# THE USE OF SLUICE GATES FOR STOCK ENHANCEMENT AND DIVERSIFICATION OF LIVELIHOODS

## Literature Review

**September 2004**

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**CONTENTS**

## INTRODUCTION

This literature review provides important background information required to ensure maximum effectiveness of the United Kingdom's Department for International Development (DFID) funded project 'The use of Sluice Gates for Stock Enhancement and Diversification of Livelihoods.' It explains research and knowledge to date on sluice gate/regulator management, different types of sluice gates, key aspects of sluice gate operation, fisheries and water management institutions, and the importance of floodplain fisheries in Bangladesh. Key water management and open water capture fisheries related problems are identified and reviewed thus providing some basis for the necessity of the project. The degradation of environment conditions suitable for floodplain fisheries and the cause of this degradation in floodplain fish habitat and resulting declining fish stocks are explored. The review also highlights measures taken to date by government, donors and non-government organizations (NGOs) for inland fisheries development and management, including floodplain fisheries.

Scientific papers on floodplain fisheries in Bangladesh are uncommon. This literature review has therefore been compiled from a review of both published and unpublished material.

## BANGLADESH – HYDROLOGY AND METEOROLOGY

Bangladesh lies between the latitudes 20º34'N and 26º33'N, and longitudinally between 88º01'E and 92º41'E. It is one of the most crowded rural areas in the world, with 130 million people living in only 147,570 square kilometres. The population density averages about 850 people per square kilometre, which is one of the highest in the world. Agriculture is the core sector of the economy. About 77% of the population live in rural areas, where each person only has an average of 0.15 acres of cultivated land. Most of the rural population are poor cultivators, and the country has a limited resources base. As a result poverty is widespread and affects more than 80% of households (Quddus and Ara 1991). The country cannot produce enough cereals and other nutritious food items like live animals, edible oil, fat, milk, milk products, pulses and various types of fruit to feed its population.

The country has three main rivers systems totalling 22,155 km in length: the Padma (also known as the Ganges), the Meghna, and the Jamuna/Brahmaputra. It also has about 700 rivers and streams. The coastline of Bangladesh is about 480 km long.

Bangladesh has one of the richest and largest floodplain systems in the world (Tsai *et al*. 1993; Rahman 1989). Ali and Islam (1998) state that inland open water resources (in the form of rivers, canals, beels, flood lands, etc.) have a total area of 4,047,316 ha. Of this, rivers and estuaries make up 1,031,563 ha, beels 114,161 ha, floodlands 2,832,729 ha, and Kaptai Lake 68,800 ha. Such a vast area of open water resources provides much potential for fish production. In addition, there are 260,658 ha of closed water bodies. Of these, ponds contribute 146,890 ha, oxbow lakes 5,488 ha, and shrimp farms 108,280 ha.

### Hydrology

Rainfall, river flow and tidal water are the major sources of surface water in Bangladesh. Nearly 90% of Bangladesh is less than 10 metres above sea level, and is located in the floodplains of the three great rivers, the Ganges, the Brahmaputra and the Meghna and their tributaries. These river systems drain a total catchment area of about 1.72 million square kilometres, which includes parts of India, China, Nepal and Bhutan. Only 8% of the catchment area lies within Bangladesh. As a result, huge quantities of water enter the country during the rainy season (July -September) on its way to the Bay of Bengal. About 90% of annual rainfall also occurs during this period. At this time, two thirds of Bangladesh is vulnerable to floods and almost every year a third to a quarter of the country goes under water (Nishat 1990). The depth of inundation and its impact varies. Rural production and lifestyles are well adapted to, and to a large extent are dependent upon, some level of inundation.

Floods normally occur every monsoon season and facilitate huge quantities of floodplain fish production. Many wild fish species migrate to the floodplain from upstream or from rivers. In addition, many local species breed and develop in the floodplain during the monsoon flooding months. Fish production in Bangladesh is therefore closely related to available levels of floodwater and the duration of floods.

## Meteorology

The climate in Bangladesh is primarily tropical monsoon in character. High temperatures, heavy rainfall, excessive humidity and marked seasonal variations are typical.

The mean annual temperature is about 25°C. Mean monthly temperatures range from about 18°C in winter and 30°C in the pre-monsoon season. Extreme temperatures range between about 5°C and 43°C, except in coastal areas where the range is narrower. There are significant seasonal temperature differences across the country; generally, the highest pre-monsoon temperatures occur in the west, and length of the cool winter period is longer in the north than near the coast.

Within Bangladesh, the mean annual rainfall is lowest in the west with 120-1500 mm per annum, and highest in the north, east and south where over 2500 mm can fall in one year. Rainfall exceeds 5000 mm per year in the extreme northeast of Sylhet. Rainfall also increases towards the southeast, with about 3,600 mm per year falling near Cox's Bazar. Lower rainfall occurs in the west, with a low of about 1110mm falling at Chapai Nawabganj. The mean annual rainfall in Bangladesh is about 2320 mm per year. However, 85% of this falls between April and September.

Cyclones are common in coastal areas, and the Meghna estuary acts like a funnel drawing in cyclones. A number of islands and the Chittagong and Cox's Bazar coast are particularly vulnerable to cyclones, which hit almost every year. There are on average six cyclones in the Bay of Bengal every year. They generally arrive in early summer (April-May) or towards the end of the rainy season (September-November).

**PHYSICAL INFRASTRUCTURE**

## Sluice Gates and Regulators: Definitions and Descriptions

### *Sluice Gates*

A sluice gate can be defined as a sliding gate for regulating water flow. A sluiceway is usually is a pipe or a tunnel, circular or rectangular in section, that passes through the body of the dam or through some hillside at one end of the dam and discharges into the stream below. The gate provided with this sluiceway is called sluice gate because it regulates flow through the sluiceway. Sluice gates are usually provided for drainage purposes (Garg 1989).

### *Regulators*

Water entering the main canal from the river, has to be distributed along different channels according to the relative urgency of demand. This distribution process is called regulation. To distribute water effectively, water discharge rates need adjustment. This is achieved by use of regulators. Regulators and therefore constructed to regulate discharge, depths, velocity etc. in canals known as canal regulation works. Such structures ensure efficient and controlled functioning of a canal irrigation system (Garg 1989).

Regulators can be classified according to the following types:

- Undershot
- Overshot
- Retracted
- Flap gate

Gates operating with a vertical lift system have the advantages of economy and suitability for a wide range of heads (FAP 3.1 1997). Overshot gates with adequate tail water will allow the movement of eggs, spawn and young fry in the surface layers without being damaged. Undershot gates may only let bottom dwelling species to pass through them when velocity is not excessive (FAP 3.1 1997). An undershot gate has a fixed flow area regardless of upstream head and discharge therefore rises at a slower rate than the upstream head. In comparison, discharge from an overshot or retracted gate rises at a faster rate than upstream head (FAP 20 1998).

Regulators can also be classified according to their function (Hassan 2002):

- Irrigation regulators - used to regulate flow into irrigation canals.
- Drainage regulators and sluices - incorporated into an embankment in most cases to allow drainage of water from land behind the embankment.
- Flushing regulators - incorporated into submersed embankments in haor areas to fill the haor area in the monsoon to a level that allows overtopping of the embankment at a safe hydraulic head.

Sluice gates in the coastal polders are used to take advantage of tidal river fluctuations. Tidal drainage sluices are used with the lowest possible crest levels and flap gates are common at river outfalls (Hassan 2002).

***Modes of Operation***

Regulators can keep countryside water levels well below natural levels to benefit farmers. Day to day gate operation facilitates maintenance of the required water level. This can provide optimal growing conditions for newly transplanted aman rice and for growing aus and jute. Gates often remain closed in the interests of farmers, but this hampers fish migration. Ideally gates should be operated in such a way that water levels are suitable for farmers and also allow the passage of fish.

## Flood Control, Drainage and Irrigation (FCDI) Projects in Bangladesh

In FCDI projects, embankments are built for flood protection, sluice gates/regulators are built for drainage at the outfall of natural channels, and barrage/pumps are installed to elevate water for irrigation. Drainage occurs primarily by gravity. Up to 1994, In Bangladesh, the Bangladesh Water Development Board (BWDB) had constructed 42 FCDI projects covering 0.711 Mha. Examples of FCDI projects include the Pabna Irrigation Project Phase-1, the Chandpur Irrigation Project and the Bhola Irrigation Project Phase-1. In addition, by 1994 BWDB had constructed 173 Flood Control and Drainage (FCD) projects covering 2.019 Mha, and 123 coastal polders with about 5000 kilometers of embankment (Hassan 2002).

## Fish Friendly Structures

Construction of ‘fish friendly’ structures, such as those dealt with under the DFID/World Bank Fourth Fisheries project, provides one approach to solving the problem of hatchling mortality when crossing sluice gates. Fish friendly structures aim to:

- Support and maintain natural longitudinal and lateral fish migration.
- Reduce hatchling mortality rates.
- Maintain connectivity between the river and beels.
- Reduce turbulence.
- Provide enough flow and depth to attract fish.
- Provide an exit and entrance velocity within the swimming speed of fish.

These and existing structures will also need effective management and operation in ways that maximize migration of important fish species in and out of compartments (Sultana and Thompson 1997). The present mode of operation and management of fish friendly structures is insensitive to gender issues and inequitable in terms of distribution of benefits and costs. Decisions to open or close gates are influenced by powerful farmer groups, and poor fishers are discriminated against. Participatory and stakeholder based management is needed to incorporate equity considerations more effectively (IUCN 2002).

Examples of fish friendly structures in Bangladesh include:

*(a) Sariakandi Fish Pass*

Sariakandi Fish Pass is located at the western part of the Bolai canal under Sariakandi Upazila. BWDB established the fish pass in 1999. The Sub-Divisional Engineer, BWDB, organized a meeting to form a fish pass operation management committee, which was supposed to be involved in decision making regarding opening the fish pass gates. No fisher representative was included on the management committee. The committee also had no members representing the landless or women. Villagers reported that the fish pass was partially ineffective due to faulty design and the gates remaining closed during peak hours. There is also no indication as to how the recurrent costs of fish pass operation, management and maintenance will be met.

*(b) Kashimpur Regulator and Fish Pass*

Kasimpur regulator and fish pass is on the Manu River, at the western end of Korakadi canal and an FCDI project. An operation manual recommends a 12 member operation committee. There are currently 11 members on the committee, which meets irregularly. No professional fishers were selected as committee members. Democratic practices are lacking. The operation committee was supposed to make an annual operational plan in consultation with fishers and farmers, but it never talked to the communities. Even community level committee members did not know about the operational plan.

*(c) Jugini Regulator and Fish Pass at Tangail*

The Tangail fish friendly regulator is located on the Lohajong River in Jugni village. There was a plan to form a committee for the operation and maintenance of the structure but this did not materialize. The local administration feels that involving community members in regulating the fish friendly structure as well as the three-vent regulator may lead to social conflict. BWDB and the district administration therefore operate the structure, which remains closed or does not function during the early fish spawning/breeding season. Destructive fishing practices both up and downstream of the fish friendly structure hamper safe migration of fish and fish hatchlings.

*(d) Morichardanra Fish Friendly Regulators*

The Morichardanra fish friendly regulator is located at the western end of the Morichardanra canal at the confluence with the Mohanonda River. BWDB formed a committee for the management of this drainage sluice. The committee was meant to operate the structure according to the needs of smaller local committees. However, committee meetings are not held, and the gates are operated in a rice-friendly rather than a fish-friendly manner.

## INSTITUTIONAL AND SOCIAL ARRANGEMENTS IN RURAL BANGLADESH

There are three levels of local organizational structuring in rural Bangladesh; the upazila, union and village. Ideally the formation, structure and functions of these levels are integrated, but in reality they do not work in a coherent or organized manner. Many formal organizations are located at the upazila level and yet are assigned to work at the village level through a union council. The Upazila Parishad has many formal organizations and institutions, while villages have both formal and informal organizations.

Recently government has introduced four tiers of local government: Gram Parishad, Union Parishad, Upzilla Parishad and Zilla Parishad. This new local institutional structure has directly elected council members (including women) at all levels. It includes NGOs and other local development agencies as partners and strengthens the councils in terms of their authority, resources bases, functional boundaries, and local level planning and programme implementation facilities. The Commission for Local Government Reformulation also recommended delegating power to local bodies for staff management and resources mobilization and utilization. A total of ten line departments and their functions have been transferred to the thana/upazilla parishad (Khan 1999).

Villages have different kinds of social, economic, developmental (NGOs and government extension services), political, religious and cultural organizations. These include the household (or family), bari, para, village (as the administrative and geophysical unit), religious organizations (mosques and temples), associations of different occupational groups (fishers, potters, weavers etc.), political organizations, social welfare and voluntary organizations such as youth club, cooperatives and other community organizations. There are also an increasing number of formal NGOs working in the villages. Relationships between village and upazila level organizations are vertical and horizontal. Interactions between levels are often absent, which hampers the pace of development.

### Upazila Organizational Structure and Functions

Beside its administrative function, the Upazila Parishad has number of formal institutions and organizations expected to do development work at a village level. These organizations include: the Agricultural Extension Service, Livestock, Fishery, Health and Family Planning, Rural Water Supply and Sanitation, Primary Education, Cooperatives (registration and extension), Social Welfare (SWP), Relief (FFWP) and a Rural Works Programme. The Upazila Development Coordination Council (UDCC) constitutes the chairmen of the Union Council, three nominated women members, and the heads of the upazila-based government organisations. The Upazila Executive Officer (UEO) is the secretary of the UDCC. One of the UP Chairmen presides over the monthly meetings of UDCC by rotation. The principal officer is the Upazila Nirbahi Officer (UNO) whose role is to initiate and coordinate development efforts. The upazila has a large contingent of officials, some of whose services are to be provided on deputation by the government:

- The Agricultural Officer (AO) is responsible for the management and supervision of planning, implementation and evaluation of agricultural extension programmes as well as the coordination of all agricultural development work. This includes distribution of

fertilizer, seeds and equipment; demonstration and propagation of improved methods; and excavation or re-excavation of canals for drainage, irrigation, and/or communication.

- The Upazila Engineer (UE) is responsible for planning and preparing schemes, making estimates for development, and execution of maintenance and repair works.
- The Upazila Cooperative Officer (UCO) is essentially an audit, inspection and loan disbursement and recovery person, assisted by inspectors. He must promote discussion regarding group formation, evaluate different types of activities conducted by cooperatives, and arrange training for the formation and functioning of such organizations.
- The Upazila Livestock Officer (ULO) is responsible for the motivation and training of villagers in the scientific rearing of livestock and poultry. He must prepare activity schemes in this respect, including vaccination against diseases, improvement of beds, cultivation of fodder, establishment and maintenance of poultry farms and provision and maintenance of veterinary centres.
- The Upazila Fishery Officer (UFO) is responsible for the preparation and supervision of fisheries production plans on the basis of ecological, socioeconomic and marketing data. He must arrange training and motivate fishers to conduct scientific fish culture. He must also mobilize and coordinate inputs and supplies for such activities.
- The Upazila Social Welfare Officer (UWO) is responsible for the overall supervision of the rural social service programme. This includes identification of vulnerable groups (e.g. women, children and youth) to help initiate income generating activities, which include skills development. He must also mobilize community resources, develop programmes and arrange for their approval, organize training (on issues such as family planning, nutrition and health care) and devise ways of using voluntary social welfare agencies.
- The Upazila Rural Development Officer (URDO) is responsible for the operation, control, supervision and training of the UCCA and organizations under it. He is responsible for the supply of inputs and credits to Krishok Shamabay Samity (KSS) – a farmers' society, encouraging them to own capital, planning for agricultural marketing and implementation of improved agricultural techniques.
- The Planning and Finance Officer (PFO) must help the Parishad prepare upazila development plans, monitor progress and expenditure reports, arrange periodic reviews of development projects and help the parishad formulate, appraise, implement, monitor and evaluate development projects. The Assistant Commissioner, who performs magisterial functions, also performs functions assigned to PFO.
- The Project Implementation Officer (PIO) is specifically concerned with FFWP projects. He must ensure the technical soundness of selected projects, their timely execution and release of foodgrain, and their verification and monitoring for submission of progress reports (Ahmed 1990).

**Union Council Organization**

Each Union Parishad has an elected chairman and 12 members (nine male and three female) from four wards. The chairman of the Union Parishad is a member of the Upazila Parishad. The main tasks of the Union Parishad are to maintain law and order in their localities and assist government officials in rural development activities such as road construction, digging canals and rivers, development and maintenance of rural growth centres, tax and revenue collection, promoting agriculture, fisheries, health, sanitation and education of rural people.

## Village Social Structure

Social structure means the inter-relationships among the different elements and components of a society. Those components are the population and its social categories, the economy and the production system, distribution of power, religious and cultural organisations and the communication systems through which a set of inter-relationships and interactions are established among the individuals, families, and communities in a given social setting.

The rural population can be stratified into different socio-economic categories, with the possession of wealth including land and occupation as key determinants of social status. The conventional categorisation of rural people is as large, medium and marginal farmer, sharecropper, landless wage labourer, business and small traders and officials and professionals. In addition to wealth and occupation, there are two closely associated criteria for social stratification: status and power. In recent decades the emphasis in the rural society with regard to status and power is gradually shifting to education and occupation. However, there is an informal shape of institution named *samaj,* which has direct linkage with the possession of wealth. Thus, a *murubbi* becomes a *matobbar* (leader) and his power is personalised which is often conditioned to his possession of wealth as well as his position in the lineage group.

## Households, Paras and Kinship

The family is the primary unit in the rural society and it is the core of all social and economic activities. Next to family, homestead or *bari* (typically a small cluster of households who are closely related) is an important social unit, which plays a very vital role in the rural society. A cluster of *baris* or part of a larger village forms *Gram Somaj* (village community). Within this village community, kinship relations and religious organisations (mosques and temples) play an important role in shaping the economy and social relationships.

Jansen (1987) found individuals and households in villages are linked through bari, para and samaj. To him, the household unit referred to the Bengali term *Chula* or *khana*; *Chula* meaning 'hearth group' and *khana* meaning 'eating unit'. Household members are, most often, a joint production and consumption unit. Within the household decisions are taken as to how the production capabilities at the disposal of the household shall be utilized. The household is based on kinship relations, and individual households are built around one elementary family. Each elementary family lives in its own house (ghor). Ghor literally means housing unit. The ghor may or may not correspond with the household. Another distinct and separate domestic unit in rural Bangladesh is the bari, which literally means home. Normally there are several ghors and several households in a bari, but a bari can also consist of only one household. Each bari has a homestead yard in its midst, and the houses face this yard, which is where domestic activities are carried out. All the households belong to an agnatic lineage (gusti). Gusti is the term for a group of households or families all of whom are agnatically related, with the exception of in-marrying wives and out-marrying daughters (Jansen 1987).

Every village has more than one para (neighborhood). Kin groups (formed by tracing common descent through ancestors) very often live in one para. Two types of kinship relations are common in Bangladesh: patrilineal systems and non-lineal cognatic systems. Kinship relations operate in various ways and play a vital role in rural social and livelihood

systems. Jahangir (1981) reports that in a para, social relations of alliance and residence are structured around a nucleus of men descended patrilineally from common ancestors. Alliances are constructed within the framework through living together, cultivating, sharing and performing socio-religious functions. The system is therefore characterized by ideological sharing of resources and, to a lesser extent, material sharing of resources.

Jahangir (1981) says that the para also shows relations of production. In the same para, poor households are structured around rich households. The poor households may or may not be the kin alliance of the rich households; in certain cases the rich households settled them to serve their multifarious needs. They owed, or still owe, the rich households part of their labour and their products. It is possible to combine agriculture, domestic handicraft and cattle rearing within the kinship relations in a particular para, but different forms of appropriation of resources and products based on non-kinship relations of domination also exist. Sometimes in a para, kinship and production relations converge, and sometimes they do not. Social relations (relations of kinship) emerge and reproduce themselves for generations. They define the concept and rules of alliance and residence. Production relations function simultaneously within the production arena and outside it. Such relations assume domination of class over class, of men over women, of caste over caste. In the para, relations of exploitation came out of relations of production, and relations of cooperation came out of kinship. Associated relations are inter-twined and function simultaneously. In Bangladesh today, kinship functions more as an institutional arrangement of relations and less as a production relation.

## Samaj

The primary functions of a samaj are performing rituals relating to birth, death, religious activities, marriage and mediation of social disagreement and conflicts. All the members of a village belong to samaj. Jahangir (1981) states that all villagers are members of samaj and the individuals are involved in ritual interactions. Samaj may be village based, para based, or may be based on lineage and religion. A big village may have many samajs. The leaders of samaj are the rural elites who play a vital role in local elections and also in promoting rural development (road construction, canal digging etc.). As a social organization linked to the village, Samaj occupies a marginal position. It gains its importance mostly in conflict situations. Samaj performs mediation in conflicts such as a land dispute involving two brothers or neighbours, or antisocial activities (fornication, stealing etc.). Mediation is carried through a bichar soba (village court). While samaj is an informal organization, bichar soba is more formal. While everyone is a member of samaj, membership of the bichar soba is restricted.

## NGOs as Emerging Rural Organizations

NGOs are active throughout the 64 districts of Bangladesh. The NGO community is large and growing and is becoming increasingly pivotal in defining good development policy and practice. At their best, these NGOs work with poor and disadvantaged groups and strive to promote bottom-up development. This contrasts sharply with the centralized, top-down approach, which has characterized so many government efforts. In the operational sense, NGOs can supplement the work of government agencies, or at times, compete with them. NGOs have developed their approaches according to the needs of the people and external appreciation and criticisms. The large NGOs are now major organizations, able to attract significant funding.

NGOs face certain challenges regarding how best to operate and interact with different NGOs and other organizations. Large NGOs can lack accountability to the people and can be insensitive to local needs, while local NGOs are often very sensitive to local needs but suffer from weak negotiating power. They also suffer from poor management and leadership skills. The large NGOs often try to control and influence the local NGOs. There can be disagreement and conflict between NGOs, and some NGOs have poor relations with local government.

## Institutional Change and the State

Rahman (1990) examined existing village social institutions through which traditional practices are being changed and new institutional relations are emerging due to an increasing level of state mediated modern institutional interventions. He also analyzed the socioeconomic position of the custodians of indigenous social institutions, and looked into the possible consequences of transition on social structures in terms of rural development. He concluded that the state has helped introduce modern technology in farming, primarily through subsidized irrigation water. But subsidies for irrigation equipment have mostly gone to the rich, rural elite (he called them matbar) families. Traditional rural power structures are therefore being gradually integrated into modern state structures.

## FLOODPLAINS IN BANGLADESH

Bangladesh is a deltic floodplain located at the confluence of three major rivers; the Ganges/Padma, the Brahmaputra/Jamuna and the Meghna. These rivers cover 7% of Bangladesh (Haggart *et al*. 1994), and drain a total catchment area of about 1.7 million square kilometers. The Bengal Delta is in fact the world's largest flooded wetland.

The country has three primary landscape types: floodplain, terrace, and hills. Floodplains constitute about 80% of the total area, and terraces and hills occupy about 8% and 12% respectively (Rahman 1990). Nearly 60% of Bangladesh is less than six metres above sea level (Hofer and Messerli 1997). About 34% of the country is inundated by monsoon water and remains underwater for about six months a year (World Bank 1990). During a year of high floods (such as 1998 or 2004), two thirds of the country is inundated.

### Estimates of Floodplain Areas

According to Rahman (1989), Bangladesh has one of the richest and largest floodplain systems in the world. Hoque (1995) estimates that inland water bodies comprise 12% of the country's area. The DOF estimates the area of floodlands to be 2,832,792 hectares. However, Welcomme (1979) states "Bangladesh possesses 9,300,000 hectares of floodplain, which includes 2,834,000 hectares of paddy fields". These remain inundated for three to four months of the year. He adds that the floodplains of Asia have been inhabited for many centuries. He also comments on the status of the floodplain and states that irrigation, drainage and flood protection works have resulted in the disappearance of many original floodplain features (Welcomme 1979).

In 1986, the Master Plan Organization (MPO) for National Planning estimated the Net Cultivable Area (NCA) of Bangladesh to be 9,562,402 hectares, out of which 6,300,723 hectares were said to be floodplains susceptible to annual submersion to different depths. The MPO also estimated areas of different flooding categories (see table 1).

**Table 1: Net Cultivable Area (NCA) under different depths/categories of land of flooding**

| **Category of flood land** | **Nature of Flooding** | **Total NCA (ha)** |
|---|---|---|
| F1 (medium high land or flood depth 30-90 cm) | Seasonal | 3,151,247 |
| F2 (medium low land or flood depth 90-180 cm) | Seasonal | 1,431,932 |
| F3 and F4 (low land or flood depth greater than 180 cm) | Seasonal/perennial | 1,180,935 |
| **Sub-total** | | **6,300,723** |
| F0 | Usually never inundated | 3,261,679 |
| **Total** | | **9,562,402** |

Source: MPO 1986; Ali 1997.

For the purpose of fisheries production computation and assessment, MPO (1987a; 1987b) only took into account F3 and F4 categories of land. However, it is notable that land under up to 90 cm of flood water also contributes to floodplain fisheries production (Ali 1997).

World Bank (1990) estimates of floodplain areas vary, sometimes by large margins, from one source to another. But the area is generally accepted to have been declining over time because of FCD works.

**Fisheries Resources in Bangladesh**

Bangladesh traditionally has rich fish stocks. The three major rivers and their numerous tributaries, haors, baors, lakes and flood lands have provided a plentiful supply of freshwater fish during the monsoon. There are more than fifteen hundred rivers and tributaries in the country and many lakh ponds, reservoirs, oxbow lakes and canals (Paul 1991). The floodwaters carry wild fish species from the rivers into the paddy fields and thus water bodies are restocked naturally each year.

According to the FAO (1995), inland fisheries resources in Bangladesh are among the richest in the world (being second after China). The world inland capture fisheries production in 1992 was 6.5 million tonnes, of which China contributed 1.23 million tonnes and Bangladesh 0.48 million tonnes (FAO 1995; Ali and Islam 1998). Inland open waters have been a major source of fish production in Bangladesh from time immemorial. In the 1960s about 90% of national fish production came from inland open water fisheries (DOF 1997).

The World Bank (1990) broadly categorizes the inland fisheries in Bangladesh as follows:

- Inland capture (floodplains fisheries)
- Inland culture (primarily pond and coastal aquaculture)
- Marine industrial
- Marine artisanal (small-scale)

The Bangladesh Fisheries Resources Survey System (BFRSS) and Ali (1985) use the following three basic production systems:

- Open water capture fishery (inland)
- Closed water culture fishery (inland)
- Marine fishery

## RURAL LIVELIHOODS IN BANGLADESH

Rural livelihoods in Bangladesh are primarily based on agriculture, followed by fishing, wage labour, small trade and other activities like handicrafts, carpentry, weaving etc. Rural livelihoods have diversified as populations have increased, and development opportunities and new technologies have been introduced.

Ensuring sustainable livelihoods in rural Bangladesh is difficult, and people compete with each other to gain access to and control of resources for survival and sometimes for savings. People often combine various sources of income to maximize their earnings and savings. This is achieved through intensification and diversification of crop-production, fishing, shifting of farming endeavors from crop to non-crop activities like poultry and livestock, and renting agricultural equipment. Some household members may migrate to urban areas, other regions or sometimes foreign countries. People also try to reduce seasonal unemployment through small scale trading, and switching employment from agricultural to non-agricultural activities like rickshaw/van pulling and construction work.

The livelihoods of many rural households, and especially of resource- (in particular land-) poor households, are a complex nexus of household production, selling labour, agricultural and off-farm income, commercial and subsistence production, and use of private and common resources. This mosaic of survival sources has many parallels with high-income countries (Leach and Mearns 1996; Woodgate 1994; Tiffin *et al*. 1994; Campbell *et al*. 1990; Falconer 1991), and is the basis upon which the analysis of resource management relationships is increasingly founded.

### The Contribution of Agriculture to the Rural Economy

Recent national trends show very slow but steady economic growth. The economy experienced slow progress in the period after independence in 1971. It grew at 2.1% per annum during 1970-1975, and during 1976-1981 at 2.5% (ADB 1994). The growth rate during the 1980s remained almost the same, but it increased in the 1990s to about 4.6% during 1990-95 (World Bank 1997). The recent improvements in economic performance mean that the *per capita* Gross National Product (GNP) has increased by an average annual rate of 2.1% between 1985 and 1995, but there are limits on the extent to which this has been evenly distributed. The rural economy of Bangladesh is dominated by agriculture, including cultivation, fisheries and livestock, which support the livelihood systems of most rural people. The agricultural growth rate, averaging 2.7% between 1980 and 1990 but only 1.1% between 1990 and 1995, has been significantly less than that of the industrial growth rate (4.9% percent from 1980-90, and 7.3% from 1990-95), and service (5.7% percent from 1980-90, and 5.4% from 1990-95) sectors. In addition, unlike the rest of the economy, the rate of growth has declined significantly in recent years (World Bank 1997).

Agriculture has traditionally been the dominant component of Gross Domestic Product (GDP), contributing 50% in 1980 (compared to 16% for industry and 34% for services). However, its dominance has declined and in 1995 its contribution was 31%. The contribution of the industrial sector is still low, at about 18%, but it is growing, whilst services, at 50% of GDP in 1995, is now the largest sector (World Bank 1997). Within agriculture, the crop

sector is most prominent. This accounted for three quarters of the agricultural sector's output in the early 1990s.

**Other Livelihood Sources**

A wide range of small-scale service and artisanal activities also provide livelihoods in rural areas (Jansen 1987). Many of these have long traditions as the dominant livelihood source for certain communities, but others have emerged or grown in recent times and do not have the formidable entry barriers which characterize traditional occupations (Ullah 1996; Rahman and Hossain 1995). Manufacturing occupations include potters, weavers and carpenters. Service occupations include boatmen, shopkeepers, irrigation pump owners and rickshaw pullers. There are also groups like the traditional professional fishers who manage common property resources (Ali 1997; Tsai *et al.* 1993). As such, whilst farming is the dominant feature of the rural economy, it is far from the only livelihood activity, and many households have multiple livelihoods which include both farming and off-farm sources of income.

**Wealth Distribution**

Another trend in the rural economy is increasing landlessness due to population growth and the consequent concentration of land in the hands of a few households. This, along with changing production structures, which concentrate more wealth in growing urban areas, has led to patterns of unequal income distribution. In 1992, the poorest 20% of the population received 9.4% of income, while the richest 20% received 37.9% and the richest 10% received 23.7% of income (World Bank 1997). Although less uneven than many comparable African or Latin American countries, this skewed wealth distribution reflects significant and growing inequality within the Bangladeshi economy. These inequalities are an everyday reality expressed at every level of society. In rural areas they are reflected in unequal access to resources, income opportunities and the institutions which structure rural life.

**Poverty**

Poverty has been the single most important challenge for Bangladesh since independence in 1971. A growing population, ineffective resource mobilization, low levels of human resources development, the under utilization of development potential and the formidable social, economic and institutional barriers facing the poor when they try to advance themselves have led to underdevelopment and endemic poverty in rural Bangladesh.

Although 'poverty' often refers to a lack of material well-being, assets and income, in rural Bangladesh it is more appropriate to see it as a multidimensional reality. Poverty is reflected in the lack of certain basic abilities: the ability to live a healthy active life free of avoidable morbidity and premature mortality; and the ability to live with dignity, adequate clothing and shelter. This expanded definition moves away from traditional uni-dimensional approaches, which view poverty simply as a matter of low income or nutritional deprivation. Poverty alleviation programmes must consider a range of variables relating to quality of life, such as nutrition, access to safe water, health and sanitation, housing, clothing, personal security, access to education, information and state distribution systems, participation and institutional capability, and crisis management capacity (Sobhan, 1991 cited in Soussan 1998). Poor people are usually socially and politically passive and in most cases, their lives and

livelihoods are insecure. As such, their poverty is often entrenched, with prospects for significant advancement limited by the low skills and assets they possess, the limited range of secure means of livelihoods open to them and the formidable barriers which they face in any attempt at advancement.

Poverty is not only a state of deprivation; it is equally importantly a state of vulnerability, particularly for women. This vulnerability often translates into personal insecurity, crisis-proneness and a limited coping capacity. It includes the level of and potential for violence and intimidation within social and institutional life and the constraints which such an environment imposes on livelihood initiatives. Crisis-proneness and a limited coping capacity reflect the stability of household welfare and thus demonstrate that poverty is a process as well as a state of being.

Poor people earn their livelihoods mainly by wage labour and small scale self-employment, both in market and non-market contexts. They have little control over these opportunities and are highly dependent on the goodwill of more powerful local groups. Economic opportunities available to them often have seasonal variations, with demand for agricultural labour high in times of peak production but low at other times. Ties of dependency and unequal power relations restrict freedom of choice. Thus, the vulnerability of the poor has three dimensions: structural limitations, variability and insecurity. It expresses itself in the endemic hunger, depravation and poor health, which characterizes many rural areas in Bangladesh.

Poor people have limited access to land and other resources, and are also disadvantaged with regards to accessing new agricultural technologies. Many poor households have large number of children below ten years of age and fewer members in the income-earning age group. Those earning have a low incomes and also have to bear a heavier burden of providing for non-earning family members. In practice, they cannot afford to invest much on the nutrition, health and education of other household children, so a vicious circle of poverty and underdevelopment develops.

## FLOODPLAIN FISHERIES

### Rural Livelihoods from Floodplain Fisheries

Fisheries contributed about 6% of the GDP for Bangladesh in 2000 and 12% of export earnings. This equates to about 9% of the labour force. In 2003, total fish production was 1.78 million tons. Inland fisheries and aquaculture contributed about 53% and 24% respectively to the annual fish production totals in Bangladesh in the 1990s, although the contribution made by culture fisheries is increasing and may have reached 40% by 2003, with inland capture falling to 39%.

Fisheries in Bangladesh include inland open waters, inland closed waters (aquaculture), and marine fisheries. All are an important source of animal protein, income, foreign exchange earnings and employment generation (Alam and Thomson 2001). The importance of floodplain fisheries is often neglected in development activities. This is despite the fact that much of the population engages in floodplain fishing for livelihood purposes, or for household consumption and good health from animal protein. Unfortunately, few studies focus on the problems faced by fishers in Bangladesh, despite the fact that they supply fish for the whole nation.

### Employment from Fishing

Estimates of people earning a full-time equivalent livelihood from the fisheries sector are incomplete and vary widely between sources. They range from 1.2 million to over 5.2 million. These are probably conservative estimates because people in the fisheries sector earn below average wages, and a significant portion of fish are caught for subsistence use and are therefore not valued in price terms. These estimates count those who are fully engaged in fishing, handling, packaging, transporting, distribution and marketing of fish. However, an estimated ten million people work as part-time fishers to supplement their income or live on fishing for some parts of the year.

According to Planning Commission (1978), about 8% of the population of Bangladesh depends on fisheries for their livelihood. However, DOF (1990) state that about 73% of households were engaged in subsistence floodplain fishing in 1987-88. Many people are also involved in fisheries related activities such as making fishing gear and fishing crafts, fish marketing, processing and transportation etc. Floodplain fisheries therefore play a significant role in providing employment, which is essential for sustainable rural livelihoods and for reducing unemployment. In Tangail district, it is estimated that some 80% of people rely on agriculture and 20% rely of fish.

### Floodplain Fisher Categories

There are different types of fisher in Bangladesh. Some fish mainly for consumption, some fish as alternative employment and some are solely dependent on fishing. Fishers can broadly be classified in to three categories on the basis of the time they spend fishing. These are:

- Full-time fishers (professional fishers)

- Part-time fishers
- Occasional fishers

***Full-time Fishers***

Full-time fishers depend solely on fishing for their livelihood. Such fishers are also called professional fishers. They are found throughout the country and usually live in separate fishing villages or paras of villages. Pokrant *et al*. (1997) state that fishing has a low status within Hindu and Muslim communities and that most fishers earn low incomes. They add that there are about 30 castes, sub-castes or (jati) and other non-Hindu groups which specialise to a greater or lesser extent in fishing as their chief source of livelihood.

Members of the professional fisher's family are also involved in transporting fish to the market, doing fish business and trading, processing fish for marketing, sun-drying for preservation etc. Women help with selling fish, making nets and bamboo traps, and other artisan works.

***Part-time or Seasonal Fishers***

Part-time fishers alternate fishing with other activities such as agriculture and daily wage labour throughout the year. Many permanent floodplain inhabitants fish during part of the year as an activity that is co-equal or inferior to alternative activities. The flood cycle, the biological cycle of the fish, and the seasonal needs of agriculture impose a cyclicity on such communities.

After planting the aman paddy, people have less agricultural work. Floodplain fishing is therefore particularly common practice in the monsoon season from July to October. Poor people often occupy themselves fishing during this period. And artisans make floodplain fishing gear like nets and bamboo traps to sell to the fishers. In this way, fishing activities can supplement income from agriculture. Many farmers also fish for their own consumption, and fish is an important source of animal protein for such rural people. As the waters drain from the floodplain, fishing increases. As the floodplain dries, soil preparation and sowing seeds takes priority, to be followed by a second burst of fishing at low water. Crops are then harvested, and the cycle repeats itself. Part-time fishers use most of the same types of gear used by professional fishers. They sometimes also practice aquaculture.

***Occasional Fishers***

During the flood season, men, women and children from rural households participate in fishing activities using fishing devices ranging from bare hands to complex fishing gear. In reality, it is difficult to distinguish between part-time fishers and occasional fishers, because, occasional fishers sometimes sell a big catch to earn money like part-time fishers. Some studies say there are two categories of fishers instead of three: professional and subsistence fishers, where occasional fishers and part-time fishers are grouped together and called subsistence fishers.

## Nutritional Benefits from Floodplain Fisheries

For centuries fish have been central to the diet of Bengalis. According to Pokrant *et al*. (1997), about 85% to 90% of the Bengal population were fish eaters in the nineteenth and early twentieth century. Who ate what kind of fish was largely determined by local and regional traditions, availability, purchasing power and certain nutritional and other qualities of different fish species. Most fish consumed were from inland or freshwater sources. Although the price of many species of inland fish has risen in recent years and the exploitation of marine resources has increased since the 1950s, freshwater fish remains to this day the preferred type and main source of fish for most Bengalis. In Bangladesh, fish consumption is more than double that of meat (BBS 1997). BBS (2000) estimate that over 70% of all animal protein consumed in Bangladesh is from fish, and de Graaf *et al*. (2001) estimate this figure to be 60%. Until recently fish and rice formed the mainstay of the diet of Bengali people.

The country has a limited resources base. As a result, poverty is widespread affecting more than 80% of households (Quddus and Ara 1991). In Bangladesh, most of the population suffers from nutritional deficiency diseases because of inadequate food consumption. Food consumption again depends on family food supply, which varies from season to season. Malnutrition is related to the socioeconomic condition, food supply, dietary habits, sanitation, water supply and health care practices of people. Quddus and Ara (1991) found that about 71% of children suffered to some degree from malnutrition. Malnutrition has many causes, including an inadequate food supply, limited purchasing power, poor health condition and insufficient knowledge about nutrition. According to Karim and Ahsan (1989), nutritional deficiencies, particularly in respect of protein, have led to the following national problems (INFS 1977; 1983; BBS 1987):

- Decreased resistance to diseases, child mortality, body deformities, etc.
- Stunted growth
- Physical debilities and mental retardation, reducing human work output in terms of quality and quantity
- Heavy drainage of national resources on curative and preventative measures

Although known the world over for its many varieties of freshwater fish and the fish-oriented food habits of its people, Bangladesh currently suffers from a considerable demand-supply gap in this sector. Based on total inland and marine fisheries catch data, the net per capita availability (consumption) of fish in Bangladesh, is about seven kilograms per annum. This is quite low by international standards, even in comparison to other developing countries (ARMCO 1992). Most poor people can hardly afford animal protein intake from consumption of beef, chicken etc. The current level of fish production should therefore be doubled to about 758,000 metric tonnes (i.e. anywhere from 14-15 kg per capita, per annum) to meet the minimum protein requirement for most of the population.

Some people have been getting very low amounts of fish for consumption in recent periods, and Hoque (1995) states that the majority of the population is still protein deficient. Most wetland residents participate in fishing activities as a supplement to nutrition and income or as a secondary occupation, but decreasing fish supplies will affect poor people the most, as they are most reliant on fish in their diet and for their livelihoods (Kent 1997). Most rural people live below the poverty level. Low income leads to a lack of nutrition. Fish provide

income for poor people and protein for all classes of people. Without fish, poor people have no alternative protein sources to eat with their staple food. Floodplain fishing is also very important for low-income groups for income.

## Fishing Seasons and Floodplain Fishing Rights

Fishing activities depend mainly on fish availability, which in turn depends on water availability. There are two main fishing seasons in a year: the monsoon season when the floodplains are full of water, and the dry season when there is little water in the floodplain. During the monsoon season, people fish from early June until November when the floodwater has drained from the floodplain. During the peak flood period (August to October), there is little demand for agricultural work, but many wild fish species are available during this period. People therefore use the opportunity to fish. During the flood season, floodplain fish and prawns become common property resources so everybody can harvest them without legal permission or payment of any rent or fees.

In the dry season (December to April), most of the floodplain becomes dry and water remains only in the deepest areas such as beels, khals and ditches/pagars. Fish accumulate here. All ditches and pagars are owned by private individuals who usually do not allow other people to fish there. The owner arranges for the fish to be harvested from their water bodies either by hiring labourers or professional fishers. Most of the canals that form beels are managed under bodies called jalmohal, which the government leases to fisheries societies or private people. Sometimes leases do not allow anybody to fish. Other leases allow professional fishers to harvest fish after payment of a significant sum of money. The lessor, or his representative, fixes the rates for different types of fishing gear.

## Floods

Severe floods, such as those in 1998, can have a devastating affect on rural livelihoods, but even the 1998 flood led to plentiful amounts of fish, and in time, a bumper rice harvest. For many, the annual monsoon is a necessity rather than an inconvenience (Chadwick *et al*. 2001). McCully (1996) states that “the Bangladeshis’ language reflects their history of living and dying with floods. Bengali distinguishes between abnormally severe floods, termed *bonna* and the more frequent rainy season floods (*barsha*) which Bangladeshi villagers do not consider a threat but rather a necessity for survival”.

## Data on Inland Capture Fisheries Production

Since 1983/84, the DOF has initiated a more systemic approach to determining national fish production, through the BFRSS. The Bangladesh Bureau of Statistics (BBS) incorporates this data into its annual Statistical Yearbook of Bangladesh. The World Bank (1990) points out that “although the FRSS has developed a reasonably good information base, the system is not free from such shortcomings as small samples, different data sources and methodologies, and a possible underestimate of fish caught for subsistence consumption.” According to different study reports and daily news, the total area of water in rivers, beels and floodplains has been decline, whilst the DOF annual Statistical Yearbook shows the same area of capture fisheries in different sub-sectors from 1983/84 to 1996/97 (DOF (1983/84 to 1996/97).

## Evidence of Declining Catches

Results of various studies carried out on inland fish production in relation to FCD, FCDI, CPP, FAP and other water resources development projects indicate that fish catches are declining in inland water bodies. In contrast, production has increased in culture fisheries, shrimp farms and marine fisheries. Products from shrimp farms and marine fisheries are mainly for sale in the international market.

Ahmad *et al*. (1997) state that open water fish production declined from 690,000 tonnes in 1972 to a low of 424,000 tonnes in 1989. In 1987, the MPO estimated a loss of fish production of between 30,000 and 45,000 metric tonnes due to the loss of 814,000 ha of floodplains caused by FCD Projects (MPO 1987b). This report also projected that from 1985 to 2005, another 2,000,000 ha of floodplains would be lost from the open water fisheries production system due to construction of an increasing number of FCD projects. This was predicted to cause a further loss of openwater capture fisheries production of 73,000 to 108,000 metric tonnes annually.

Hoque (1995) also pints out that fish diversity is decreasing. There are now 13 critically endangered, 28 endangered and 14 vulnerable fish species out of a total of 296 freshwater/brackish fish species existing in Bangladesh.

The Bangladesh Aquaculture Development Project Preparation Report (1986), supported Asian Development Bank (ADB), estimated that by the year 2000, implementation of over 150 flood control projects would be complete and many more would be planned. The report anticipated that by the year 2000, the net negative impact of these projects on the natural fisheries production would be annual declines of 150,000 to 250,000 metric tonnes.

### *Evidence from FAP-17*

After the devastating flood of 1988 in Bangladesh, a FAP was formulated and implemented between July 1991 and June 1995. This plan included the Fisheries Studies and Pilot Projects (FAP-17), to study the fisheries aspects of this proposal. The final report of FAP-17 (1995) summarised the following study results:

*(a) Loss of catch through loss of habitat*

Whenever flood control projects reduce the area of flooded land, there will be a loss of habitat for fish production. Results from unregulated floodplains, beels and canals outside eight flood control projects in four FAP regions showed that the loss in annual fish yields or catch per unit area varied according to region and land height.

*(b) Reductions in catch per unit area (CPUA)*

FAP-17 studies revealed a complex relationship between catch size, the degree of flood control, fish densities and the amount of fishing effort. Under full flood control, the annual CPUA was reduced by 81% where flooding was controlled for the needs of deep-water rice cultivation. Catches increased in two projects due to higher fishing efforts and catches were reduced by 37% in a third project under partial flood control. CPUA values were similar inside and outside

the three projects. In a fourth project, the CPUA was 20% less inside because the entry of fish was restricted.

*(c) Reduced fish density/abundance*

Of the four projects providing full flood control or controlled flooding, statistical analysis revealed that fish densities were significantly lower in two of them. In a third project, lower densities were found before cuts in embankments were made. In projects providing partial flood control, no significant difference in fish densities inside and outside the embankments were detected. Flood control schemes can therefore result in a significant reduction in fish abundance even when sluice gates provide restricted access to floodplains.

*(d) Increased fishing effort*

Full flood control reduced the opportunities and the amount of fishing effort per unit area of floodplains compared with that in unregulated floodplains. On the other hand, controlled river flooding stimulated increased fishing efforts made by small scale, subsistence fishers along village shorelines.

The findings also showed that flood control reduces biodiversity and fish migration, disrupts fish community structures, and reduces the number of migratory fishes in catches.

***The Northeast Region (FAP-6)***

In the northeast region (FAP-6), fisheries impacts of 19 partial flood control projects were studied. Of these, six showed strong negative impacts on fisheries, nine showed no impact to some impacts on fisheries, and the remaining four demonstrated beneficial impacts due to the retention of water levels in the dry season, which supported fish survival and growth.

Of the 18 full flood control projects studied, eight showed strong negative impacts on fisheries; seven showed no impact and the remaining three showed mixed results. Of the four river channelization projects studied, two demonstrated strong negative impacts while the other two showed no impact.

The Fisheries Specialist Report (FAP-6 1993) pointed out that while assessing fisheries impacts of FCD and FCDI projects, it is important to note that many or most of the FCD and FCDI projects do not behave according to their design. Problems encountered are:

- Premature overtopping of submersible embankments
- Excessive breaching of submersible and full embankments by floods or public cuts
- Failed operation of many drainage and irrigation structures due to mechanical damage and siltation
- River channel siltation

Many of the projects reverted partially to pre-FCD and pre-FCDI conditions, thereby influencing the extent of negative impacts on fisheries. The impacts of any particular FCD and FCDI project can also vary from year to year. Furthermore, there is a general overall decline in the structural maintenance in the region. Situations are therefore slowly returning to pre-FCD and pre-FCDI conditions. The report recommended that in conceptualizing and assessing

impacts of FCD and FCDI projects on fisheries, it is important to distinguish between what might happen over the long term if the structures performed perfectly, and what has actually transpired, given the highly imperfect behaviour (from FCD and FCDI engineering perspectives) of many projects.

***Southeast Region***

Studies under FAP-12 (1992) revealed an annual net fish production loss of 374 to 424 metric tonnes due to the construction of Meghna-Dhanagoda FCDI Project in Chandpur District. Ali (1994) estimated the annual loss of fish production to be 2,816 metric tonnes from drained floodplains (15,820 ha) and beels (180 ha), and the closure of internal canals (580 ha) inside the Meghna-Dhanagoda Project. The difference between these two estimates was principally due to differences in calculating per hectare productivity rates in the two computations.

In addition to the Meghna-Dhanagoda Project, two other projects operate in the southeast region: Chandpur Irrigation Project (CIP) and Muhury Irrigation Project (MIP). Negative impacts of CIP were studied and documented under the Irrigation Fisheries Development Project (IFDP) during 1979 - 1982. Under MIP, a cross dam across the Feni River was completed in 1985. This resulted in the disappearance of the Hilsa fishery in the Feni River upstream of the dam (Ali 1997).

***Additional FAP Evidence***

The FAP-5 fisheries documentation (FAP-5 1992) reiterates that flood control projects have negative effects on capture fisheries. But FAP-5 did not gather any new information or mention the effects of FCD and FCDI projects already under execution.

Other FAP study reports (FAP-2 1991; FAP-4 1993) state “inland capture fisheries is one of the sectors worst affected by flood control developments in Bangladesh”. The reports further note that freshwater river fish stocks have virtually collapsed (FAP-4 1993).

***Evidence from Recent Studies***

Research by de Graaf *et al*. (1999) suggests that whilst flood control programmes may benefit some rice farmers, the impacts on reproduction and larval fish drift, and hence fishers, are significant. The structural approach to flood hazards has severely affected floodplain fisheries by blocking fish migration and dispersal routes and reducing wetland areas (Mirza and Ericksen 1996; Sultana and Thompson 1997; Khan *et al*. 1994). Construction of structures to prevent or control flooding poses serious threats to long-term sustainability of floodplain ecology and associated local livelihoods (Haque and Zaman 1993; Chadwick *et al*. 1999). In Hail Haor, a flood control scheme in the northeast of Bangladesh, older fishers recall catching 100 fish species, of which only 70 are currently found. The 30 that are no longer caught are mostly valuable white fish (mostly members of the Cyprinidae and Pangasidae families, which migrate upstream and spawn in floodplains), but they are found in the river outside the flood control scheme, suggesting that regulator/sluice gate penetration is the main problem (Kazi Hashem pers. com. 2003). White fish compose 5-10% of the total inland catch in Bangladesh, and are the group affected most by flood control programmes. Tagging work has shown that white fish, which include the important major carps, can get through sluice gates but only in small numbers. Likewise, larval release experiments revealed that 25% of all

hatchlings passing the Jugini regulator in Tangail, died because of this passage (Marttin and de Graaf 2002).

Hatchling mortality is particularly problematic for undershot gates, probably due to increased levels of turbulence. For example, research on larval survival in Tangail revealed that 44% of larvae passing the regulator in undershot mode died within 24 hours, compared to 11% dying when passing the regulator in overshot mode (de Graaf *et al*. 2001).

There is therefore considerable evidence that inland openwater fisheries production has been affected by FCD and FCDI projects and that floodplain fisheries are generally in decline. However, DOF fish catch statistics show that fish production increased after 1992, particularly in the floodlands and beels. Opinions on DOF fish catch statistics vary. Ali (1997) questions documented increases in floodland fish production and productivity from 1988/89 to 1992/93. FAP-20 (FAP-20 1998 cited in Ali 1997) also questions data presented for the Tangail district.

## Reasons for Declining Capture Fisheries Production

Evidence suggests that fish production from inland capture fisheries has been in decline for some time. The World Bank Bangladesh Fisheries Sector Review (World Bank 1990) gives the following serious environmental problems as factors hindering fisheries development in Bangladesh:

1. FCD projects
2. The use of pesticides that can kill fish and fry
3. Industrial pollution of inland and marine waters, which harms fry habitats.

In addition to the negative impacts on the physical floodplain fisheries environment, rapid population growth has also increased demand for fish from floodlands. Many non-fishers must engage in fishing activities due to a lack of employment opportunities elsewhere. Ahmad *et al*. (1997) states that increasing human populations and construction of FCD and FCDI schemes have contributed to assemblage changes in fish populations, overfishing, disruption to fish migration patterns, damage to fish habitats and breeding grounds, temporal and spatial reductions in aquatic habitat, and increases in vulnerability to capture.

### *FCD Projects*

To date over 40% of the Bangladesh floodplain has been modified and compartmentalised to allow more control over water for rice growing, on which the country depends. In the Brahmaputra floodplain alone, approximately 2.1 million hectares of wetland has been lost due to flood control, drainage and irrigation schemes (Nishat 1993). A news item in the Daily Star, published on 20 August 1997, reported that BWDB sources had stated that over the last four decades, BWDB, had rendered 40.84 lakh hectares of land flood free, reclaimed one lakh hectare of coastal land and provided irrigation to 11.3 lakh hectares of other land. Although FCD projects were implemented to increase rice production, available evidence indicates that these projects have been of little value for rice production, whereas their affects on fisheries have been devastating. Construction of embankments, sluice gates, culverts and other structures prevents monsoon floodwater from entering floodplains quickly and thus reduces floodwater quantities. Fish fry cannot enter floodplains, because the entry of floodwater into the areas is delayed. Rahman and Huq (1994) state that indiscriminate construction of flood

control structures has impeded water flow and floodplain productivity. They estimate that some structures may have reduced indigenous floodplain fisheries by over 70%.

According to Nishat (1993), development activities have a major negative impact on capture fisheries. They substantially reduce the area of regularly inundated floodplains and the area of permanent beels, and they block fish migration routes. Many fishers have lost their livelihoods, or changed the location of the fishing activities from floodplains to rivers. This has led to overfishing in these river areas thus adversely affecting fish migration potential. The magnitude of these losses is usually substantially more than has been previously estimated. Nishat (1993) adds that the absence of integrated flood control and fisheries planning has led, in some cases, to acute social conflicts between fishers and farmers.

The United Nations Development Programme (UNDP) report on Human Development in Bangladesh (UNDP 1995) points out that activities undertaken to increase rice production have undermined fisheries and other natural resources relied on by poor people. This has caused a shift in the use of common property resources away from poor people to wealthier property owners. The report adds that as a consequence of irrigated boro cultivation, an increasing quantity of wetlands are being drained, thus jeopardizing their availability as a sources of food, fuel, fodder and other basic materials for poor people.

***Pesticide use and Chemical Pollution***

Dumping poisonous industrial effluents and wastes into the openwater system, and the use of agricultural biocides with long-term residual effects, are damaging fisheries resources (Karim and Ahsan 1989). The FAP-6 fisheries study (FAP-6 1993) states that the increase in the use of pesticides in the region has paralleled the introduction of modern rice varieties. This presents a threat to floodplain fisheries as it leads to contamination of fish flesh with pesticides, which have moved up the food chain. This renders the fish flesh unsafe for human consumption. In Bangladesh, about 90% of all agricultural pesticides are used on rice; primarily boro rice. The use of pesticides is regulated by the Pesticide Ordinance of 1971 and the Pesticide Rules of 1985, but these regulations are not well enforced. Ali (1994) notes the occurrence of chemical pesticides in the khals and ponds within the Meghna-Dhonagoda Irrigation Project area and resultant mortalities of fish.

According to ESCAP (1988) less than 75% of agricultural chemicals applied remain in the soil. Thus, more than 25% of chemicals applied (and more than 40% of fertilizers applied) are washed away. These chemicals can kill fish, especially fry. Excessive use of agricultural chemicals in Bangladesh has seriously harmed fish habitats, fish fry and fish production.

Insecticides account for about 95% of pesticide use. According to the PhD research findings of Bhouyain (1995), laboratory tests show that nogos and dimecron are highly toxic to fish (*Oreochomus mossambicus*) and fish food (*Diaphanosoma brachchyum* and *Diaptomus gracilis*). In field tests the nogos and the dimecron had no such effects on the physicochemical properties of the pond water but they had a negative influence on primary productivity and zooplankton production. Bhouyain's research provides strong evidence that aquatic organisms such as phytoplankton, are affected even by very low doses of organophosphorous pesticides.

In the Year Book of Environmental Pollution Control, EPC (1980) points out that pesticides and heavy metals are the most common water body pollutants. Freshwater resources in

Bangladesh receive large quantities of pesticides in every year, and every day they also receive large quantities of untreated industrial waste water that contains poisonous substances such as mercury, copper, zinc and cadmium.

***Irrigation Water Withdrawal – Impacts on Fish and Fish Habitats***

Karim and Ahsan (1989) describe how drainage or pumping out water from the low-lying beel areas, in order to allow use of land for agricultural purposes, is completely destroying fish populations. Pumping out water from canals in order to irrigate agricultural areas compounds this problem. Some 11.3 lakh hectares of cropland is currently irrigated, and demand for water peaks during the dry months of January to April. This is the time when the area and volume of surface water is at its lowest. Those fish, prawn and other aquatic animals that can survive in these shrunken dry season water bodies are vulnerable to fishing and other density dependent factors such as disease and malnutrition. Abstraction of water for irrigation exacerbates these problems as it further reduces aquatic habitats (MPO 1987b).

The government of Bangladesh has introduced a number of new technologies for growing more rice, including irrigation provision for High Yield Variety (HYV) rice fields. The government supplied low lift pumps to irrigate crop fields. These pumps took water from the rivers, canals, beels and ponds. As a result, many fishing areas dried out in the dry season. Low lift pump irrigation was replaced by the introduction of shallow tube well irrigation, which extracts water from groundwater sources. However, low-lift pump irrigation technologies still exist, and people still use these pumps to drain water bodies in order to harvest all the fish. This process is called de-watering.

## Organizations and their Responsibilities

Several agencies and organizations are involved in the fisheries sector. The Ministry of Fisheries and Livestock (MOFL) is the lead agency responsible for formulating fisheries policy and development strategies. Under the MOFL, the following agencies are involved with fisheries development and management with a view to increasing fish production and improving fishers' livelihoods:

(i) Department of Fisheries (DOF) - responsible for management, development, training, extension and regulations enforcement.
(ii) Bangladesh Fisheries Development Cooperation (BFDC) - responsible for marketing and creating marketing facilities, including commercial exploitation.
(iii) Bangladesh Fisheries Research Institute (BFRI) - responsible for undertaking field needs-based research.
(iv) Marine Fisheries Academy - responsible for training cadets for marine fishing vessels.

The Ministry of Land (MOL) is the most important of the other agencies involved in the fisheries sector. It is responsible for managing the leases of all water bodies (fisheries) above 20 acres (eight hectares). Other government agencies with activities related to fisheries resources, fish habitats, financing, socioeconomic issues etc. include the Ministry of Water Resources, BWDB, the Ministry of Environment and Forests, the Ministry of Education, the Ministry of Local Government and Rural Development (LGRD) and Cooperatives, and the Ministry of Finance/Banks. All these government agencies have their own policies, institutions and regulations, which due to a lack of coordination can sometimes affect fisheries resources and fishers' interests. NGOs and community-based organizations are also involved in fisheries management and development activities.

The Fisheries Division, under the Ministry, oversees fisheries resources planning, development and management through the DOF. There are district and upazila level officials all over the country to take care of fisheries resources on behalf of the DOF. Many NGOs also work under the guidance of the DOF to organize stakeholders and develop their skills, access and financial strength for fisheries resources development, mainly in public water bodies. But the MOL is responsible for controlling and managing public water bodies through the Deputy Commissioner's (DC) administrative machinery. The MOFL has no control over such water bodies. Institutional conflict over the distribution of rights and responsibilities for access to and control over the environment where fish live therefore exists at the very top of the management hierarchy.

Nishat (2002) states that building institutions is more difficult when the framework is a structure rather than the habitat and the system as a whole. BWDB also plays a key role in this regard. The DOF has little role to play unless a fish pass or fish friendly structure is officially 'handed over' to it by BWDB. This handing over is often associated with access to resources to operate, manage and maintain such structures. As the implementing agency, BWDB is responsible for the maintenance of all structures, including fish passes and fish friendly structures. Accordingly, the government of Bangladesh allocates revenue to BWDB. The DOF cannot draw directly on these resources for operation, management and

maintenance, even if the structure is handed over. This makes DOF work on building appropriate institutions to manage fish passes and fish friendly structures particularly challenging. Conflicts of interest between the MOL, DOF and BWDB over public water resources have affected fisheries activities in Bangladesh for many years.

**Local Government Institutional Bottlenecks**

The institutional capabilities of local organizations are poor in terms of their structure, personnel skills, work efficiency, responsibilities, accountability, and links and interactions with people and other organizations. Formal local government organizations at village and upazila levels (and their related departments) usually function in a top-down way. They depend on central government and work with their respective departments and ministries. There is therefore little interaction and integration between programmes (agriculture, fisheries, water development, road construction etc.) at village and upazila levels. Although NGOs have emerged as vital local organizations (for micro-credit, employment generation and poverty alleviation etc.), they very often have poor relations with government organizations working in the same locality.

Government officials often neglect their duties and do not come to the villages to perform their work (agriculture, fisheries, livestock, health and forestry). Local people are also not conscious about the activities of government officials and their rights in his regard. Most people remain passive and indifferent about local government activities. There is also a lack of supervision and monitoring of government programmes by higher levels. Corruption and misappropriation of resources occurs at several levels of government activity. The quality and achievements of local level government activities is therefore very poor.

Soussan and Datta (1998) state that government institutions involved in rural development (for example agriculture, fisheries and water sector development) are centralized, top-down, authoritative and unresponsive to local needs. They also state that the organizational structure of local government bodies (such as BWDB) is usually inappropriate for the management, operation and maintenance of their assigned programmes/activities. Such bodies can implement projects but do not have much operational flexibility and capacity to respond to complex locally specific circumstances.

Local government organizations are supposed to serve people according to their needs and priorities, but have little space to encourage genuine local participation in their activities. Soussan and Datta (1998) say that many of the problems, which an institution such as BWDB needs to respond to, are not technical. Rather, they might involve reconciling the needs and interests of different stakeholder groups, mitigating water management conflicts and balancing complex social, economic, environmental and technical issues in decision-making processes. This requires some degree of legitimacy so that different stakeholders accept decisions reached even if they require some level of compromise. Soussan and Datta (1998) stressed that existing institutional frameworks cannot and do not address the true needs of local people. Rather, they often address the vested interests of certain powerful groups. The institutions lack interaction and coordination among themselves, and there is a need to establish a new, more responsive, efficient and integrated institutional framework for managing natural resources such as water, and addressing the needs of local people and ecosystems. Rahman *et al*. (2003) also comments that Bangladesh lacks a coordinated and integrated institutional framework for sustainable natural resource management, resulting in fragmented and ineffective approaches. This is

problematic as natural resource systems are under tremendous pressure to provide different services and benefits to a variety of stakeholders.

## Fisheries Administration and Management

The term 'fisheries management' is used in Bangladesh to imply the lease and management of *jalmohal* or *jalkor* (water estates). These include rivers (or segments of rivers), beels, baors and other water bodies. Jalmohals are public property, owned and leased out by the MOL for the accrual of rental income. All water bodies/fisheries except flooded land, manmade ponds and shrimp farms, are public property owned by the government and controlled by the MOL.

Current fisheries management arrangements began when Permanent Settlement Regulation 1 was proclaimed in India. Under this Regulation, large chunks of land were permanently given to landlords (*zamindars*) (Ali 1992). Such zaminderies or estates included not only land, but also portions of large rivers (like the Ganges/Padma, Brahmaputra/Jamuna and Meghna) or their tributaries, their floodplains, beels (deep depressions in the floodplains) and baors (oxbow lakes, or old river bends cut off from the main river). These water bodies or Jalmohals became the private properties of landlords who leased them out to earn revenue. Lease periods varied from one Bengali year for open water bodies such as a riverine jalmohal, to three years for beels, baors and other closed water bodies. There are currently about 10,000 jalmohals. They include man-made tanks and ponds in the old *zamindars* (Ali 1997).

Through the State Acquisition and Tenancy Act of 1950 (East Bengal Act - XXVIII of 1951) the then Government of East Bengal (later, East Pakistan, and now, Bangladesh), acquired the right to receive rent from *zamindars*. The then Revenue Department of the provincial government thus became the owner of all jalmohals, including homestead tanks and ponds in the *zamindars*. The Revenue Department of the provincial government (now known as the MOL) retained the jalmohal administration and management systems previously practiced by the landlords. The only change that occurred was that the Revenue Department and the attached Board of Revenue administered the lease of jalmohals through District Collectors (now designated as Deputy Commissioners).

Open auctions were held to grant the leases of jalmohals to the highest bidders. The base rent (lease value) for a jalmohal to be put up for auction was determined by taking an average of the lease value for the preceding three years or three lease terms, and increasing that by 10%. Under this arrangement, landlords (or other influential people) obtained the income from the jalmohals.

The lease system involved placing any jalmohal above 20 acres (eight hectares) on open auction where anybody could participate (Khan *et al*. 1994). After independence, the MOL Administration and Land Reforms decided to restrict the first round of jalmohal auction to fisher's cooperative societies due to pressure from fishers. Such cooperative societies had to be registered with the Department of Cooperatives department. This change was instituted with a view to helping poor fishers. Lease settlements were made with cooperative societies offering the highest rent. Such offers had to be 25% higher than the preceding year or term of rent. If a fishers' cooperative society failed to make a bid or failed to offer the base rent predetermined by the authority, the jalmohal was put up for auction for a second time. This time anybody could participate in the auction and obtain the lease. This procedure was partially amended by the MOL in 1994. According to this amendment, if no offer of rent incorporating an increase of 25% over the preceding term's rent is received even after invitation of tenders for three times in

succession, tender would be invited for the fourth time when the restriction of 25% increase over last term's lease value will be lifted (Ali 1995).

The successful tenderer has to pay 50% of the bid value as soon as tender processing is closed, and the remaining 50% is to be paid within the next seven days. A tender committee was constituted in each district with the Deputy Commissioner of the district as Chairman, Additional Deputy Commissioner (Revenue), District Fisheries Officer, and District Cooperative Officer as members and Deputy Collector (Revenue) as Member-Secretary. Three members including the Chairman would constitute the quorum to conduct the business of the committee. This committee was empowered to process all tenders and make lease settlements.

**Management of Small Jalmohals**

Jalmohal leasing is currently determined by the MOL under memorandum number Bhumi/7/5/91/424(12) dated 12 September 1991. In 1984, management of jalmohals up to 20 acres (eight hectares) in area was given to Upazilla Parishads for management on the condition that Upazilla Parishads pay 1% of income from such jalmohals to the MOL. In 1997 they were transferred again to the Ministry of Youth and Sports, to create employment for the youth community. The Union Parishad manages water bodies up to three acres (1.2 hectares) for use as a common property resource for drinking water, bathing, fishing, jute retting etc. by local people. The MOL manages all other open and closed jalmohals of more than 20 acres.

**Incentives for Mismanagement and Exploitation**

The leasing management policy is mainly for revenue collection and goes against the principles of ecological management of fisheries resources or the rights and interests of the fishing community. Once possession of the leased jalmohal is handed over to the lessee, he treats it as his private property and exploits the fish/prawn resources in it to maximize income. Short lease terms of one to three years encourage overfishing.

In 1995, the leasing of riverine jalmohals was abolished under notification No. Bhumi/Bibidho-11/95/576 dated 4 September 1995 of the MOL. This abolition without any alternate management arrangements has reportedly resulted in the plundering of fish and other aquatic animal resources in the rivers.

Giving preference to fishers' cooperative societies has led to the formation of many such societies. But although the system appears to favour the fishing community, in most cases poor fishers cannot access fisheries because of their poverty, their lack of organization and the influence of powerful groups. Few fishers have property rights on inland fishing grounds. Rather, these rest with socially powerful agents who are not part of the fishing community (Toufique 1997). These socially powerful agents are often the same people who historically had the jalmohal leases. Sometimes they form a cooperative society to get the lease for a Jalmohal, and sometimes they pay the lease money on behalf of a genuine society but then control the fishery. Fishers must then work on contract basis, share basis or as labourers. Poor fishers are therefore always deprived and exploited, and conflict between fishers and leaseholds is common (Khan *et al.* 1994).

## Fisheries Management by Other Owners

Several other government agencies own waterbodies. The Department of Forests owns several large and small rivers, canals and creeks within the Sunderbans Reserve Forest. The administration and management of fishing in these waters is confined to collection of tolls, taxes and rents from fisherman and fishing boats entering and passing through the reserved forest area by the Forest Department. Fishers and fish traders must pay a Boat Licence Certificate (BLC), a dry fuel consumption fee (DFC) and a levy on different varieties of fish, prawn and dry fish in their boats at different rates. The Forest Department thus earns significant revenue from fishing and fish transportation activities.

BWDB and the Department of Roads and Highways create water bodies such as canals and ditches. Such water bodies are leased out through open auction by the owner agencies mainly for fish culture.

## New Water Management Institutions in Tangail District

The Compartmentalization Pilot Project (CPP) in Tangail District is trying to develop new institutional arrangements for improved management of local water resources through different Water User Groups (WUGs). The CPP aims to achieve this through semi-controlled flooding, controlled drainage and new institutional arrangements. The main characteristics of the proposed institutional arrangements are:

- A three tier system of representation and management related to water management within hydrologically defined areas;
- Three parties are recognized and encouraged to participate and contribute: a) interest groups, b) technical departments and c) local government;
- The foundation of all arrangements are the users of water and they will have the largest share in terms of numbers and possibly, in terms of influence;
- The arrangements will reflect the principle of ‘subsidiarity’: what can be done, managed and decided at a lower level will not be done or decided at a higher level;
- Institutions should have responsibilities commensurate with their importance and vice versa. If tasks are minimal or simple, the body that deals with them should be equally simple;
- All proposed institutions should be such that they could, ultimately, be attached to existing government agencies. This does not mean that they will necessarily become government agencies. It means that the Government of Bangladesh can allocate administrative, financial and regulatory responsibilities vis-à-vis such institutions to an existing Department, Board or Council.
- NGOs are recognized as valuable and should participate in and contribute to these institutions.

More specifically, the project proposed to take the following steps and arrangements:

- WUGs: comprising a functionally and socioeconomically defined category of people (farmers, fishers, women and landless) would be formed. These are relatively homogeneous groups as far as their interest in water management is concerned. This does not exclude differences at other levels. Within one sub-compartment between five and 20 WUGs could be identified.

- Sub-Compartmental Water Management Committees (SCWMCs): comprising representatives from WUGs and selected government field staff. SCWMCs will facilitate local resource mobilization and upward representation;
- A Compartment Water Management Committee will be in charge of water management at the compartmental level. It will comprise representatives of the SCWMCs, technical departments, NGOs and local government. The Compartment Water Management Committee will initially be preceded by a temporary institution; an Interim Compartment Water Management Committee. This Committee will oversee and facilitate project implementation and interdepartmental collaboration, and it will advise the project team. Its composition will be similar to the SCWMC (Euroconsult and others 1994).

In the initial stages, the project identified several institutional problems: low levels of agreement and cooperation between government agencies such as the Department of Agricultural Extension (DAE) and BWDB, and low participation of the stakeholder groups (farmers and fishers).

## Development Planning in the Fisheries Sector

For many decades Bangladesh openwater fisheries were neglected in terms of research and investment compared with aquaculture. Fish production from these important wetland ecosystems has been traditionally regarded as a gift from nature without need for conservation or management. Poor fishers who depend on natural wetlands have also been ignored in the past when wetland conversion to drylands to grow more rice led to their displacement.

The drop in openwater fisheries production in the 1980s attracted the attention of government, and since then, several steps have been undertaken to develop openwater fisheries in Bangladesh. Such steps include the New Fisheries Management Policy, Open Access Fisheries, floodplain stocking programmes, the Fourth Fisheries Project and various other community based approaches. These are described in more detail below.

The World Bank (1990) states that major fisheries development projects are planned, financed, and implemented by government. All the five-year plans have emphasized three key national objectives for the fisheries sector:

1. To increase fish production and improve human nutrition.
2. To increase employment opportunities.
3. To increase seafood exports.

The fourth five-year plan added three new objectives:

1. To increase GDP.
2. To improve the general environment and public health.
3. To improve the socio-economic conditions of the fishers, fish farmers, and others engaged in the fisheries sectors.

### *New Fisheries Management Policy*

In early 1986, the MOFL initiated a new fisheries management concept, called the New Fisheries Management Policy (NFMP). This policy aimed to ensure maximum benefits from

fishing in the jalmohals reached genuine fishers. This would involve eliminating middlemen leaseholders, and enforcing measures to sustain fisheries resources. To do this the MOFL sought to obtain possession of some selected jalmohals from the MOL on the condition that the MOFL would ensure that the MOL was reimbursed with rent for the jalmohal, with the usual increase of 10% for each term. The NFMP envisaged the following:

1. Each fisher living beside each jalmohal would be given renewable license to fish in the jalmohal in exchange for a license fee, the amount of which would be determined by the size and capability of the fishing gear and the number of fishers in the fishing unit.
2. The Thana (Upazilla) Fisheries Officer jointly with the representative of the National Fisher's Association Fishers would make a list of these fishers. The Thana Fisheries Management Committee would approve this list. Thereafter, the list would be examined and approved by the District Fisheries Management Committee. After approval by this committee, the Thana Fisheries Officer would issue renewable licenses to listed individual fishers and fishing units.
3. The Bangladesh Krishi (Agricultural) Bank was to supply credit to the listed fishers. Credit up to Tk. 6,000/- would be given without any collateral.

From 1987 to 1989, the Ford Foundation funded a study of NFMP implementation in selected jalmohals. The study - Experiments in the New Approaches to the New and Improved Management of Openwater Fisheries (ENIMOF) was conducted by the DOF, the Bangladesh Centre for Advanced Studies (BCAS) and the International Centre for Aquatic Living Resources Management (ICLARM). The study's major findings were:

- Exploitation by middlemen leaseholders was reduced in jalmohals managed by the DOF under ENIMOF and under DOF's own resources.
- License fees charged for different fishing units by the DOF were much smaller and covered a full one-year period. This compares favorably with the higher rents charged by leaseholders for short periods of time or for different seasons.
- Fishers found it difficult to obtain credit from the Bangladesh Krishi (Agricultural) Bank.
- Brush-parks or *katas* installed in the riverine jalmohals to conserve fish resources had no noticeable effects. In fact large numbers of katas were built by non-fishers in the rivers.

According to the Inter-Ministerial agreement between MOFL and MOL, implementation of the NFMP was the responsibility of the MOFL (BCAS 1989). A national level committee chaired by the secretary to the MOFL was established. The MOL was also represented on this committee. This committee identified 300 out of 10,000 jalmohals in Bangladesh for inclusion in NFMP, but the MOL only handed over 250 of these to the MOFL (FAP-6 1993).

The NFMP was implemented by the DOF under the MOFL during the first two to three years according to plan. Thereafter, the MOL took over responsibility for implementing the NFMP. Since then, the Thana Nirbahi Officer (TNO), a direct subordinate officer of the Deputy Commissioner of the district, is implementing NFMP in some jalmohals. TNO, however, works through the Thana level Jalmohal Management Committee and the Thana Fisheries Officer.

The spirit of the NFMP as envisaged at its inception has apparently disappeared. Kremer and Hat-Yai (1994) describe existing NFMP implementation as 'moribund'. Although NFMP was supposed to be managed by the MOFL, in reality the MOL controls all land on which fisheries operate. Implementing this new concept was problematic. Stakeholders had very different perceptions of what should emerge. There was also a lack of coordination between the MOL

and MOFL, both at higher and local levels. This may have contributed to the resultant failure in this policy.

### *Open Access Fisheries*

On 16 August 1995, while inaugurating the Fish Fortnight 1995, the Prime Minister announced that leasing open jalmohals would be abolished. The MOL then issued the necessary notification abolishing leasing of riverine jalmohals. Although beels, haors and similar waterbodies are components of the riverine ecosystem, the MOL treated them as closed waterbodies. But for riverine jalmohals there is no longer any specific management policy or protocol. Some have been declared closed so that leaseholders could continue to control them but most are open access resources and currently lack any controls on fishing effort or numbers of fishers. This places aquatic resources in the riverine jalmohals at the mercy of local power brokers and powerful elites.

### *Floodplain Re-Stocking Programmes*

In the early 1990s, the government tried to re-stock some openwater fisheries with fingerlings purchased from hatcheries with the intention of replenishing lost species, particularly indigenous carps that had almost disappeared from the openwaters. After some initial re-stocking from the government's own resources, two major donor funded projects were undertaken (Ali 1997).

The Second Aquaculture Development Project was undertaken by the DOF and supported by the ADB. This project included a component for replenishing indigenous major carp stocks by filling 'nursery' beels in the north-eastern districts with carp hatchlings. The Second Aquaculture Project failed due to faulty project design and implementation. The project ended up poisoning the beels, thus destroying aquatic biodiversity amongst floodplain species. In addition, there was no reliable production monitoring system.

The Third Fisheries Project (TFP) was undertaken by the DOF with support from the World Bank, British Overseas Development Administration and UNDP. This conducted a major openwater stocking exercise in the western part of the country between 1991 and 1996. In contrast to the Second Aquaculture Project, the TFP identified floodplains, and rather than stocking hatchlings, stocked these floodplains with larger fingerlings later in the year just at the beginning of the monsoon in June/July. The TFP also established an intensive fish catch monitoring program in a number of floodplains.

The results of the TFP stocking work showed that in some cases floodplain fish production increased substantially. Nevertheless the approach used to stock areas with fingerlings and prevent their capture was too top-down and lacked the support of local people, at least in the initial stages of the project. It was only later that the project recognized the need to involve local people, particularly the fishers themselves, and NGOs as partners to help organize the fishers.

### *The Fourth Fisheries Project*

The Fourth Fisheries Project aims to support sustainable growth in fish and shrimp production for domestic consumption and export, and equitable distribution of the benefits generated from this. It also aims to contribute to poverty alleviation in Bangladesh by

improving the livelihoods of poor people dependent on fisheries resources. In addition, while not directly monitored under the project, it is hoped that increased production will have important nutritional and health benefits, particularly for the poor for whom fish contribute about 60% of animal protein in their diet. The duration of the Fourth Fisheries Project is April 1999 to June 2004. Project purposes are as follows:

- Improve the access of poor people to aquatic resources for food and income.
- Improve the capacity of local users to manage aquatic resources in a sustainable and equitable fashion.
- Sustain and where possible enhance the production of fish and shrimp by small-scale activities.
- Improve employment opportunities and income for small-scale producers.
- Improve the capacity of the DOF and other relevant public sector agencies, to effectively support private sector fisheries.

The project has five major components:

1. Open-water fisheries management.
2. Shrimp and coastal aquaculture.
3. Fresh water aquaculture, extension and training.
4. Aquatic resource development management and conservation studies.
5. Institutional support.

The Fourth Fisheries still relies on local NGOs to help communities with byelaws and accounts. This is despite the fact that the project has been active for several years. It demonstrates the fact that weak capacity and corruption can be very problematic. Legitimate committees are needed, but empowering weak people is problematic, especially when project leaves.

***Community-based Approaches to Fisheries Management***

In addition to the major stocking projects funded by the ADB and the World Bank, from the mid-1990s, a number of smaller scale pilot projects have been conducted. One such project includes the Oxbow Lakes (mainly closed water bodies) project funded by Danida and IFAD. These projects have emphasized the participation of fisher communities. They have focused more on social development and conservation of fish stocks for sustainable catches rather than on stocking. New approaches are slowly recognizing the importance of using interdisciplinary approaches in partnership with fishing communities (Allison and McBride 2003). Calls for government to re-evaluate tradition top-down approaches to fisheries management and replace them with bottom-up participatory approaches are increasingly common (For example see Rahman and Ahmed 2002). Rahman and Ahmed (2002) also stress the need for bottom up processes and consultation during sluice gate construction and management.

Another project is the Community based inland openwater fishery management and development project initiated by the DOF in 1995. The project idea evolved from participatory action research. The project intends “to ensure more sustainable exploitation of openwater fish resources, including protecting natural recruitment of indigenous species to the fisheries for the future generations” (DOF 1998). Selected jalmohals are formally transferred by the MOL to the DOF, on the condition that rent is paid to the MOL. This rent was to be 25% higher than the preceding term’s lease value. The DOF then works in collaboration with a large number of

national NGOs like BRAC, CARITAS and PROSHIKA, and with local NGOs like Banchte Shekha, BAZI and CRED. These NGOs organize and help fishers to actively participate in the management of the jalmohal. They help develop and strengthen fishers' organisations and develop appropriate institutions for co-management, and they improve the livelihoods of poor fishers including helping them develop alternative income sources.

The project has completed pilot exercises in several openwater bodies. The Ford Foundation provides funding, and ICLARM (located in Manila, the Philippines) provides technical assistance to the project. ICLARM also ensures coordination between project partners. A team from the DOF conducts surveys and monitoring and feeds back information to project participants (DOF 1998). It is too early to say that the project can provide a sustainable approach to the management of openwater fisheries, and further project pilot work is needed to determine the sustainability of existing local community management arrangements and benefits reaching the community. Project results in a range of beels and some rivers are encouraging, but success has been limited by a lack of formal recognition of fisher rights and by the short duration of the project. The second phase of this project has begun, with DFID in place to assess it.

## The Potential of Improved Sluice Gate/Regulator Management

Whilst fish friendly structures might go some way towards improving the success rate of fish passage into empoldered flood plains, de Graaf *et al*. (2001) stress, that "a major impact could be expected if a programme would focus on the improvement of the management and where possible on the adaptation of existing regulators in the river system." Major carp and other white fish instinctively swim upstream to migrate, and are positively attracted to fast flowing moving water. However, if the speed at which water flows out of compartments is too fast, the time of year that sluice gates are open too late or too early, such fish will not be able to enter the compartment and hence the floodplains to spawn.

Altering the opening times and discharge rates of sluice gate/regulators could increase fish stocks in compartments if the migrating behaviour of fish in understood, along with technical issues likely to decrease sluice gate penetration induced mortality. However, obtaining this technical knowledge is just the first step in ensuring that any optimal sluice gate management protocol is then implemented.

Decisions on when to open regulators are made by a variety of different stakeholders. Committees sometimes exist, but few function effectively. Sluice gates are usually managed according to the needs of rice farmers, who may have different interests to those of fishers, who are often the poorest and least powerful stakeholders in any decision-making process that does occur. Implementation of any optimal sluice gate management protocol is therefore by no means guaranteed.

Mutual benefits for fishing and farming are possible (Hoggarth *et al*. 1999a; 1999b). Particularly in view of the fact that many fishers are also farmers and vice versa. For example, opening the sluice gates during early floods could allow compartments to drain and migrating fish to enter. Likewise, periodically through the flood, pulses of larvae and eggs drift downstream, and if sluice gates were open, fry could get washed into the flood plain (Marttin and de Graaf 2002). De Graaf *et al*. (2001) produced a hypothetical model of how this could operate with sluice gates in the CPP in Tangail. Whilst such mutual benefits are possible, the institutional, social and decision-making processes determining sluice gate

operation may not allow these to materialize. This will require the active involvement of local fishing communities and the reconciliation of conflicting interests between farmers and fishers (Sultana and Thompson 1997). A good understanding will be needed of existing farming and fishing operations both inside and outside compartments in order to evaluate the potential for change.

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