds and other closed water bodies and brackish water aquaculture mainly shrimp culture in the impoundment in the coastal region are in practice in Bangladesh. More attention has been paid for aquaculture development than other sector. However, mariculture has not yet developed in Bangladesh, though there is scope of mariculture, particularly some of some first growing species of fish like sea bass (*Lates calcarifer*).

**Freshwater Aquaculture**

Though aquaculture is an age old practice in Bangladesh, the culture technique was very primitive and traditional in nature with stocking carp fry collected from natural waters. Production rate was very low. However, freshwater aquaculture in the manmade ponds and other closed water bodies has developed significantly during the last two and half decades due to introduction of improved technology of aquaculture, seed production technology, extension activities, and other public sector interventions and incentives.

Government policy envisages promotion of environment friendly sustainable aquaculture for improvement of socioeconomic condition of the poor, poverty reduction and increase of per capita fish consumption. Along side the Government support, many NGOs have been involved in aquaculture development mainly with the poor and landless. Towards development measures Government has implemented many development projects supported by international and bilateral agencies such as ADB, WB, IFAD, UNDP/ FAO, DFID, DANIDA.

Freshwater aquaculture production has increased on an average @ 31 per cent per annum over the last 20 years (see Figure 6.2). Per hectare production has increased from 735 kg/ha in 1983-84 to 2609 kg/ha in 2003-04 with maximum production around 8 ton/ ha/yr (DOF, 2004).
Aquaculture Resources

Almost all well to do households in rural Bangladesh have manmade ponds which, in the past, were dug for multipurpose uses including fish culture at artisanal and recreational level. According to a survey conducted during 1983, the country has 1.3 million manmade freshwater ponds measuring 0.147 million ha of which 52 per cent ponds were under fish culture, 30 per cent cultivable and 18 per cent derelict. The culturable and derelict ponds were not used for aquaculture due to lack of awareness, lack of knowledge of fish culture, lack of fund, multiple ownership etc. About 94 per cent of the ponds are owned by the private sector and the remaining 6 per cent are owned by government as khas jalmohal (meant for fisheries) and water bodies owned by different government, semi government organizations and institutions. Department of fisheries has recently made an estimate of fresh water aquaculture area to be 0.3 m. ha including ditches, road side burrow pit and other closed water bodies. However, a systemic survey is required to know the exact area under fresh water aquaculture and the aquaculture status.

Significant development has taken place during the last two decades in aquaculture in respect of culture technology/productivity and expansion of culture area through development of culturable and derelict ponds into cultured pond and excavation of new ponds.

Aquaculture Practices

Aquaculture system in majority of the domestic ponds with multiple uses is extensive to improved extensive type at subsistence level to semi-commercial level. However many entrepreneurs have come up for commercial purpose using semi-intensive and intensive type of aquaculture. Aquaculture is more profitable than agriculture and as such it is now being practiced commercially by converting agriculture land into fish ponds.

Aquaculture has a breakthrough with introduction/development of poly culture of Indian carps and exotic Chinese carp and sufficient availability of good quality seed produced through hypophysation technique of major carp and other fishes since 1980s. Along with carp, other first growing fishes like Thai Pungas (P. suchi), Thai Sarputi (Puntius gonionotus), African Magur (C.
gariepinus), Thai Koi (Anabas testudineus) have found ways in the aquaculture system of Bangladesh. Thai Pangus and Thai Sarputi are being widely cultured. African Magur has lost its popularity due to its omnivorousness and ugly appearance. As many as 15 species of fish are being used for aquaculture. The aquaculture species are as follows (Ali, 1989; DOF, 2005):

- Rui (Labeo rohita)
- Catla (Catla catla)
- Mrigal (C. mrigala)
- Kalibous (L. calbasu)
- Silver carp (Hypopthalmichthys molitrix)
- Common carp (Cyprinus carpio)
- Mirror carp (Cyprinus carpio, var – specularis)
- Grass carp (Ctenopharyngodon idellus)
- Bighead carp (Aristichthys nobilis)
- Black carp (Mylopharyngodon piceus)
- Thai Pangus (Pangasius suchi)
- Thai Sarputi (Puntius gosionotus)
- Tilapia (Oreochromis mossambicus and niloticus)
- African Magur (Clarias gariepinus)
- Thai Koi (Anabas testudineus)

Cage fish culture and pen fish culture have been in practice in the recent years but are not much developed. Pen culture are undertaken in roadside canals and semi closed water bodies mainly in rainy seasons. Cage culture with Thail Pangas and Tilapia is practiced at small scale levels. The technology of cage culture is yet to be developed.

Besides, culture and trading of different ornamental fishes mostly imported have developed at small scale level mainly in the urban area through private initiatives. Public sector initiative for development of ornamental fishes is lacking.

**Fish Seed Production and Infrastructure**

For promotion of fresh water aquaculture lot of infrastructures have been developed both in public and private sector. Government has established 112 fish seed farms in different locations of the country since early 1960s to raise fish fry/fingerlings from carp spawn/hatchlings collected from rivers for distribution to farmers and to demonstrate the technology.
Freshwater aquaculture was almost entirely dependent on wild fry collected from rivers. Hatchlings (3-5 days old carp fry) collected from rivers were raised to larger size (fingerlings) in nurseries mainly by private sector for subsequent stocking in culture pond. That practice continued till 1980 when seed production technology through induced spawning of carp was developed and introduced. The induced spawning technique was first developed in 1965 by the research wing of DOF, which gradually refined and commercial production was possible by early 1980.

Subsequently carp hatcheries were established in the Government farms for producing spawn/hatchlings through hypophysation technique. Besides few large fish hatcheries have been established at public sector for distribution of spawn/hatchling to private nursery operators. Gradually private sector has taken up the hatchery technology. Now fish seed production is almost entirely in the private sector. In the public sector, there are 6 large fish hatcheries and medium to small hatcheries in some of the 112 fish seed farms with nursery facilities for raising fingerlings, while in the private sector there are about 756 hatcheries producing 138.09 billion spawn/hatchlings (about 98.6 per cent of the total hatchling production) and the rest (1.4 per cent) is produced in the public sector. Collection of carp hatchlings from natural water has reduced drastically due to over exploitation and degradation of fish habitats. Presently only 0.24 billion hatchlings are collected from the natural water. There are about 7057 nurseries in private sector which annually produce 5030 million fry/fingerlings. Public nurseries in the fish seed farms and large hatchery complex produce some 20 million fry/fingerlings annually (DOF, 2005). Production of fish seed is more than sufficient to meet up the need for aquaculture, but, inspite of that, there are problems regarding quality of fry and distribution in remote areas.

Problems and Constraints

The hatcheries and nurseries have developed mainly in the surrounding of urban centres and along major roads. Distribution of fingerlings in remote areas appears to be insufficient due to poor communication systems in remote areas. Unplanned hybridization and use of unhealthy/dwarf brood fish in hatcheries have been found
to produce fries with slow growth and disease proneness which is a threat to aquaculture. This is due to ignorance of the hatchery operators and their high ambitious commercial motives. Government has taken up awareness programme for maintaining good brood stock and has established brood banks for supply of quality broods to the private hatcheries.

Fish disease is still not any problem in freshwater aquaculture except the epidemic disease “Epizootic Ulcerative Syndrome” that broke out in 1988 in all waters including fishponds and caused heavy loss to the fish farmers. This disease has now subsided. Natural calamities particularly floods affect aquaculture. Unusual high flood causes inundation of fish ponds causing heavy loss to the fish farmers.

There is no law to regulate and control aquaculture for proper management, except the Tank Improvement Act 1939 aiming at bringing all ponds under fish culture. According to the act no pond can be left without fish culture. If any pond owner fails to undertake fish culture in his pond, Government would take over the control of the pond and lease out to any interested person for fish culture but it is very difficult to implement the Act. Multiple ownership of pond in many cases become barrier to fish culture.

**Brackish Water Aquaculture**

Brackish water aquaculture mainly with shrimp is an important commercial activity in the coastal region of Bangladesh. It has emerged as an export oriented industry during the last two and half decades following the high demand and price of shrimp in the international market including suitable environment and government incentives and investment including trade liberalization and market promotion etc. Shrimp farming contributes significantly to country’s economy, export earning, employment generation and livelihoods. Shrimp is the second largest export earning item contributing about 4.2 per cent of the country’s total export earning and 93 per cent of sectoral (Fisheries sector) export earning. Currently (2003-04) the country has earned US $362.86 million annually from export of shrimp. Shrimp aquaculture and related activities provide employment of about 1.05 million people (Fisheries sector review 2002-03).
The shrimp sector has developed rapidly during this period both horizontally and vertically. It has increased by 14 per cent in respect of farming area and 39 per cent in respect of production per year during the last 20 years (DOF 2005, Muir 2003).

**Shrimp Farming Area**

Bangladesh has about 2,50,000 ha coastal area suitable (tidally inundated) for brackish water shrimp farming. Out of the total suitable area, presently about 170,000 ha area is under brackish shrimp farming mainly in the districts of Satkhira, Khulna, Bagerhat and Cox’s Bazar. The land used for shrimp farming is mostly privately owned (about 90 per cent) and were earlier used for rice cultivation or salt production except some government owned poor mangrove area in Cox’s Bazar area leased to private sector shrimp farming. Along side the brackish water aquaculture, freshwater shrimp (M. rosenbergii) farming in both coastal and fresh water area was introduced and developed rapidly. Presently about 30,000 ha area is under fresh water shrimp farming (DOF, 2005; Muir, 2003).

**Shrimp Farming Practices and Development**

Initially, the farming system was most primitive and traditional by trapping shrimp juveniles in inundated large impoundment and the production rate was very low.

Aquaculture technology improved gradually and selective stocking with shrimp fry (P. monodon) collected from natural waters was introduced. Culture system improved from traditional to extensive and improved extensive type of aquaculture. Presently 80-85 per cent farming area is under extensive type of culture with production from 150 kg to 300 kg/ha/yr while 15-20 per cent farm are under improved extensive culture with production varying from 400 kg-1000 kg/ha/yr (Karim, 1999).

Semi-intensive farming introduced in about 1000 ha during early 1990s was abandoned due to outbreak of viral disease caused due to stocking of diseased fry imported from Thailand. Farming practices are mostly eco-friendly and organic in nature but the productivity is quite low compared to other countries like India
Table 6.7: Shrimp Culture System/Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Stocking and Practices</th>
<th>Area</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Trapping fry with no feed and no fertilization</td>
<td>Mixed up</td>
<td></td>
</tr>
<tr>
<td></td>
<td>extensive type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extensive</td>
<td>Selective stocking @ 1-3 PL/m2 with no feeding and no fertilization</td>
<td>80-85 %</td>
<td>150-300 kg/ha</td>
</tr>
<tr>
<td>Improved extensive</td>
<td>Selective stocking @ 4-5 PL/m2 with regular feeding and fertilization</td>
<td>15-20%</td>
<td>400-1000 kg/ha</td>
</tr>
<tr>
<td>Semi intensive</td>
<td>Selective stocking @ 25-40 PL/m2 with intensive feeding and fertilization, control water management by pumping, aeration</td>
<td>Almost Nil</td>
<td>400-8000 kg/ha</td>
</tr>
</tbody>
</table>
and Thailand. Presently the country produces 63,000 m. ton. of brackish water shrimp and about 12,000 m/ton of fresh water shrimp (m. rosenbergii) annually (Muir 2004, DOF 2005). There is enough scope of increasing the productivity through improvement of culture technology and thereby to increase the export earning of the country.

**Shrimp Seed Production**

Till mid 1990s shrimp farming was entirely dependent on wild fry collected by thousands of men, women and children usually ousted from agriculture due to shrimp farming. Some 444,000 people were engaged in fry collection and about 4000 million shrimp fry were collected. This practice, has, however, decreased due to ban on wild fry collection and development of shrimp hatcheries producing sufficient shrimp fries. In collecting one target fry of Bagda/galda, another 100 or more aquatic organisms of fish, shrimp etc. are destroyed which is a great threat to fish and shrimp stock and biodiversity. Realizing this harmful effect of wild fry collections Government banned shrimp from collection in 2004. But it was very difficult to implement the ban which would adversely affect livelihoods of fry collectors without any alternate job opportunities. Presently about 46 Bagda hatcheries and 18 Golda hatcheries have been established which are restrictively producing about 3050 million Bagda PL and 50 million Galda PL. In spite of sufficient availability of hatchery produced PL, farmers prefer wild fry for better growth (DOF, 2005; Rahman, et al. 2006).

**Problems and Constraints**

Despite of significant benefits in the country’s economy, employment generation, export earning and livelihoods, shrimp farming has been associated with, social and environmental and marketing problems.

The rich and powerful people from outside of the locality started commercial shrimp farming by taking lease of rice field from the agri-farmers. Sometimes they would take over the possession of the land forcefully. The share croppers and agri-labourers were ousted from the job. Agri farms were affected by saline water leached
out from adjacent shrimp farms. All these created social problems. However, in subsequent time, with the involvement of land owners in shrimp farming and creation of alternate job opportunities, the social problems have subsided to a great extent. Increase of soil and water salinity, loss of cattle growing area, destruction of some poor mangroves at early stages of shrimp farming are recognized as some of the environmental problems due to shrimp farming. However, measures have already been taken to keep the adverse impacts of shrimp farming as minimum as possible.

The shrimp farming and related industries are facing many problems. Major problems in shrimp farming is the white spot viral disease that broke out in 1994-95 as a great havoc and caused heavy loss to the productivity and to the farmers and finally to the country’s economy and is still causing harms to shrimp farming every year at different degrees. Other problems that the sector faces are the fluctuation and fall of price in international markets, poor culture technology and low productivity, natural calamities, transportation of hatchery produced shrimp PL from Cox’s Bazar to Khulna where about 80 per cent of the farms are located and meeting buyers’ requirements such as implementation of HACCP and traceability. The sector is constrained by lack of regulatory framework of farming and hatchery operation, lack of sufficient manpower in the Department of Fisheries for extension service and enforcing quality control laws/regulations of fish and fish products for export.

Sustainability of export oriented shrimp farming and industry depends mainly on the foreign markets, particularly the acceptability of the products by the buyers/consumers in respect of quality and safeness of the products; and environmental, biodiversity and social issues that relate to the production and processing of the products. In ensuring quality and safeness, the HACCP, traceability and TED (Turtle Excluder Device) in Fishing Trawler as measure for conserving an endangered species of Turtle) programs imposed by the main buyers of shrimp – the EU countries and USA, have been the major threat to the shrimp farming industry towards sustainability. However the HACCP programme has been successfully implemented but the traceability of the products for export is yet to be implemented. Implementation of traceability is very difficult and involves sufficient manpower and other support.
**Sustainability of Shrimp Farming in Bangladesh**

A suitable environment for shrimp farming is a comparative advantage in Bangladesh. The advantages for shrimp farming is stimulated by high demand and high price of shrimp in foreign markets and nevertheless by traditional knowledge of farming including technological development globally, Government policy support and incentives including trade liberalization.

Viral disease that broke out in 1994 has been a continuing major threat to shrimp farming, causing heavy losses to farmers. However, with proper management, including hatchery management to produce disease-free fry, the disease can be controlled to a great extent.

Though shrimp farming has developed rapidly and is contributing significantly to the country's economy, but its sustainability being subject to multiple factors has been questionable.

Foreign market is the main determining factor for the sustainability of shrimp farming while the sustainability of foreign market depends on the quality and safety assurance of the products as per buyers requirement including social and environmental factors associated with shrimp farming, processing and trade.

Shrimp farming in Bangladesh is mostly extensive type in nature and as such it has not environmental hazards except destruction of some poor mangrove in the Cox's Bazar in the early stage of shrimp farming in 1980s. Social conflict that arose in the beginning of shrimp farming has subsided due to involvement of local people/land owner in shrimp farming. It has now become socially acceptable economic activity in the country.

The farming system is becoming more environmentally and socially responsible and Government is committed to resolve any social and economic problems and to ensure product quality and safety standards required by overseas buyers. Efforts are also being made by farmers, processors and exporters to be more cautious and responsible in their business affairs to attract foreign buyers and to make the industry sustainable.

To date, the main emphasis in the shrimp sector has been to tap overseas markets. However, another more sustainable option might be to explore the promotion of greater domestic consumption
of shrimp. Bangladesh is experiencing shortages of fish for its growing population and large quantities of fish are imported from India, Myanmar and Thailand. Farm produced shrimp may help to fill part of the domestic gap in supply. So far, domestic measures to improve access to fish and shrimp and enhance food security have focused on freshwater pond fishing. There are no technical reasons as to why such production cannot be extended to both brackish water and freshwater shrimp.

However, for the foreseeable future, shrimp farming in Bangladesh is likely to remain export-oriented as it is price competitive internationally and its relatively eco-friendly character make it attractive to overseas buyers provided quality and safety of the product is ensured as per buyers requirement.

**Pearl Culture**

There are few species of freshwater mussels and marine oyster (Placuna placinta) which bear natural pearls of much economic value. Freshwater pink pearl of Bangladesh is very attractive. Five species of freshwater mussels bear pink pearl. Of them Lamelleta marginalis and L. perreysia are important for pearl production. About 7-10 per cent of freshwater mussels bears natural pearls (Bhuiyan, 1998). A group of people, known as ‘Bede’ (gypsy) extract pearls from fresh water mussels while the pearls from marine oysters are extracted by the fishers and tribal people. Production level of natural pearls is quite low. According to BSCIC (Bangladesh Small and Cottage Industries Corporation), Bangladesh produces about 8 kg. of pink pearls annually. Technology is available in the world particularly in Japan and Philippines for producing pearl by artificial induced technique of pearl production. These countries are producing pearl commercially through applying induced technique. In Bangladesh attempts were made to produce induced pearl in fresh water mussels since early 1960s in the fisheries research station at Chandpur and subsequently a project was undertaken producing induced pearl, but it was not fully successful due to mainly technological deficiency. Japan is advanced in producing pearl through induced technique. Therefore Japan, under the BIMSTEC-Japan cooperation, may assist Bangladesh in developing induced pearl production technology in fresh water mussels and oyster in Bangladesh.
6.3. Marketing and Export/Import of Fish and Fish Products

All fishes/shrimp produced in the country are consumed/used locally except some 80,000 m. ton of fish and shrimp which are exported, that is, more than 96 per cent of the fishes/shrimp produced are consumed locally and the remaining about 4 per cent is exported. The marketing of fish/shrimp is entirely in the hands of the private sector. The local marketing is channeled from the fishers/farmers to consumers through a chain of middleman, known hierarchically, as Faria (wholesalers), Aratdar (stockists) and Mohajons (financiers/money lender). For domestic consumption fishes are marketed fresh and chilled/iced and are not preserved properly. Hence there is quite a high rate of post harvest loss which is about 5 per cent of the total landing. Fish markets including the retail markets are with poor sanitation and hygienic condition due to lack of infrastructure facilities and knowledge of the people involved in transportation and trading. Fish and fish products exported include frozen fish, frozen shrimp, dry fish, salted and dehydrated fish, turtle and tortoise, shark fins and fish maws. Of the exported quantity of fish and fish products, shrimp constitutes 70 per cent and the rest are fish, crab, turtle and tortoise etc. and in terms of value shrimp contributes more than 93 per cent of the total export earning (EPB 2004). Export of fish and fish products have increased rapidly during the last 20 years (Figures 6.4 and 6.5).

Export of fish and fish products contributing about 4.7 per cent to the total export earning of the country is the second highest export item. Export earning from the fisheries sector is presently (EPB 2004) to the tune of US $ 400 million (Shrimp US $ 362, fish US $ 37.14 million).

Major export markets of shrimp are the European countries (52 per cent), USA (38 per cent), and Japan (5 per cent). frozen/iced hilsha is exported to mainly India through land ports. The main determining factor of export market is assurance of quality and safeness of the products, but nevertheless are also the environmental and social issues associated with the production and processing system of the fish and products exported. The government through MOFL and DOF is responsible to ensure quality and hygienic aspects of the fish and fish products for export following the
HACCP method imposed by EU during early 1990s and to issue quality assurance certificate for exports of fish and fish products to EU countries, USA and Japan. The DOF has a quality control and fish inspection wing with three quality control laboratories at Dhaka, Chittagong and Khulna for implementation of quality control regulation, adopted in 1983 and revised in 1997 following HACCP method and to issue quality assurance certificate for exports of fish.
and fish products. Due to non-compliance of HACCP, particularly in processing, EU banned import of fish and fish products from Bangladesh and few Asian countries in 1997. However, the ban was withdrawn after upgrading the processing plants to HACCP standard. Recently EU has imposed a new item namely traceability of the products for export to the exporting countries including Bangladesh, which is yet to be implemented (Atiq, et. al. 2006).

With expansion of export oriented shrimp farming following the high demand and price of shrimp in international markets as many as 130 fish processing plants were established in unplanned way in the private sector without considering the availability of raw materials. Two thirds of the capacity of the processing plants remain unutilized due to shortage of raw materials. Till today as many as 60 processing plants have been developed to HACCP standard. However, other processing plants can export fish and fish products to other countries except EU countries, USA and Japan. Considerable improvement/development has been made both in public sector (DOF) and private sector (Fish processor) in respect of quality control of fish and fish products for export in response of buyers requirements but there are still lot of lackings particularly in public sector. The DOF quality control laboratories are not properly equipped to meet up the HACCP and traceability requirements. The Quality Control and Fish Inspection Wing of DoF is not adequately manned both quantitatively and qualitatively. Technical and financial supports are needed in this field to improve and to make the export sector sustainable.

Bangladesh is known to be a fish exporting country but recently with increasing demand of fish for the growing population fresh fishes in good quantity are being imported from India, Myanmar and Thailand. The imported fishes are reported to have been produced in odd environment and are preserved by chemicals harmful to human body. Quality control measures for the imported fish need to be introduced.

6.4. RESEARCH AND DEVELOPMENT

Research has been considered as an integral part of fisheries development in Bangladesh. Since early 1960s fisheries research
on inland capture fisheries and fresh water aquaculture and fish technology (fish byproduct, nutrition, fish processing and quality control, product development etc.) were initiated under the research wing of the Department of Fisheries. Some tangible achievements were made in research particularly in aquaculture e.g. breeding of major carp through induced spawning was for the first time done successfully and administered and extended all over the country in subsequent period.

Under the government administrative and financial systems, research faced serious problems. So to give more autonomy and flexibility, a separate autonomous research organization namely Bangladesh Fisheries Research Institute (BFRI) was established in 1983 to undertake field need based research. The research institute has four research stations for different disciplines such as aquaculture research, riverine fisheries research, brackish water fisheries and marine fisheries. Since then BFRI has undertaken research in different fields of fisheries and has made significant achievements particularly in developing different aquaculture packages and hilsha fisheries management guidelines with its limited facilities. Many areas are still unattended but the institute is badly constrained by lack of fund to undertake research as per need of the sector particularly in marine and inland capture fisheries development and management and also fish technology. Both financial and technical assistance and cooperation are needed to run research in fisheries sector under the fisheries research institute. Japan may extend cooperation in fisheries research of Bangladesh.

6.5. FISHERIES POLICY AND INSTITUTION

There was no consolidated fisheries policy until 1998 when the National Fisheries Policy, 1998 was formally adopted and declared for the first time. In the past the policies were rather fragmented as adopted as and when required on different issues of fisheries and were in most cases translated into action as ordinance, act and rule and sometimes as executives order of the government. However major policy objectives were sometimes recorded in five year/ two-year development plan, sectoral review paper or sectoral status report. The National Fisheries Policy of Bangladesh 1998 covers all those policies. However some policies such as New Fisheries
Management Policy (NFMP) and the jalmohal (Fishery) Management Policy of MOL for leasing jalmohal are in practice as separate policy though covered under the national fisheries policy. Besides other ministries such as Ministry of Water Resource, Ministry of Forest and Environment and Ministry of Land have recently adopted policies related to fish habitats conservation and development.

The major policy objectives of the government in fisheries sector as are envisaged in the national fisheries policy of MOFL adopted in 1998 are as follows:

(i) Development of fisheries resources and increase of fish production.
(ii) Poverty alleviation through creation of employment opportunities and improvement of socio-economic condition of fisher community.
(iii) Meet the national demand for animal protein.
(iv) Increase foreign exchange earning and economic growth through export of fish and fish products.
(v) Maintain environment balance, protect biodiversity, and improve public health.

Fish production, harvesting and marketing are almost entirely in the hands of the private sector while the Government’s responsibility is promotional and regulatory.

In the past, the Government policy for land use, water resource and agriculture was exclusively focused to grow more food through agriculture development ignoring other uses of wetlands and floodplains such as fisheries, aquatic plants, forests, navigation, etc. These policies negatively impacted on the other uses. On realizing the consequences, the Government has adopted a number of policy changes during recent years. Now the importance of fisheries and environment has been recognized and reflected in the water resource policy of MOWR, land use policy of MOL, agriculture policy of MOA and environment policy of MOEF.

6.5.1. Legal Frame Work

There exist a set of acts, ordinance, laws and rules for protection, conservation, development and management of fisheries resources.
The following are the existing Acts, ordinance, laws and rules.

(i) The Protection and Conservation of Fish Act 1950 and Rules for conservation and management of inland fisheries.

(ii) The Tank Improvement Act 1939 for bringing the ponds (Private ponds not used for fish culture) under fish culture by law.

(iii) The Marine Fisheries Ordinance and Rule 1083 for protection, conservation and management of marine fisheries.

(iv) The Fish and Fish products (Inspection and Quality Control) Ordinance 1983 and Rule 1997 for post harvest quality control and safety assurance of fish and fish products for local consumption and export.

(v) Law for Ban on import of shrimp fry.

(vi) Law for Ban on collection of shrimp fry from natural waters.

(vii) Law for introducing Turtle Excluder Device (TED) in fishing trawlers.


(x) Shrimp Farm Taxation Law, 1992.

There is no law to regulate the aquaculture activities both in freshwater and brackish water aquaculture including technical and environmental issues. However the existing laws/rules are not properly enforced mainly due to lack of sufficient manpower and logistic with the implementing agencies.

6.5.2. Institutional Framework

All water bodies, except seasonally flooded private paddy field and some of the manmade ponds, are owned by the Government. The Government owned inland water bodies (rivers, canals, beels, oxbow lakes etc.) are known as jalmoahals and since 1950 have been controlled and managed by the Ministry of Land (MOL) with the aim of collecting Government revenue by leasing out fishing rights. Since 1995 leasing of jalmoahal in flowing river has been cancelled and fishing has been declared open and free. The Ministry of Fisheries and Livestock (MOFL) is responsible for management, development and conservation of the fisheries resources for sustainable yield from the fisheries- both in inland and marine water.
Jalmohals measuring up to 3 acres and with an annual lease value of up to Tk. 5,000 have been placed under Union Parishad since 1987 for common use by the local people for drinking, bathing, fishing, retting jute, etc. All closed/semi closed water bodies (ponds and closed beel) measuring 3-20 acres have been placed under the Ministry of Youth and Sports for leasing to registered youth cooperatives to create income opportunities. Water bodies measuring above 20 acre are retained with the MOL for revenue oriented management through leasing by tender with a preference for fisher cooperatives. During 1986-1995 some 257 jalmohals above 20 acres area were placed under the New Fisheries Management Policy (NFMP) implemented by MOFL & MOL jointly through licensing fishing rights directly to the “genuine fishers” by abolishing the middleman who generally exploit the poor fisher. With declaration of open access to flowing river fisheries with no revenue collection, the NFMP experiment was practically abandoned. But in 1998 some 31 jalmohals have been placed under NFPMP and are continuing. Besides selected jalmohals are as and when required transferred to the MOFL for development and management under different development projects of DOF. The water bodies falling within the Sundarbans reserved forest are currently managed by the Department of Forest. Fishing access to marine waters is open to all with paying licensee fees to Government (DOF).

Bangladesh Navy and Coast Guard play an important role in protection and conservation of marine fisheries resources in the EEZ in addition to DOF. They are engaged to guard marine fishing against illegal fishing by foreign vessel in implementing marine fisheries laws and regulations.

All activities of production, harvesting marketing and utilization were in the hands its private sector while government’s role is promotional and regulatory for formulating policy and regulation for development and management of fisheries resources for which the MOFL with its different organizations is responsible. Other related agencies involved in fisheries sector are the MOL, MOWR, MOEF, MOC, MOD, MOFP, MOA, Banks, Donors, CBO, NGOs etc.

The Ministry of Fisheries and Livestock is the lead agency responsible for formulating fisheries policy and strategies for proper management and development of fisheries resources for sustainable
fish production. Under the MOFL, there are four agencies (i) DOF, (ii) BFRI, (iii) BFDC, and (iv) Marine Fisheries Academy. Of these DOF has the relevant functions and responsibilities for development and management of fisheries and aquaculture.

Amongst other agencies involved in the fisheries sector, the MOL has the key role as it controls all the public water bodies. The Bangladesh Water Development Board and Local Government Engineering Department are mainly responsible for water management for its proper use while the Ministry of Forest and Environment is responsible among others for protection and conservation of environment and ecology including control of pollution. In the private sector, CBOs (Fishers cooperative societies) and many NGOs are involved in fisheries sector.

6.6. INTERNATIONAL AND BILATERAL COOPERATION IN FISHERIES SECTOR: BANGLADESH

The sectoral developments that initiated since 1960s got full impetus after liberation of the country in 1971. Development activities in fisheries sector were undertaken through different development projects/programmes supported both financially and technologically by different international and bilateral donors in different fields of fisheries sector. Major donors of fisheries sector are WB, ADB, IFAD, FAO/UNDP, UNICEF, DFID, DANIDA, JAPAN (JICA), USAID etc. (Table 6.8).

Among the donors, Japan was the pioneer to support the fisheries sector of Bangladesh with assistance in exploratory survey of fisheries resource in the Bay of Bengal during 1958-60 which provided valuable information about the stock of marine fish and shrimp which formed the basis for development of marine fisheries in Bangladesh. For development of fishing technology Japan participated in joint venture programme for exploitation of marine fishes during 1978-83. For marine fisheries research and development Japan provided a research vessel (Anusandhani) as grant and equipment for marine fisheries research during early 1980s. With Japan's grant on turnkey basis a modern fish landing jetty has been constructed at Chittagong. Japan provided support in education and training in the past for development of manpower in fisheries sector.
Table 6.8: International and Bilateral Development Partners in Fisheries Sector Development

<table>
<thead>
<tr>
<th>Field of support/cooperation</th>
<th>Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inland Capture Fisheries</td>
<td>WB, ADB, DFID, FAO/UNDP, Denmark</td>
</tr>
<tr>
<td>Freshwater Aquaculture</td>
<td>ADB, WB, DANIDA, FAO/UNDP, UNICEF, IFAD</td>
</tr>
<tr>
<td>Brackishwater Aquaculture</td>
<td>WB, DFID, BOBP</td>
</tr>
<tr>
<td>Marine Fisheries</td>
<td>FAO, UNDP, Japan, DANIDA, USSR (former) FAO/UNDP, EU</td>
</tr>
<tr>
<td>Quality Control and Fish Processing</td>
<td>FAO/UNDP, EU</td>
</tr>
<tr>
<td>Education and Training</td>
<td>DFID, USAID, FAO/UNDP, JAICA</td>
</tr>
<tr>
<td>Research</td>
<td>WB, FAO, UNDP</td>
</tr>
<tr>
<td>Fisheries Infrastructure</td>
<td>Japan, WB, ADB</td>
</tr>
</tbody>
</table>

Source: DOF

The major needs of fisheries sectoral development are (i) assessing the status of fisheries resources both in inland and marine fisheries with a strong monitoring system, (ii) technology development through research and studies, (iii) development of quality control system with manpower and equipment, (iv) financial support for development and management of fisheries sector as a whole, and (v) above all, proper development and management policy strategies and their implementation focusing on community empowerment and involvement.

6.7. AREAS FOR COOPERATION WITH JAPAN IN BANGLADESH FISHERIES SECTOR

In the historical perspective of Japan's cooperation and assistance in fisheries development in Bangladesh, Japan, under the BIMSTEC-Japan cooperation, may also extend its support to the present needs in the fisheries sector of Bangladesh as have been highlighted in the previous sections. The probable fields where Japan may extend cooperation and assistance are as follows:

(i) Financial and technical assistance for fisheries resources survey
(inland and marine) including assessment of deep sea pelagic resource in the Bay of Bengal in particular
(ii) Assistance for monitoring of marine fisheries resource including provision of research vessels
(iii) Study for development of fishing technology (fishing gear/fishing technique) for exploitation of under exploited species in the inshore water upto 40 m. depth and also for reducing destruction fish fry, larvae etc.
(iv) Study for determining size of fishing effort for MSY in the marine Artisanal sector
(v) Sea ranching for replenishing over exploited species like P. monodon.
(vi) Infrastructure development – Fish and shrimp landing centres, particularly a fish landing-cum wholesale fish market at Dhaka city and also in large cities with all facilities for maintaining sanitation and hygienic condition.
(vii) Assistance for improvement of quality control laboratory of DOF with equipment and training of personnel including assistance in establishing HACCP and Traceability system in Bangladesh.
(viii) Development of mariculture technology including breeding and culture system of local species of fishes.
(ix) Development of pearl culture technology through technical and financial support including training of manpower
(x) Financial assistance to develop improved brackish water shrimp culture system for increased production, improving socioeconomic condition of the fishers, awareness raising, empowerment and creating alternate job opportunity for the fishing communities to reduce fishing pressure.
(xi) Assistance and cooperation to undertake research and for institutional development, including development of manpower through training and education.

Japan’s cooperation (mainly the financial assistance) may also help strengthening and executing the mutual cooperation among BIMSTEC countries particularly for development and exchange of technology. There are expertise and technology available in BIMSTEC countries particularly India, Thailand and Bangladesh for mutual exchange and cooperation. However, from Bangladesh perspectives, the following fields are considered pertinent for
cooperation among BIMSTEC countries: (i) Cooperation in sharing water of international rivers particularly the Ganges water between India and Bangladesh, (ii) Unauthorized fishing on cross boundary areas of BIMSTEC countries in the Bay of Bengal, (iii) Exchange of technology in the field of fisheries development management, aquaculture and related fields, (iv) Trade cooperation: Explore and develop trade of fish and fish products among BIMSTEC countries including quality assurance of fish and fish products traded among BIMSTEC countries, (v) Management of shared stock of fish in the Bay of Bengal.

Bangladesh has already developed technology in the fields of fresh water fin-fish aquaculture and freshwater fish hatchery operation, community based co-management of fisheries both in inland and coastal fisheries, culture based community fisheries in seasonal flood plain and fisheries village approach of fisheries extension system, which have been tested and operated successfully with positive outcome. Bangladesh can provide technical cooperation in those fields to BIMSTEC countries where needed.

6.8. CONCLUSIONS AND RECOMMENDATIONS

Fisheries sector plays vital role in the economy, employment generation and nutrition supply in people's diet in Bangladesh. There has been an overall significant growth in this sector during the last 3 decades though inland fisheries which was, in the past, the major source of fish production, contributing more than 90 per cent of country's total fish production and supporting livelihoods of million of the poor, has declined during the same period due to over-exploitation and loss and degradation of fish habitats as a consequence of development intervention and natural causes in absence of proper fisheries management of practices. As a consequence livelihoods of the poor and the biodiversity have been affected. However, there exist challenges, opportunities, problems and constraints centering to sustainable development of the fisheries sector. Because of the complex nature of the inland capture fisheries and involvement of poor and landless people for their livelihoods, it is very difficult to take regulatory measure in the inland fisheries for its proper management. Again the gradual loss and degradation
fish habitats due to siltation caused naturally and also due to human activities for agriculture development is the major challenge for inland fisheries and it is very difficult or next to impossibility to face the challenge. However, by taking all possible development and management measure very rightly and properly, it may be possible, at least to sustain the present level or to enhance to a little extent. This would require sufficient amount of development and management efforts in the light of the present policy approach of community based co-management of fisheries including establishment of fish sanctuaries along with possible measure to protect and develop the fish habitats and enforce of fisheries and environment regulation/laws. The fresh water aquaculture has got a momentum of development and there is still scope for further improvement in this area through further expansion towards commercialization and technological improvement. The major problem in the aquaculture now encountered is the inbreed and hybridization in fry production in hatcheries that is likely to induce retarded growth and susceptibility to disease. Intensification of culture practice may also lead to disease out break in fish-ponds, which to counteract good management and eco friendly culture practices are needed.

Shrimp farming has much scope of development particularly in enhancing productivity with little or no social and environmental implication. Fresh water shrimp farming has more scope of development and expansion throughout the country. Disease and low production are the major problem/ constraint in the shrimp farming. Technological improvement in culture system with good management practices is the major development need of this sector. The situation is fully realized by both public and private sector involved in the shrimp farming industry. The major challenge of this sector (Shrimp farming and industry) is ensuring proper quality and safety of products including social and environment issues related to shrimp for its continued access to international markets which is the main determining factor for the sustainability of the sector. In order to ensure sustainability of the shrimp farming, all stakeholders including the public sector, farmers, processor and exporters need to be committed to maintain code of conduct for responsible farming and good management practice including
implementing of HACCP and Traceability at all level of the industry from farming system to shipping for export.

There has been a gradual and steady growth of marine fisheries during the last three decades. Marine fisheries resources have been exploited in the coastal and inshore water upto 100m depth based on the information of the stock assessed at different times during the period from 1960s to mid 1980s. Marine catch data show that the present catch has exceeded the estimated harvestable stock, which gives rise to doubt about the reliability of the data. However, there is indication of decline of stock of some species of shrimp as is revealed from CPUE. Reliable information is necessary for judicious exploitation of the resources for proper management. Besides information on pelagic stock in deep area still remain unknown though there is indication of the presence of pelagic fishes like tuna, meckeral etc in deep sea which need to be assessed properly for commercial exploitation. DOF does not have any research vessel for regular monitoring of the fishers resources status on the sea. The research vessel provided by Japan as grant is now out of order and the repair of it is not cost effective. DOF is also constrained by sufficient manpower for enforcing the marine fisheries laws. Increasing fishing pressure in the marine artisanal sector is a major threat to the resource resulting reduced catch and affecting fishers livelihood in absence of any alternate job opportunity.

In summary, the fisheries sector of Bangladesh along side the potential of development is infested with host of problems, constraints and challenges that need appropriate measures to remove those for sustainable development of the fisheries of Bangladesh and in this context some recommendations are outlined below:

- Community based co-management (government and community) system be introduced in the inland capture fisheries.
- Fish sanctuaries be established in suitable water bodies and managed through community involvement.
- Where and as far as possible, silted up water bodies (beels and link canal) be excavated.
- Use of agro-chemicals be reduced to control water pollution.
- Where feasible, fish pass or fish friendly sluice gates be introduced as control structure in river channels in BWDB
flood control embankment. Existing sluice gates be operated/managed in fish friendly ways to facilitate migration of fishes between rivers and floodplains.

- Long term leasing system of jalmohal for biological management be introduced instead revenue oriented short term leasing system.
- Fisheries laws and regulations for both inland and marine fisheries be enforced properly.
- For coastal fisheries conservation, management and development, community based management system be introduced through awareness raising, organizing and empowering the fishing community. Marine reserve be established and sea ranching programme for depleted stock be launched.
- Fishing effort be regulated in the light of the fish stock particularly in the marine artisanal fisheries sector.
- Assessment of stock in all marine waters including deep sea pelagic resource be made on priority basis for judicious exploitation of the resources on sustainable basis.
- Development of fishing/gear technology be made for exploitation of under exploited resources and also to reduce over-exploitation and destruction of resources.
- Aquaculture including hatchery operation be brought under regulation/laws to control inbreed problem and unplanned hybridization, environmental hazards and disease.
- Encourage regional and bilateral dialogue on water sharing with neighbouring countries under BIMSTEC.
- Code of conduct of responsible fisheries and aquaculture and good management practices be ensured at all stages including technical, economic, social and environmental issues.
- Quality and safety of fish and fish products both for export and local consumption be ensured. Market infrastructure with proper hygienic, sanitation and other facilities be developed.
- Appropriate policy and strategy for management and development fisheries including their implementation be adopted and continued.

In many of the above fields of action, financial and technical assistance are needed from external sources in addition to the government support. Along with other major donors, Japan's
assistance and cooperation in the fields mentioned above will be of great help for fisheries sectoral development in Bangladesh.

REFERENCES


Begum, Ferdous Ara, 2005. Fish Culture in Floodplain. Souvenir of Fish Fortnight 2005 DOF.


DOF (1985). Water Area Statistics of Bangladesh

DOF 1999. A Brief on Department of Fisheries, Government of Bangladesh.


DoF, 2005. Souvenir, Fish Fortnight 2005, Department of Fisheries.


DoF, 2006a. Fishery Statistical Year Book of Bangladesh, Department of Fisheries, 2004-05.


FAO Fishery Country Profile - Bangladesh

FAO Fishery Country Profile – India

FAO Fishery Country Profile - Japan
FAO Fishery Country Profile – Myanmar
FAO Fishery Country Profile – Nepal
FAO Fishery Country Profile – Sri Lanka
FAO Fishery Country Profile – Thailand
FAO Yearbook-Fishery-Statistics (Aquaculture production)
FAO Yearbook-Fishery-Statistics (Capture production)
Hossain M. Mokammel, 2005. Importance of Traceability on the Quality Control of Fish and Fisheries Products, Souvenir of Fish Fortnight 2005 DOF.