MACH

Technical Paper 4

Wetland Protection and Enhancement through Sanctuaries in Bangladesh

Management of Aquatic Ecosystems through Community Husbandry

January 2006

A project of the Government of Bangladesh
Supported by USAID
Project Partners:
Winrock International
Bangladesh Centre for Advanced Studies (BCAS)
Center for Natural Resource Studies (CNRS)
CARITAS Bangladesh

Wetland Protection and Enhancement through Sanctuaries in Bangladesh

MACH
Technical Paper 4

Md. Liaquat Ali and Paul Thompson

January 2006

Dhaka

Winrock International
Bangladesh Center for Advance Studies
Center for Natural Resource Studies
CARITAS Bangladesh

ABSTRACT

The inland open water fisheries of Bangladesh have experienced a significant decline during the last four decades due largely to man-made causes such as over fishing, use of destructive fishing methods, degradation and loss of fish habitat, and short-sighted management. Due to loss of water area in the dry season, fish have become more vulnerable to fishing, which results in a disproportionate loss of brood stock, posing the risk of depleting the stock to below replaceable levels. Since the 1950 Conservation and Protection of Fish Act, the government has taken up measures to protect and conserve fisheries resources.

Since 1960 fish sanctuaries have been established by the government through different development projects, but these have not been sustainable. As soon as the projects were over, the sanctuaries ceased to exist. However, during the last decade fish sanctuaries have been established as part of testing community participation in management regimes through different projects such as, MACH, CBFM-2, FFP and other government financed projects. In most cases sanctuaries have been established in part of the water bodies leased to the community organization for fisheries management. Presently a total of 426 fish sanctuaries are reported to exist in 257 water bodies in Bangladesh.

Under the MACH project, which has been implemented since 1999 in three sites namely Hail-Haor, Turag-Bangshi and Kangsha-Malijhee basins, a total of 56 fish sanctuaries covering 173 ha have been established. These sanctuaries have shown positive impacts on increased fish catches and biodiversity. Under the MACH project one substantial area in Hail Haor comprising of two entire beels has been set aside by the government as a permanent central sanctuary outside of leasing, setting a precedent for nationally significant wetland sanctuaries.

The MACH project objective is to develop and demonstrate a community-based approach to sustainable natural resources conservation and management in aquatic ecosystems through a set of management interventions. The establishment and management of fish sanctuaries has been considered to be one of the most appropriate and effective measure for sustainable management of the fisheries resources of the aquatic ecosystems under MACH project.

Selection of a site for a fish sanctuary needs to be technically, socially and environmentally appropriate if it is to be effective and sustainable. Management of the sanctuary including proper enforcement against poaching is the key activity for its success. MACH project has ensured this by involving the community at all stages in planning and implementation. MACH and the communities have also assured this by putting FADs or Fish Aggregating Devices into sanctuaries for protection from illegal netting and harvest and to provide substrate for food and shelter for fish.

A major gap and issue in the sustainability of fish and wetland sanctuaries in Bangladesh is their status, planning and recognition. The government now proposes that more fish sanctuaries be established, but how this will be achieved is not clear. The growing consensus view of small sanctuaries established within part of water bodies managed by local communities (in the case of MACH including all categories of stakeholders and overseen by a co-management body including local government) has by now shown positive impacts and appears to be the main way forward. There is also space for larger wetland sanctuaries to protect habitat, fish and other wildlife, but these also need to be planned and managed through community participation and should not displace fishing communities.

How large an area of ecosystem/water body should be devoted to sanctuaries and how big an individual sanctuary should be, are key questions for planning. For inland water bodies no definitive answer or model to address these questions has been developed. However, different experts have suggested from their empirical knowledge and experience that about 10% of the dry season area of a water body should at a minimum be devoted to sanctuary. The Department of Fisheries in its draft Inland Capture Fisheries Strategy also suggests 10% of dry season water area should be protected as

sanctuary. The sanctuaries established by MACH protect 5.3% of the dry season water area in three large wetlands.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the valuable support and inputs from a number of individuals and organizations for this study. The Department of Fisheries and its different projects including Fourth Fisheries Project (World Bank, UK Department for International Development - DFID), Community Based Fisheries Management Project phase-2 (DFID), Fisheries Management under New Fisheries Policy (Government of Bangladesh - GOB), Fish Culture Development Project in Jabai Beel in Naogaon district (GOB), Fish Culture and Fisheries Management in Beels and Charas in Western Bangladesh (GOB), Aquaculture Development Project (International Fund for Agricultural Development - IFAD), Patuakhali and Barguna Aquaculture Extension Project (Danish International Development Agency - DANIDA), have provided necessary information regarding fish sanctuary establishment. In this respect we are grateful to Mr. Mahabubur Rahman Khan, Project Director CBFM-2 Project, Mr. S. Kabir Hossain of CBFM-2 Project, Mr. Akhtar Hossain of Jabai Beel Project, Mr. Wahidunnabi Chowdhury of PBAEP, Mr. Mohammad Hossain of ADP, Mr. Shapan Kumar Deb of Fish Culture Project in Western Bangladesh, Mr. Kafiluddin Kaya of Fourth Fisheries Project, Mr. Zahirul Islam, consultant of Fourth Fisheries Project, and Mr. Arjul Chandra Chanda of Department of Fisheries for their cooperation in providing information.

The authors also acknowledge the support and suggestions of Mr. Mokhlesur Rahman of Centre for Natural Resource Studies (CNRS), Dr. Khabir Ahmed of Bangladesh Agricultural Research Council (BARC), Mr. Sachindra Halder of CNRS, Dr. Munir Ahmed of TARA, and Darrell Deppert the Chief of Party of the MACH and MACH II project. This report is a product of the MACH II project sponsored by USAID and implemented by Winrock International and partner organizations CNRS, BCAS and Caritas.

Table of Contents

Tables

1. INTRODUCTION

Located in the delta of two major rivers, Bangladesh possesses vast natural inland waters in the form of rivers, canals, *beels* (floodplain depressions), *haors* (deeply flooded basins in the northeast), and seasonal floodplains. These inland fisheries have provided Bangladeshi's with a large food supply and made Bangladesh one of the top three countries for freshwater fish production (FAO, 2003) along with its two large neighbors – China and India. The total inland water area amounts to about 4.05 million ha, comprising: seasonal floodplain 2.83 m. ha, rivers 1.03 m. ha, beels 0.12 m. ha, and reservoir 0.07 m. ha. The inland waters are inhabited by about 260 species of fish (Rahman 1989), 25 species of shrimp and a range of aquatic plant species of subsistence and commercial importance. In addition, Bangladesh has a large complex area of estuarine and coastal waters and islands, and holds use rights over 164,000 km^2 of the Bay of Bengal, these marine and coastal areas support about 475 species of fish and 36 species of shrimp (DOF, 2005a). In 2003-2004 the country produced an estimated 2.10 million tons of fish, of which inland capture fisheries contributed 35% (730,000 tons), freshwater aquaculture contributed 38% (800,000 tons), brackish water aquaculture 5% (120,000 tons), and marine fisheries 22% (460,000 tons) (DOF, 2005a).

In the past the major source of fish production in Bangladesh was the inland open water fisheries, which, even during 1960s, contributed about 90% of the country's total fish catch. Inland capture fisheries have always played a very important role in employment generation and in animal protein supply in rural Bangladesh. About 60-70% of rural households undertake some sort of fishing either for livelihood or for household own consumption (Minkin et al., 1997; Thompson et al., 1999). About 0.77 million full time fishers depend on inland fisheries for their livelihoods and another 10 million people including poor and middle class people are engaged in part time fishing, in fish transportation, distribution, trade, input supply (net, boat, ice, etc)(MOFL, 1998). Inland fisheries are still the main source of animal protein in the diet of rural people. Fish is the favorite food of the people in Bangladesh, and along with rice constitutes the traditional diet. Around large wetlands the percentage of part time and household fishing goes up. In some areas more than 80% of the households fish at some time during the year.

Floodplains play a vital role in these inland fisheries. About two thirds of the country's land is flood prone and more than one third of the land remains under water every year for 4-6 months during the rainy season (Ali 1997). The floodplains are rich in fish food and various nutrients. At the onset of the monsoon, fish migrate from the rivers to the floodplain for breeding, feeding and growing. In addition many local resident varieties of fishes also breed and grow in the floodplain. The riverine fishes that grow in the floodplain partly return back to the river with receding of flood water and the rest are caught or find shelter in suitable perennial water bodies in the floodplain. The floodplain/wetland resident species also accumulate in the deeper parts of floodplains and wetlands known as beels, which serve as dry season refuges for fish that will form the next year's breeding stock.

Due to over fishing, use of gears that target juvenile and migrating fish, degradation and loss of fish habitats, obstruction of fish migration routes by construction of embankments and water control structures to increase agriculture production, rapid siltation of water bodies through increased river sediment, and water pollution by industry and agri-chemicals, the natural inland fish stocks, including those of the floodplains, have declined significantly and biodiversity has been adversely affected (Ali 1997). Many floodplain/wetland areas have been brought under Flood Control and Drainage projects which have drastically reduced dry season water areas leaving fewer suitable water bodies for survival of fish. Embankments and flood protection gates and sluices have obstructed fish migration from the main rivers to the floodplains for the purpose of breeding and feeding resulting in a decline of the fish stock in the floodplains. Livelihoods of those who would depend on inland fisheries have been affected and fish consumption has fallen.

To reverse this trend and ensure sustainable inland fisheries, various development and management measures have been implemented by the government, with international, bilateral and domestic resources. Among the management interventions adopted, the establishment of fish sanctuaries has recently been considered to be one of the most effective techniques for protection and conservation of

the inland fisheries of Bangladesh. This paper highlights the experience, lessons and prospects of fish sanctuaries in the inland fisheries of Bangladesh. It focuses in particular on the approach and attempts to establish permanent fish and wetland sanctuaries in some critical floodplain ecosystems through the USAID supported project "Management of Aquatic Ecosystem through Communities Husbandry" (MACH). This project has been carried out by Winrock International through a grant from USAID and local currency funds jointly awarded by the US and the Bangladesh Government. Winrock has worked through three local partners the Center for Natural Resource Studies (CNRS), the Bangladesh Center for Advanced Studies (BCAS) and Caritas Bangladesh.

2. PAST EXPERIENCE OF FISHERIES CONSERVATION IN BANGLADESH

A renewable aquatic living resource like fish, when under exploitation, needs a management regime as it is not inexhaustible. Experience has shown that unregulated (open-access) harvesting leads to depletion of fish stocks. Therefore management measures are needed so that young fish are protected to grow before capture and enough are left as breeding stock for future generations. Even if effort is limited to sustainable levels, enough suitable wetland habitat with sufficient productivity and congenial ecological conditions needs to be ensured. These concepts are not new, regulation of effort, but not habitat protection, was incorporated in the Indian Fisheries Act 1887, which was the first legal instrument adopted in the then British India and applied throughout whole of India including state of Bengal part of which is now Bangladesh (Jhingran 1983). That act provided for: (i) restriction of fishing using explosives or poison, (ii) restriction on erection of fixed engines (Any net, cage, trap or other contrivance for catching fish, fixed in earth or made stationary in any other way) and construction of weirs, and (iii) restriction on gear type, season of use and mesh size of nets. In many states of India rules were framed and implemented under this act, but there is no evidence of implementing this act in the Province of Bengal. In 1950, the then East Pakistan (now Bangladesh) Conservation and Protection of Fish Act 1950 (the "Fish Act") was passed. The Fish Act 1950 provides for regulations to be introduced covering: (i) restriction on size at capture of some fish species for a specific period, (ii) restriction on catch of any species for specific time or season, (iii) closure of fishing in any water body for any time period, (iv) restriction of fishing by dewatering or any other destructive method, (v) restriction on the use of any kind of gear and mesh size of net, (vi) restriction on placing fixed engine in a water body, which may hamper fish migration.

In Bangladesh attempts to limit fishing effort to sustainable levels and more recently to halt or reverse the rapid decline in inland fish catches and threat of national extinction for several fish species have been taken over the last half centaury based on the Protection and Conservation of Fish Act 1950. Any such measures have been difficult to implement due to institutional weakness of the implementing agencies, influence of local elites, fishing pressure from many poor people, and lack of local ownership of decisions. Besides the Act only provides a framework and does not ensure that rules on fishing efforts will achieve a sustainable level, which is the focal point of biological management of fisheries resources. Moreover, it is very difficult to implement top-down restrictions in the very complex system of inland fisheries in Bangladesh and in the context of the socioeconomic condition of the people dependant on fishing for their livelihoods. This experience has been repeated in other countries in the region.

The dry season is the most critical time for floodplain fisheries. During this time fishes, including migratory species, are trapped in the floodplain depressions and become increasingly vulnerable to intense fishing pressure as the floodwaters recede. Survival of fish in the wetlands of the beels and haors during the dry season is directly related to the water level remaining in the depressions. Fish are exposed to greater predation and increased susceptibility to capture as the water level drops due to water extraction for irrigation and evaporation in the relentless heat of the dry season. Loss of surface water in the dry season, for whatever reason, results in a disproportionate reduction in the parent fish stock, posing the risk of depleting species to below replaceable levels.

Under the provision of the Fish Act of 1950 fishing can be prohibited in any water body for any period. The Government of Bangladesh has established fish sanctuaries in different water bodies from time to time. In addition to improvement of fish habitat, silted up beels, *baors* (oxbow lakes) and link canals have been excavated by the government through food for work programs at various times. By

the year 2000 a total of about 8,300 hectares of water area of ponds, borrow pit, oxbow lakes, dead rivers, canals and beels had been excavated under this program (DOF, 2005a). However, all of these measures were ad hoc and did not form part of a longer term plan to protect wetland and fishery habitat.

In the late 1990s the government approved a series of sectoral policies, of these the National Fisheries Policy (MOFL 1998), National Water Policy (MWR 1999), National Environment Policy (MOEF 1995), and national land use policy 2001 (MOL 2001), jointly place a new emphasis on maintaining and protecting the remaining inland water bodies. For example, the National Water Policy requires that while planning, designing and implementing water management projects care should be taken so that fisheries are not affected and adequate provision should be made in water control structures to facilitate fish migration. Draining of remaining wetlands at least at the policy level is now banned, and the National Environment Policy envisages measures to restore water bodies for fish production. Notably the National Fisheries Policy 1998 includes establishment of fish sanctuaries as one of a series of policy directions although it does not elaborate what status such sanctuaries would have or the processes to be adopted.

Over time, particularly in the last two decades of testing different management regimes for inland open water fisheries resources, the main focus has drawn towards community and local government co-management of wetland resources. The Government is now developing a series of strategies for implementation of the National Fisheries Policy, one of which covers inland capture fisheries and emphasizes access control rather than revenue generation, and community participation, along with sanctuaries as a key management measure (DOF 2005b). It also provides for setting up a local committee in each Upazila termed the Upazila Fisheries Committee or UFC that would coordinate between local government and community organizations for sustainable fishery and wetland management. The lessons drawn in this paper are directly relevant to the actions plans for implementing these strategies.

3. FISH SANCTUARIES

In the context of limited legislation and general fishing rules that are difficult to enforce, intense fishing pressure, complex local power relations and use rights, continuing loss of dry season fish refuges, fish sanctuaries have received recent emphasis. Sanctuaries, reserves, protected areas and “no-take zones” have proved to be effective tools for conservation of fish resources in many countries both in inland and marine waters. They now appear to be the most effective mechanism for protection, conservation and management of inland fisheries in Bangladesh. The establishment and management of fish sanctuaries appears to be easier than most other management interventions and they are popular with fishing communities. However, the effectiveness of sanctuaries depends on several key factors such as identification of the type of sanctuary needed, selection of water body, appropriateness and compliance with the rules introduced.

Depending on the purpose the sanctuary may be seasonal/ temporary or permanent. One factor is the lifecycle of the main species being protected, fish species that attain maturity within a year or even spawn twice a year need only a few months refuge in the dry season and then they are capable of repopulating seasonally flooded land. The refuges for these species need only be seasonal to ensure that they survive to reproduce, this is mainly the case for small floodplain resident species. On the other hand fish species such as major and minor carps that require several years to mature to breeding age need a permanent refuge so that enough can live and grow there until they reach breeding age/size and can then spawn either within the same sanctuary or in a seasonal sanctuary area in suitable habitat.

Sanctuary planning is more complex than a decision on seasonal or permanent duration; scale and level of importance are also factors. Sanctuaries are specific defined areas where uses are not permitted and wetland habitats are protected. This naturally serves to protect fish but protects also the habitat needs of other aquatic fauna and flora that support or are supported by fish. Either the sanctuary itself needs to protect all the key periods in the lifecycle of those species which collectively

means protecting a large enough area of a wetland ecosystem, or it needs to be part of a network of protected areas that maintain the habitats used by key species at different stages in their lifecycles.

Fish that attain maturity after several years tend to depend more on rivers and they also tend to move longer distances in rivers, and so sanctuaries in rivers should be permanent and cover a larger area, or there should be several. The wetland system in a given area of course supports many fish species and as a system includes beels, rivers, canals and floodplains. Key areas in each habitat type need to be protected as sanctuaries that may be small or larger, some year-round and some seasonal.

Moreover, some wetlands and species are of local importance for livelihoods, while others may be of national or international significance for their biodiversity, for example wetlands where a high proportion of certain fish species spawn in Bangladesh, or wetlands where a high percentage of the global population of water birds winter. In general sanctuaries that are intended to ensure a better catch of fish in the surrounding water body can form part of the management plan of the users and agencies responsible for that water body, and as will be seen tend to be managed by the local community in several projects. However, sanctuaries that serve national or international needs may have to be set aside without being part of a local fishery management plan and with a higher level of recognition by government. Examples of types of fish sanctuary are given in Table 1.

Table 1 Different types of fish sanctuary.

Type of sanctuary	Objective/Purpose	Characteristics
Seasonal / temporary	Protect short lived species at a vulnerable stage in their life cycle	Fishing may be closed for breeding season in the breeding ground to allow successful spawning, or in the dry season to project brood stock.
Permanent	Protect brood stock of long lived species as well as of short lived species.	Fishing is closed for the whole year for all species to develop/ protect brood stock.
Species specific	To replenish any endangered/ depleted species of fish.	To protect a particular species in its preferred habitat for all or a major part of its life cycle (fishing for other species may or may not be allowed within the sanctuary)
Harvest reserve	To increase catch and to conserve brood stock.	Fishing is closed for a certain period in a given area - say 3 or 5 years - primarily so that those who stop fishing can at the end of this time get an increased catch but it also helps some fish to breed.

4. HISTORY OF SANCTUARY ESTABLISHMENT IN BANGLADESH AND OTHER COUNTRIES

4.1 Reserve Based Fishing Systems in Bangladesh

Fish aggregating devices and harvest reserves need to be distinguished from sanctuaries but involve techniques that have been adapted to use in sanctuaries. Periodical closing of fishing in some specified area of a water body that is protected by making brush piles with branches of trees and bamboos (locally called *katha*) to attract fish thereby increasing the harvest is a traditional practice in Bangladesh and in other tropical countries of the region and of the world. If the closed period is long enough then short lived species get a chance to breed and grow before they are harvested. But if, as is more often the case, the period is shorter and almost all fish are caught from the katha leaving almost none, then it is harmful for the fish stock. In Indonesia harvest reserves are established in rivers with main objective of harvesting after one year for increased catch. Studies showed that catch in those rivers with harvest reserves has increased many times compared to that in rivers with no harvest reserves (Hoggarth, 2000). In Bangladesh numerous katha are placed in rivers, canals and beels for harvesting fish. These are harvested several times in a year and almost all the fishes are taken out giving them no chance to breed (Tsai Chu Fa et al. 1985).

Ever since the introduction of the leasing system for *jalmohals* (fisheries that may be a river section, one or a group of beels) for collecting government revenue during the British period, jalmohals in

rivers and seasonal beels were classed as annual fisheries and those in perennial beels were classed as pile fisheries. Annual fisheries were leased for one year but the pile fisheries were leased for three years with harvesting expected to take place in the third year. The management of a pile fishery includes placing brush piles and guarding against poaching. The purpose of the pile fishery is primarily to accumulate more fish in safe shelter and to protect them to grow larger so there is a greater harvest as well as to allow some fish to breed. The pile fisheries thus served as short term sanctuaries to the extent that they had a spill over effect – provided fish could escape to breed outside of the fishery. This was the one in-built conservation mechanism in earlier leasing practices. Many beels were pile fisheries, but due to siltation most of the beels have become seasonal and fishing takes place every year. The leaseholders believe that the fish go out of the pile fishery during the monsoon to graze, grow and spawn but that most of them would come back to the original habitat (pile) as flood water recedes. Brush shelters are normally placed in the pile fishery and complete harvesting is carried out at the end of the three year lease, however small fishes are harvested every year. Sometimes a few kathas are set and harvested in other years. Although there is a conservation element in this management practice, large fishes are caught once every third year.

Removing branches to harvest a kata

Another system of managing beel fisheries namely "reserve fishery" was in practice in the past. In the reserve fishery system, fishing was undertaken once during 5-7 years after a high fish stock had developed in an area. In 1967 an 80 hectare reserve fishery named Gacherdahor Fishery in Kishoreganj was harvested after a fishing closure for five years. Species-wise fish catch was recorded by the Fisheries Research Station, Chandpur and gives a picture of what the Bangladesh inland fisheries in an almost undisturbed state must once have been like. The estimated catch was an unbelievable figure of 5,134 kg/ha, with major carp (rui, katla and mrigal) constituting 35%, minor carp (calboush, ghania, nandil) 33%, catfish 18% and shorpunti 4%. (Tsai Chu Fa et al. 1985). Sadly the inland fisheries are now heavily depleted, some of these species are even threatened with extinction within Bangladesh (IUCN 2000**)**, and the reserve fishery system is no longer practiced.

4.2 Fish Sanctuaries in Bangladesh

Fish sanctuaries were established formally for the first time in some 23 strategically located beels and river sections (Jalmohals) during 1960-1965 under the Development and Management scheme of the Department of Fisheries. After encouraging results, another 25 sanctuaries were selected by the DOF and established during 1965-70 under another scheme. These water bodies were handed over to the MOFL/DOF by the Ministry of Land (MOL) for establishing sanctuaries, but on condition of continued regular payment of lease money to MOL. The sanctuaries were planned to continue permanently for all time and fishing was completely closed year round in the entire jalmohal. The management actions included placing bamboo and brush shelters in the deeper parts of the water bodies and employing paid guards. There was no provision of impact assessment of the sanctuaries. Lease money was paid from the fund provision under the project. Guarding was inadequate and inefficient. Sometimes the guards themselves indulged in illegal fishing. Although it was planned that the sanctuaries would be permanent continuing perpetually, after the scheme period was over DOF could not pay the lease and the MOL took back these water bodies and leased them out. In 1987 ten jalmahals covering an area of 8,000 ha were again declared as sanctuaries under the Integrated Fisheries Development Project of DOF. The procedure for establishing and managing these sanctuaries was the same as in the 1960s, and the fate of those sanctuaries was also the same.

Under the New Fisheries Management Policy (NFMP) adopted by the government. (jointly by MOFL and MOL) in 1986, fishing rights were directly awarded to "genuine fishers" through a licensing system for management of the fisheries on a sustainable basis by the fishers. Some 257 jalmohals of different categories were brought under the NFMP. In many of these rivers and beels it was reported that the licensed fishers established sanctuaries in part of the area they managed, and catches were reported to have increased significantly. However, no detailed information about which and how many jalmohals had fish sanctuaries was recorded and the system faced the same problem as in the earlier projects noted above, namely that MOL required the continued payment of annually increasing leases by the licensed fishers, resulting in dependence on moneyed individuals and increasing fishing pressure (Ahmed et al. 1997; Naqi 1989). But as soon as the NFMP became non-functional due to declaration of lease free access in flowing waters in 1995, the jalmahals that were under NFMP were either leased out by the MOL again or became open access and any conservation measures were lost. However, the NFMP was reintroduced in 1998 in 31 jalmohals and a project was undertaken by DOF during 1999-2003, through this sanctuaries were established in 16 of these jalmohals by the fishing societies.

Under the Flood Action Plan component 6, a sanctuary was established in 1995 for 5 years by DOF and Bangladesh Water Development Board (BWDB) on both sides of a Fish Pass constructed by BWDB at in the embankment surrounding Kawadighi Haor, Moulvibazar. The sanctuary covered 26 hectares of canals plus 500 meters of river and was intended to protect fish migrating through the structure (SNC and EPC 1998). It was managed by Kawadighi Haor Fisheries Association and the DOF/BWDB jointly, but it is reported that subsequently it is mainly used as a fish trap.

In the light of the NFMP, during 1995-1999 a more flexible pilot project named Community Based Fisheries Management (CBFM) was taken up involving NGOs, International Center for Living Aquatic Resources Management and DOF with support from the Ford Foundation. A total of 18 jalmahals and one seasonal floodplain were taken under the project. In four of them for the first time local fishing communities established fish sanctuaries in part of the water body and these were managed by the local fishers organized through the project (Thompson et al. 2003). The impact of the sanctuaries was in most cases encouraging, and these sanctuaries continued into a second phase (CBFM-2 Project).

Sanctuary and Beel Management Committee, Ashurar Beel, Dinajpur,1998, CBFM-1

The CBFM-2 project with support of the UK DFID and IFAD expanded the earlier piloting during 2001-2006 by involving more NGOs and covering about 117 water bodies including 15 of the first phase sites. However, several of these water bodies are linked (for example adjoining river sections), making about 47 sites. One or more sanctuaries have been established in part of each of the water bodies which are being managed by community groups. A total of 157 sanctuaries have so far been established under the project.

Kua sanctuary, Maliate Beel, 2003, CBFM-2

The MACH (Management of Aquatic Ecosystems through Community Husbandry) project has, since 1999, established 56 distinct

sanctuaries in three large wetland systems. Full details of this experience are given in Section 5. The key aspects are that most of the sanctuaries have had habitat improvements in the form of excavation to ensure that they hold more dry season water, and installation of fish protection structures (including concrete ones) in part of their area to provide shelter for fish, surfaces for aquatic organisms to grow on creating fish food, and to make poaching difficult. In some cases several small sanctuaries have been merged to make larger year-round no-fishing zones. In general each community organization has at least one sanctuary and usually one or more in each water body that it manages. Although the total wetland area in the monsoon in these three systems is over 30,000 ha, the dry season area of water is much less, and the focus has been on protecting key dry season water to restore fish populations.

The Fourth Fisheries Project was the largest DOF project during 1999-2005, and included a major component for inland fisheries conservation and enhancement through establishment of fish sanctuaries, stocking of floodplains and habitat improvement. During the project emphasis switched from annual stocking and fish friendly structures, to establishing fish sanctuaries. The project at different times worked in 62 sites (mostly individual jalmohals but including some larger wetlands comprising of several jalmohals). By mid 2005 it had established what was reported to be effective community based management through 46 community based organizations (Fisheries Management Committees) in 40 sites (22 rivers, 11 beels and 7 dead rivers and closed beels) in different strategic locations of the country. The jalmohals have been reserved by the government for leasing to organized community/ fisher groups for sustainable management. As part of management, all but two of the community based organizations have established and are managing fish sanctuaries in parts of the water bodies, following management plans that are prepared with and endorsed by DOF officials in the field, and with NGO assistance. As of November 2005, 89 fish sanctuaries covering an area of 907 ha were reported under these 46 CBOs, this compares with a total typical monsoon water extent of 19,100 ha, typical dry season water extent of 8,500 ha, and jalmohal area of 7,287 ha (unpublished data provided by Fourth Fisheries Project Management Unit). Additional sanctuaries were also created in other water bodies under the project and DOF is trying to ensure these areas remain protected although the community organizations in those sites were unable to manage the water bodies effectively for various reasons (such as disputes, local conflicts, legal cases, elite dominance).

A number of fish sanctuaries have also been established through a number of other projects of DOF and other agencies since 2000, these and the sanctuaries discussed above are summarized in Table 2. Overall it is estimated that as of mid-2005 about 426 individual sanctuaries existed in 257 sites/water bodies with the support of and included in the management plans of 253 community based organizations and with some form of government endorsement. Virtually all of these covered a part of the concerned water bodies.

Table 2 Establishment of Inland Fish and Aquatic Sanctuaries in Bangladesh as of 2005.

Sl No.	Project/program (donor and main implementers)	Sanctuaries established						Managed by	Period of operation and present status
		River and khal		Beels*		Total			
		No	Area (ha)	No	Area (ha)	No	Area (ha)		
Abandoned sanctuaries									
1	Development Management Scheme (Govt, DOF)					23		DOF	1960-65
2	Scheme for Establishment of Fish Sanctuary (Govt, DOF)					25		DOF	1965-70
3	Integrated Fisheries Management Project (GOB, DOF)	10	7500		500	10	8000	DOF	1987-92
4	New Fisheries Management Policy (GOB, DOF)					15		DOF/ fisher association	1986-95
5	FAP-6 (CIDA, BWDB)	1	26.2 + 500 m river section	-	-	1	26.2 + 500 m	DOF/ BWDB/ fisher association	1995-2000
6	Dampara Water Management Project (CIDA, BWDB/DOF)	12		27		39	1	Project/ local committee	2003-04 sanctuaries in 5 water bodies continued under CBFM-2
Existing sanctuaries									
7	CBFM Project-1 (Ford Foundation, ICLARM, NGOs, DOF)	1	1	3	10	4	11	NGO/CBO/ DOF	1996-99 (continued into CBFM-2)**
8	CBFM Project-2 (DFID/IFAD, WorldFish, DOF, NGOs)	58	24.22	106	67.14	164	91.36	CBO/NGO/ DOF/	2001-06
9	Fourth Fisheries Project (World Bank/DFID/ GEF/GOB, DOF)	54	711	39	195	93	907	DOF/CBO/ NGO/	1999-06***
10	MACH Project (USAID/GOB, NGOs)	14	21.49	42	151.39	56	172.88	CBO/NGO/ GOB	1998-06
11	Fisheries Management in Jalmohals under New Fisheries Management Policy (GOB, DOF)					16	25	GOB/Fisher association	1999-03 Continuing
12	Fish Culture and Fisheries Management in Beel and Chhara in Western Bangladesh (GOB, DOF)	2	2.3	18	10.01	20	12.31	GOB/CBO	2001-05 Continuing
13	Fish culture development project in Jabai Beel in Naogaon district (GOB, DOF)			4	4	4	4	GOB/CBO	1999-04 Continuing
14	Aquaculture Development Project (IFAD, DOF)			15	9.66	15	9.66	GOB/NGO/ CBO	2002-04 Continuing
15	Patuakhali-Barguna Aquaculture Extension Project (DANIDA, DOF)	14	20.5			14	20.5	DOF/ NGOs	2004 Continuing
16	SEMP (UNDP, - CNRS, BCAS & NACOM)	8	4.3	10	4.67	18	8.97	NGO/CBO	2000-03 Continuing
17	CBWM (Ford Foundation, CNRS)	2		5		7	1.33	NGO/CBO	1998-00 Continuing
18	Tanguar Haor (GOB, MOEF)					1	9,500	GOB	2000 declared Ramsar site****
19	Kaptai Lake (GOB, BFDC)					2	324	BFDC	1997 & 2000
	Total existing fish sanctuaries (breakdown incomplete)	**153**	**784.81**	**242**	**451.87**	**413**	**1588.01**		excludes Tanguar Haor****

* Includes baors and dead rivers

** areas included in CBFM-2

*** sanctuaries reported to be functioning by DOF staff in late 2005, project investment in sanctuaries was reported to be for 53 covering 1361 ha, but some of these areas reported were for the whole waterbody not the actual sanctuary

**** It is not clear how much of this area declared as a Ramsar site is a no fishing zone.

One notable exception among these sanctuaries is Tanguar Haor, Bangladesh's second Ramsar site, which was declared in July 2000. This site contains a number of beels for which the collection of revenue and leasing of fishing rights has presently ended. The site is under Ministry of Environment and Forests jurisdiction and is being protected as a sanctuary for birds, plants, fish and other wildlife, but human uses continue within at least parts of the total area. This represents the first large freshwater wetland protected area in the country, although there is no specific legal status for such a protected area. Similarly there are plans under the Department of Environment to protect parts of Hakaluki Haor, which in its entirety has been declared as an Environmentally Critical Area, but at present no specific sanctuaries exist there other than those established with communities under projects covered by Table 2.

A similar example of a large sanctuary is "Baikka Beel" in Hail Haor established through the MACH project (see Section 5.5). Out of a dry season water area of 3,500-4,000 ha, an area of about 100 ha has been set aside as a wetland sanctuary. The Ministry of Land has given up leasing and revenue generation there, and a community organization under the oversight of a local government committee is protecting the area from all fishing, hunting and resource use. This is the largest wetland sanctuary under community management in Bangladesh and eco-tourism facilities are being developed there.

In addition the government has established directly a few large area specific closed seasons, that might be termed as sanctuaries, targeted at protection of estuarine and marine fish stocks, including hilsha "Hilsa sanctuaries" have been declared by government in four river sections covering 330 km (vide gazette no. SRO 195-Rules/2005 dated 2 July 2005), but it should be noted that two of these areas overlap with sanctuaries and community management under Fourth Fisheries Project with ill defined sanctuaries already counted above, for example three 100 ha sanctuaries in Andarmanik River. It has also declared a very short closed season in the estuary covering an area of 6,882 km^2 where all kinds of fishing is prohibited seasonally, as indicated in the Table 3.

Table 3 Establishment of Coastal and Marine Sanctuaries in Bangladesh as of 2005.

Sl No.	Name of Project/Program (donor and main implementers)	Total Sanctuaries established		Managed by	Period of operation and present status
		No	Area (ha)		
1	Forest Department Fisheries Conservation Programme (GOB, Forest Department in Sundarban)	18		GOB	
2	Hilsha Fisheries Management Programme of DOF	4	330 km	DOF	2005, Continuing (Fishing closed during April-May in four sections of Meghna, Tentulia and Andharmanik Rivers)
3	Hilsa Fisheries Management Programme (GOB, DOF)	1	6882 km^2	DOF	2005- (Fishing closed from 15 to 24 October – peak hilsha spawning period)
4	Marine Reserves (GOB, DOF/Coast Guard)	1	698 km^2	DOF/ Coast Guard/ Navy	Continuing.

* Some of this area overlaps with areas under year round sanctuaries in Table 2

4.3 Marine Reserves

Marine Reserves have been widely introduced all over the world during the last 30 years for protection and conservation of marine fisheries and marine habitats/ecosystems, particularly coral reefs. Definitions vary and are somewhat confusing. For example, any marine habitat in which human activity is managed has been termed a marine protected area although this allows fishing within the management plan, while areas where no extractive use of any resource (living, fissile or mineral) nor any habitat destruction are allowed have been called fully protected marine reserves (Palumbi, 2002).

However, the total area of marine reserves in the world is a small fraction of one percent of the world's ocean area (NRC, 1999) while the land area protected in terrestrial protected areas (such as national parks and other reserves) is about 4% (Primack, 2000).

Most marine reserves are claimed to have impacted positively on the fish stock. In a review of 104 reserves by Halpern (in press), it was found that the fish population density increased by from 60% to 150% across a wide range of countries in North America, the tropical Pacific and Africa.

For the first time in Bangladesh in 2002 one marine reserve (sanctuary) covering an area of 698 km^2 in between 20º51' N - 21º08' N and 91º20' E - 91º32' E has been established through a government Gazette notification (SRO No.327/2000 dated 21 October 2002), whereby any type of fishing has been prohibited within this area throughout the year.

5. FISH SANCTUARIES UNDER THE MACH PROJECT

5.1 Project Concept

The Management of Aquatic Ecosystems through Community Husbandry (MACH) project is a USAID supported pilot project that started in 1998 and is implemented jointly by Winrock International, Bangladesh Centre for Advanced Studies, Caritas Bangladesh, and Centre for Natural Resource Studies.

The major purpose of the MACH project is to demonstrate to communities, local government and policy makers, the viability of community approaches to sustainable natural resource conservation and management in aquatic ecosystems, with ultimate goal of ensuring food security to those dependent on wetland aquatic resources.

The MACH approach has been to consider all factors that affect the community and the aquatic resources at the ecosystem level. This has involved a multi-disciplinary, multi-sectoral and participatory process of planning, implementation and monitoring. For example, recognizing that reduction of fishing pressure to sustainable level is a critical part of fisheries management, and that this would cause hardship for some fishers, the project supported training and micro-credit for alternative occupations and income sources for fishing households.

Reducing fishing pressure to sustainable levels has been done mainly through creating fish sanctuaries, plus the use of closed seasons in the early monsoon when fish that over-winter in the sanctuaries can move out to upstream areas or to shallow waters to breed. However, considering the degraded condition of many of the wetlands, the project has piloted restoration of wetland habitat through excavation and swamp forest and riverside tree planting, and when habitats were restored and fishing rules in place, has reintroduced locally extinct fish species to those wetlands. To support all of this community awareness of the issues was raised, and implementation has been through community participation by developing Resource Management Organizations (RMOs) that work in a co-management framework with local government.

5.2 MACH Locations

Hail Haor

This is a basin located in Srimangal and Moulvibazar Upazilas of Moulvibazar district. The haor is surrounded on its east, west and south by hills, to the north is low land with a flood control embankment. Water originates from the surrounding 350 small hill streams and the Lungla-Balisashi River. Hail Haor's only discharge point is the Gopla River which connects directly to the Upper Meghna. The haor basin becomes a large single body of water covering about 13,000 ha in the rainy season, but separates into 17 seasonal and 47 perennial beels with a total water area of less than 4,000 hectares in the dry season. The catchment area of the Haor is about 60,000 ha, comprising a chain of tea gardens, pineapple fields, rubber plantations, and remnants of natural forest and plantations on the hills. Areas above flood level are intensively cropped (2-3 crops/year) with rice. Fishing occurs in the

haor year-round. During the wet season, subsistence and gill net fishers predominate. Larger fish are caught from the drying beels in the dry season. The population of the area is about 160,000 in 60 villages. About 84% of households are involved in fishing, and 53% are full time fishing households.

Turag-Bangshi River basin

The Turag-Bangshi floodplain is located in Kaliakoir Upazila of Gazipur district. Upstream the basin is connected via the Dhaleswari-Pungli River to the greater Jamuna floodplain, and downstream it is connected through the Tongi River with the Buriganga-Meghna River system. The Upper Turag-Lower Bangshi is the main source of water in the region and flows through the site. All associated beels and other floodplain areas are connected to the main river through a series of khals and other channels. This is a deeply flooded area in the low-red soil plateau of Modhapur tract. The floodplain is inundated when water flows over the banks of the Turag-Bangshi river making all the low areas become a connected sheet of water in the monsoon. By late November, most of the water recedes and boro rice is planted in almost all of the low-lying areas. During the rainy season the water area is about 4,300 ha while in the dry season the water area becomes less than 700 ha. About 2,68,900 people live in this area with 84% of households being involved in fishing, and 15 % of households are full time fishers.

Kangsha-Malijhee river basin

Kangsha-Malijhee basin located in Sherpur district, and includes part of the Sylhet Basin and Northern Piedmont Plain. This area forms the upper portion of the catchment of the Kangsha-Malijhee River. All floodwaters come from the Garo/Meghalaya Hills through a number of hill streams and rivers. These in turn eventually drain out of the area through the Kaliganga-Kangsha River, which is part of the Sylhet Basin Haor complex of rivers and streams. Topographically a low-lying plain generally sloping from the north-west to south-east, this site was once a large lake. Presently the wet season water area is about 8,210 ha with a dry season water area of about 900 ha. About 623,000 people inhabit the area, about 90% of households catch fish, and 9% are full time fishing households. The catchment area is about 21,239 ha. The higher land surrounding the site is intensively cropped. Massive changes have occurred in the last 20 years with rapid and almost complete deforestation of the upper watershed and lower wetland areas, followed by a rapid loss of connection due to embankments and increased sedimentation.

5.3 The fisheries and data sources

All the three project sites have a high potential of fish and other aquatic production but have been subject to over fishing, destructive fishing, and habitat degradation due to siltation, use of water for agriculture and pollution. The dry season is the most critical time for all fish species when the majority of wetlands are dry or nearly dry. During this time fishing pressure is high and fishes become vulnerable to fishing. Fishing by dewatering during the dry months is very common in the beels and this often leaves no fish stock to breed in the next spawning season. In these circumstances fish sanctuaries were considered by the project to be a potentially effective mechanism for conservation of the fish stock, and were taken up as the most important activity for sustainable management of fisheries in the MACH Project sites.

Many of the beels and canals within the MACH project area dried up or do not retain sufficient water to provide suitable habitat for sufficient dry season fish populations. Many water bodies/ beels/ canals brought under the management of the MACH project community groups have been excavated to ensure retaining sufficient water in dry season.

In order to assess the changes in the fish production, biodiversity and livelihoods of those who are dependent on the aquatic resources due to project interventions, a monitoring program including the baseline data acquisition has been carried out throughout the project implementation period.

5.4 Management of Fisheries/ Sanctuaries

After raising awareness and motivating communities and resource users about the need for aquatic resource conservation and management, the major management intervention of the project has been to improve wetland (fishery) management through community participation in each project site. For this purpose the leases to a number of water bodies (jalmohals) have been reserved by Ministry of Land on a long term basis (10 years) for management by the MACH community based organizations called Resource Management Organizations (RMO). These have been constituted of representatives from all professions including fishers, farmers, landless, women, and local elites (teacher, businessmen, service holder), living around these water bodies. The RMOs are registered with the Social Welfare Department to give them a legal status. One RMO manages fishing in one or more nearby water bodies leased to it plus floodplain areas (private land that is seasonally flooded).

Among others, the condition of the leases include that fish sanctuaries would be established in part of these jalmohals or water bodies. A total of 36 jalmohals with a total area of 575.6 ha have been leased by the RMOs. In parts of 17 of these jalmohals, and in other public waterbodies, sanctuaries have been established with MACH project support. The location and area of the sanctuaries are determined by the RMO with advice of the project personnel. Usually the deeper part of a jalmohal has been reserved as a sanctuary so that maximum benefit can be gained during the dry season. Table 4 summarizes the breakdown of 56 sanctuaries covering about 173 ha.

Table 4 Number and area (ha) of MACH supported wetland sanctuaries existing in December 2005 by year of establishment.

Year and waterbody type	Hail Haor			Turag-Bangshi**			Kangsha-Malijhee		
	No	Improved habitat* (ha)	No fishing area (ha)	No	Improved habitat* (ha)	No fishing area (ha)	No	Improved habitat* (ha)	No fishing area (ha)
Beel									
2001	6	3.84	4.63	9	2.12	10.60	12	2.40	4.71
2002	1	0.06	0.06	5	4.43	22.14	0	0	0
2003	1	8.85	8.85	0	0	0	0	0	0
2004	0***	40.67	85.68	6	2.02	10.12	1	0.61	1.74
2005	0	0	0	0	0	0	1	1.21	2.86
River/khal									
2001	0	0	0	3	2.35	11.74	2	0.67	0.90
2002	1	0.48	4.18	0	0	0	3	0.89	1.17
2003	1	0.19	0.39	0	0	0	3	0.86	2.79
2004	0	0	0	0	0	0	1	0.20	0.32
2005	0	0	0	0	0	0	0	0	0
Total	10	54.10	103.79	23	10.92	54.59	23	6.84	14.48

* re-excavated area and/or area with fish protection devices such as hexapods within sanctuary (the area reported in MACH annual reports).

** in 2005 six sanctuaries with 9.2 acres of improved habitat and total no fishing area of 46 acres were created in nearby areas of Kaliakoir but outside of the RMO management/influence areas.

*** part of the same national sanctuary as the beel area reported in 2003 in this site, note that 111.22 acres is khas land which is part of the no-fishing zone but not formally declared as sanctuary by the government.

Abandoned sanctuaries:

Hail Haor - in several cases more than one spot with improved habitat is in a contiguous sanctuary (no fishing zone) so the number of sanctuaries reported here is reduced from previous reports. Four sanctuaries (total area 6.48 acres) were only observed for one year 2001-02. Another of 0.52 acres was planned and included in project reports for 2001 but was never actually established.

Turag-Bangshi - two of unknown characteristics, one replaced in 2001 the other in 2004.

Kangsha-Malijhee - one 0.21 acre fish protection device of 2001 was converted shortly after to a katha for fishing by the RMO with LGC approval.

The RMO is responsible for payment of lease values, maintaining or restoring the wetland status of the jalmohals, establishing and managing any sanctuaries including preventing poaching, and ensuring that its rules regarding fishing are observed. Typically the RMOs allow fishing by the users of the resource and the families living in around the water body during the monsoon. Also allowed is fishing on payment of gear based fees or by paying for a fishing contract in the post-monsoon and dry season.

The earning from the fishery is used by the RMO to pay the lease, and cover maintenance of sanctuaries and their operating costs. These part-jalmohal sanctuaries are being maintained on a permanent (year-round, multiple year) basis, and in several beel sanctuaries Fish Aggregating Devices (FADs) in the form of concrete "hexapods" and pipes have been provided by MACH as fish shelters that are a long term alternative to brush-piles that will not stress limited forest resources and cannot be removed. These sanctuaries are not officially recognized in the lease agreements, but are included in the RMO management plans that are expected to be endorsed by the local DOF officers. Thus the sanctuaries function as part of the wetland/jalmohal management by the RMO and are intended to result in a net increase in fish catches from the total fishery/jalmohal. Fishing continues in the remaining part of the water body all year (except for any closed season observed by the RMO), so fish sheltering in these smaller sanctuaries risk being caught when they move out, but some can safely survive the dry season there and have a chance to spawn during the closed season in the wider wetland.

Sanctuary established by MACH in Turag River

5.5 Establishment of Permanent Sanctuaries under the MACH Project

In addition to the sanctuaries established in parts of the Jalmohals leased to the RMO for biological management, another eight waterbodies have been set aside as sanctuaries on a permanent basis: two in Hail Haor, five in Turag-Bangshi and one in Kangsha-Malijjee (Table 5). These water bodies have been declared as "permanent" sanctuaries by the Ministry of Land. In fact they have been leased to the local RMOs on payment of nominal lease fees at the rate of Taka 101 for a river section and Taka 501 for the beels for a 10 year period (potentially renewable) on the understanding that there will be no fishing in the whole of those areas and they will be managed as fish sanctuaries for the entire period. If the RMO fails to protect and manage them as sanctuaries, they would be taken back for leasing by the government. The lease period may be extended for another term if the performance of the sanctuary is satisfactory. An upazila level committee headed by UNO will evaluate the performance of the sanctuaries.

These RMOs are responsible for the sanctuaries including guarding, placing fish shelters and paying the nominal lease fee, they are expected to cover these costs from local resource mobilization through fisher fees in the rest of their management area, and from small grants to be made from endowment funds administered by upazila level committees on which the RMOs as well as Union Parishad chairmen and Upazila officers sit. Out of the eight permanent sanctuaries, five are managed by RMOs who also manage other water bodies where they can fish.

Table 5 Permanent sanctuaries established under MACH Project.

Project site	Wetland	Sub areas/ waterbodies	Sanctuary area ha (acre)	Total jalmohal and wetland area ha (acre)	RMO	Lease (Tk per year)
Hail Haor	Hail Haor national sanctuary	Jaduria Beel	40.7 (100.50)	40.7 (100.50) whole beel	Jaduria	501
		Chapra Magura Beel	8.9 (21.88)	8.9 (21.88) whole beel	Baragangina	501
T-B Site	Mokash Beel		0.9 (2.24)	12.5 (30.98) 454 (1123)	Mokash	501
	Alua Beel		1.8 (4.44)	4.1 (10.07) 714 (1764)	Alua	501
	Turag River (14 km section)	Galachipa Kum	5.1 (12.5)*	Not applicable	Turag	101
		Lalkhar Kum	5.1 (12.5) *	Not applicable	Turag	101
		Gaptali Syedpur Kum	5.1 (12.5) *	Not applicable	Turag	101
K-M Site	Malijhee river (part)		4.0 (10) *	Not applicable	Takimari Dharabasia	101

* Each river sanctuary is based on a scour hole (kum) and includes the full width of the river for 200 m upstream and 200 m downstream of the kum

Guard boat in Hail Haor permanent sanctuary

Out of these sanctuaries the two jalmohals in Hail Haor plus adjacent wetlands comprise a total area of about 100 ha that is known as Baikka Beel Sanctuary and is protected by Baragangina RMO. Since 2004 all hunting, fishing and other uses of the sanctuary area have ended, apart from limited access to move livestock and some grazing. The RMO working with the project team, local stakeholders, and the Local Government Committee has developed and implemented a detailed management plan, including hiring guards. As a result, lotus *Nelumbo nucifera* beds have expanded, once scarce fish such as chital have been seen spawning in the area, fishers report increased catches and larger fish in adjacent areas outside the sanctuary, and waterbird populations have returned. In 2004 only 16 waterbird species with eight ducks of one species were recorded during the mid-winter survey, in 2006 33 waterbird species including almost 5,400 ducks of eight species were observed. With this rapid restoration of biodiversity, MACH is now developing arrangements with the RMO for eco-tourism including a visitor tower for observing the sanctuary. Sustainability is expected through an allocation from the endowment fund set aside by MACH and from visitor fees.

However, in the case of the three sanctuaries in Turag River, the Turag RMO has not formally been entrusted to manage the rest of the river (where fishing is open access). This appears to be an anomaly in the thinking of Ministry of Land and Department of Fisheries, since they have reserved river sections for community management under other projects, and in Fourth Fisheries Project have helped and endorsed community organizations collecting modest gear fees to pay for making sanctuaries as part of local management plans (in those cases not set aside and recognized by Ministry of Land). Thus Turag RMO has no authority to raise any revenue from the rest of the river and its users to cover the costs of protecting these sanctuaries, an issue which needs to be addressed in the planning of permanent sanctuaries that are managed by community organizations.

5.6 Impacts of Fish Sanctuaries

Establishment of sanctuaries started from the second year of the MACH project (2000). Increases in fish catch in the project intervention areas over the period 2000-2005 indicate the positive impact of

sanctuaries along with other management interventions such as excavation, seasonal closing of fishing, not allowing fish harvest by dewatering, and reduction in use of destructive fishing by current jal. But the impact of sanctuaries cannot be assessed separately. Fish production has significantly increased in the three project sites as appears from the catch monitoring, with a notable success in restoring the most degraded of the fisheries in Turag-Bangshi site (Table 6). Fish biodiversity has also increased to some extent, but each year some of the scarcer species are or are not recorded (Table 7). This increase may also be due to the combined effects of sanctuaries and the same other interventions noted above. Therefore the package of improved management practices adopted by the RMOs under MACH, which includes as a core change the protection of year-round sanctuaries in relatively small areas that hold water year-round, has been successful.

Table 6 Catch per unit area (kg/ha) in MACH sites.

Project site	Base Year	Impact Year-1	Impact Year-2	Impact Year-3	Impact Year-4	Impact Year-5	Overall average	Change (%)*
Hail Haor	171.08	205.05	190.75	287.28	161.82	388.63	247	144
Turag Bangshi	57.8	124.75	104.78	140.08	315.19	320.68	201	348
Kangsha-Malijhee	150.16	149.16	273.37	315.62	-	-	246	164

* average of five (or 3) impact years as a percentage of the baseline year.

Table 7 Fish biodiversity (number of species recorded in sample catches) in MACH sites.

Project Site	Base Year	Impact Year-1	Impact Year-2	Impact Year-3	Impact Year-4	Overall	Average with	Change (%) *
Hail Haor site	71	71	69	79	67	85	72	101
Turag-Bangshi	82	81	86	91	85	95	86	105
Kangsha Malijhee	64	67	71	73	na	78	70	110

* average of four impact years as a percentage of the baseline year.

6. SIZE OF SANCTUARY

How large an area in a region or in an aquatic ecosystem should be devoted to sanctuaries, and how big individual sanctuaries should be, are key questions for the wider adoption and planning of aquatic sanctuaries.

These apparently simple questions are actually very complex. The required sanctuary area will ideally depend on many factors - present state of fish stocks (abundance by species), reproductive capacity (fecundity) of individual species, age at first maturity, longevity, fishing (catches) and natural mortality (spawn to maturity), productivity of the water body (carrying capacity), etc. To ensure the breeding stock required to sustain the fishery at about “maximum sustainable yield” level in an ecosystem taking into consideration these factors would be optimum. There are no known models that have been developed for determining the optimum size of a sanctuary for the complex multi-species inland fisheries of wetlands. However many models have been developed for marine fisheries (Palumbi 2003) including ones for sanctuary benefits. Models and empirical investigation in marine waters suggest larger marine reserves (sanctuaries) host more species than smaller reserves (Neigel et al. 2000).

An individual marine reserve or sanctuary should not be too small as it will not be self sustaining because most larvae (fish and other organisms) produced in it are transported elsewhere, while a large reserve will retain too much of reserve’s productivity releasing too little at the edges to effectively enhance the fishery in surrounding areas. Therefore medium size reserves have been recommended for enhancing fisheries most effectively (Botsford et al. 2001). Whether such estimates and principles can be applied to planning sanctuaries in inland fisheries in Bangladesh or elsewhere is not known.

Ahmad Khabir and Munir Ahmed (2002) reported from empirical knowledge and experience that the area required for fish sanctuaries may be 25% of the dry season area in case of beels and 10% in case rivers. They opined that the area might vary according to geographic condition, physiographic condition, hydrological condition, river network, species composition, target species, and fishing pressure on the aquatic resource. But they also claimed that protecting a 20 decimal (0.08 ha) kua

(ditch in floodplain beel) could support the fishery in a seasonal beel covering 200 ha in the wet season (protected area of 0.004% of the wet season beel area).

Under the CBFM project, communities in one seasonal floodplain have protected several kuas – average total per dry season of 0.16 ha, compared with a total dry season water area of 2.9 ha (6 %) and wet season area of 250 ha (0.006%), with positive impacts (Sultana et al. 2005). Under the CBFM-2 project individual sanctuary sizes vary from kuas of about 8 decimals (0.03 ha) to 20 acres (8 ha), in all cases covering part of a water body (WorldFish Center 2003), on average about 1% of the estimated total wet season area of the water bodies comprises sanctuaries.

Fish sanctuaries in the Fourth Fisheries Project sites covered a reported total area of 907 ha compared with a dry season water area of 8,502 ha or 11% of the dry season area and 2.3% of wet season area (unpublished project data). However, about half of this total sanctuary area is in five main river sites that reported large sanctuaries and it is uncertain if these are being fully observed (excluding these reduces the sanctuary area to 487 ha or under 6 ha per sanctuary but still representing 10% of dry season water area).
Shankar (2002) based on modeling of the fishery in Pabna floodplains found that while closing 30-40% of the dry season water area from all fishing was optimal for catch, setting aside 10% as sanctuaries would sustain a productive fishery. DOF's draft strategy paper for inland capture fisheries management (DOF 2005b) adopts this last figure and suggests that the sanctuary area should be around 10% of dry season area of water bodies.

Under the MACH project, the area of sanctuaries established in different sites now stands at 5.3% of the dry season water area and 0.86% of the wet season water area of the three sites (Table 8). One reason for this is that only some of the jalmohals within the MACH sites are under community management, the other leaseholders of permanent beels within Hail Haor for example while appreciating the sanctuaries do not have incentives to create their own sanctuaries within the areas that they lease.

Table 8 Comparison of sanctuary area under MACH with total wetland area.

Site	Wet season area (ha)	Dry season area (ha)	Sanctuary area (ha)	Percentage of total area	
				Wet season	Dry season
Hail Haor	13,000	3,000	104	0.8	3.5
Turag-Bangshi	4,373	253	55	1.3	21.7
Kangsha-Malijhe	8,270	900	14	0.2	1.6
Total	25,583	4,153	173	0.7	4.2

Lastly, size has been considered so far only in terms of fisheries, the sanctuaries established by MACH, as in other projects, are almost all intended to protect fish in the dry season so that the productivity and diversity of the fishery overall is restored and improved resulting in higher yet sustainable fish catches. At least in Hail Haor there is also an additional objective, of preserving and restoring a wetland area to protect the full range of aquatic biodiversity and haor ecosystem. In principle for this, the larger the area the better, so that human disturbance, for example of water birds, is minimized, but too large an area could displace fishers adversely affecting livelihoods and resulting in poaching and non-compliance. A compromise has to be reached, but in large wetland systems, where fishers have alternative fishing grounds nearby, there is a case for setting aside at least one larger part of that wetland as a sanctuary to protect aquatic plants, fish, birds, and other wildlife. For example, the 100 ha of Baikka Beel that has been set aside in Hail Haor as a permanent sanctuary would appear to be large but is a relatively small percentage of the dry season water area (3%) and a smaller area would be unlikely to protect a representative range of wintering water birds from hunting and frequent disturbance by fishers. As it stands now this size has generated considerable bird diversity and has already brought back species that had not been seen in the haor in recent years.

7. ENFORCEMENT OF AND COMPLIANCE WITH SANCTUARIES

Prevention of fishing and observance of rules is the vital issue for sanctuary management. The success and benefits of a sanctuary depend on how it is protected from illegal fishing and the extent that the sanctuary area has as good an aquatic environment as it is possible to maintain – the habitat of water depths, quality, vegetation, and other fauna. In the earlier DOF managed sanctuaries the community and the actual users were not involved in the planning stage nor in the management of the sanctuary. One or two guards were engaged in protecting a sanctuary against any illegal fishing there. The community, having no stake in the sanctuary, was always trying to catch fish in the sanctuary by avoiding the guards or persuading them not to enforce the rules. Now, with the policy shift in favor of community based and participatory approaches in fisheries management, the communities are actively involved in planning, creating, maintaining and enforcing sanctuaries. This concept is being applied for sanctuary establishment and management as a part of a wider fishery or wetland management system under different development projects such as CBFM, MACH, FFP and under other projects of the DOF and NGOs.

Now, in almost all these cases the sanctuaries have been established in a part of each jalmohal that is reserved for management by the organized community, leaving the rest of the area for harvesting by the community. The sanctuaries are reportedly effective and the fisher community gets a direct benefit from the sanctuary in terms of a higher and/or more valuable catch from the adjacent areas outside the sanctuary, which encourages the community members to voluntarily comply with the sanctuary that they have planned and agreed to, and it also gives an inventive for the community organization to maintain the sanctuary and keep watch and apprehend any poachers.

The exception to this is some of the permanent sanctuaries set up through MACH project. For example, two adjacent and contiguous beels in Hail Haor where the entire beel area has been declared as a sanctuary without giving any direct benefit from those jalmohals to the community who are managing the sanctuary. This special case sets an important precedent for wetland protected areas in Bangladesh. The community (RMO) is leading in its protection, but the benefits serve a large area and have been appreciated by all stakeholders to the extent that leaseholders and fishers from other parts of the haor have offered to make modest financial contributions to the costs of guarding and maintaining that area. Incentives are required for the community organization to protect such areas, and MACH is setting precedents and examples for this by arranging long term financial support for permanent sanctuaries through a fixed allocation out of the interest from the endowment fund it is establishing, and by developing simple visitor facilities.

8. PROBLEMS AND CONSTRAINTS

A major problem in management of fisheries in public water bodies is the policy conflict between the government ministries. The Ministry of Land (MOL) is the custodian of the water bodies and is responsible for collecting the maximum revenue by leasing those water bodies, on the other hand the Ministry of Fisheries and Livestock (MOFL)'s mandate is to ensure that all of the country's fisheries including water bodies (jalmohals) are managed to ensure the maximum sustainable yield of fish, while the Ministry of Environment and Forests (MOEF) aims to protect natural habitats maintain biodiversity and ensure an acceptable quality of water. Most of the sanctuaries have been established under development projects. The procedure of transferring the water bodies or jalmohals from MOL to MOFL for biological management or establishment of sanctuary is a lengthy and difficult task. After long negotiation and struggle, water bodies could be physically transferred to the projects and community management, maybe only in the middle of the project life and after the project paid the full revenue due from the project start. However, when the project period is over, lease fees cannot be paid from the normal budget of DOF for shortage of fund, and if the community organization does not continue to do this or there is no community organization, then the water bodies are taken back by the

MOL and are leased to others for fishing. When this happens all the effort of establishing the sanctuary along with its achievements will have gone in vain.

The achievement of MACH in this is having the MOL directly set aside complete jalmohals for sanctuaries on payment of a nominal lease by the user community and on condition that no fishing at all be undertaken there. Where there are several water bodies connected this approach may be replicated. It also paves the way for national recognition of designated wetland sanctuaries.

Poaching (illegal fishing) is the major problem for sanctuaries. As fish become more abundant in a sanctuary it becomes attractive for poaching. Now-a-days, by setting a gill net (current jal) one can catch a lot of fish easily. Using brush piles or other structures in the sanctuary helps reduce this risk, but negligence or dishonesty by guards is a big risk. Water pollution is also a threat to sanctuaries. It may kill fish directly, or due to an unfavorable environment and loss of food, fish may move away to pollution free areas where they can be caught by the fishers. Agro-chemical pollution is affecting fish and other aquatic organisms everywhere, but rules in the areas immediately surrounding a sanctuary may be needed. Pumping out of water from a beel sanctuary for agriculture or extreme drought may reduce the water area and depth in a sanctuary, resulting in heavy natural mortality, degradation of water quality, and possibly disease outbreak.

In the long-term there is a risk that sanctuaries (and water bodies) will silt up unless more actions are taken to control soil erosion and maintain the banks of channels. MACH has addressed this through riparian tree planting and improving cultivation practices on slopes by using contour cultivation.

In community based management, a local committee is responsible for management including fish sanctuaries. Lack of coordination among the committee members, and with government and/or concerned NGOs may also lead to failure of a sanctuary.

Lastly proper site selection considering physical, hydrological, biological, environmental and social factors is very important in establishing a sanctuary, and this is addressed in the recommendations.

9. POLICY RECOMMENDATIONS

Although the national fisheries policy envisages establishing fish sanctuaries, there is no national guideline for establishment and management of fish sanctuaries. There are two issues: guidance for establishing sanctuaries within water bodies as part of their sound management and policy and legal status for larger “national” sanctuaries that comprise one or more complete jalmohals plus other public lands (such as the permanent sanctuary in Hail Haor established through MACH or the sanctuary/Ramsar site of Tanguar Haor). There is presently no clear legal basis for establishing or recognizing sanctuaries, but the needs are different in the two categories.

Fish sanctuaries established within part of a fishery by those managing that fishery (usually now a community organization) are recognized through local management plans, and the evidence from MACH and other projects such as CBFM is that local government (Union Parishad and Upazila administration) are supportive of these – endorsing the use of fines on poachers within such sanctuaries for example and helping to put pressure on those who disobey the rules. This needs strengthening, and wider support from government. In the Jalmohal leasing system of MOL, a conservation element may be included as a condition of lease. In each leased Jalmohal (perennial) a sanctuary should be established in part of the Jalmohal and be maintained/managed by the lessee and for that the lease value may be reduced proportionately. Proper monitoring systems of the enforcement of this system should be made by the Government.

National level permanent wetland sanctuaries should be established in strategic locations to protect representative “best” wetland habitats throughout the country. These would comprise an entire beel or

canal, or a long enough section of river including deeper parts of the river (river scour holes) to protect the full range of biodiversity in that ecosystem. Obviously the number of such wetland sanctuaries will be limited. Wetlands of international and national importance and the criteria for defining the latter will need to be defined. The Ramsar convention 1971, to which Bangladesh is a signatory, has already defined wetlands of international importance and Bangladesh has declared two sites under the convention, but several other wetlands also meet the criteria. Moreover, the Ramsar convention has some emphasis on migratory birds, for nationally significant wetland we may wish to place more emphasis on fish and aquatic plant populations and biodiversity. An appropriate legal status is needed for such national sanctuaries. Management of these sanctuaries should be through co-management and active involvement of the community (fisher/user community organizations) and local government (Union Council) working with the central government (Upazila/District administration and line departments. For management including maintenance of such sanctuaries, sufficient funds need to be provided to the agencies/administration charged with this responsibility, this may be from the revenue budget or as is being piloted under MACH and endowment managed by the Upazila and providing grants to community organizations to guard sanctuaries. As in the two existing examples of this type as the national interest is best served by protecting the fishery and wildlife of such areas there should be no leasing or revenue collection, other than a nominal payment that establishes the right of the management body to manage and guard the sanctuary.

At the policy level, to restore fisheries in each flood protected area where migration of fish has been restricted, a fish sanctuary should be established through government support for community participation. This should have an emphasis on including fishers in sanctuary planning and management as they may not be involved in practice in any committees that have been established for water management. Where there is no suitable water body for establishing a sanctuary but the area retains sufficient water for a reasonable period for growth and breeding of fish, then silted up water bodies (khas fishery) should be excavated within the area to be set aside as fish sanctuaries. Once suitable habitat is restored and protected, beel-floodplain resident fishes that may have been lost from that flood protected area may be re-introduced there.

While details of management and planning involve local government and communities, sanctuary establishment needs a national strategy and guidelines with supporting rules and amendments to legislation. As part of the coordination of inland capture fisheries and wetland management and protection, an apex national committee is needed which would include sanctuaries as an important part of its remit, with the Secretary, MOFL as the chairperson, Joint Secretary of MOL as Vice Chairman and DG, DOF as Member-Secretary of the committee and with membership from other relevant ministries notably MOEF, MOWR, and MOLGRD.

10. TECHNICAL RECOMMENDATIONS

10.1 Site selection and size

Selection of water bodies for establishing national wetland and fish sanctuaries is the key decision which needs to consider biological, environmental and socioeconomic points of views.

National sanctuaries

The sanctuary area should have good productivity in term of plants, plankton and invertebrates to support fish and other fauna. It should already have a diverse stock of fish species and hold populations of resident, breeding or over-wintering animals and/or plants that reach large population sizes in the Bangladesh context, or include significant populations of species that are scarce and/or threatened within Bangladesh. It should have a favorable environment in terms of water quality – free from pollution - and sufficient depth of water, and connectivity with other water bodies and surrounding floodplains – that is a physical location in the wider ecosystem for facilitating fish migration and dispersion. It should be large enough to have low human disturbance from areas outside

the sanctuary. Due consideration needs to be given in selection of such a sanctuary area so that the fishers living around and harvesting the water body(s) are not severely affected by establishment of a sanctuary in the whole of that water body. This means that they should have other fishing areas nearby where they can undertake fishing for their livelihood, and those neighboring areas must be reserved for community management and use. There should also be provision for grants/credit and training for fishers who may be adversely affected to take up alternative occupations.

Sanctuaries within a well managed fishery

The fishery managers (community) should chose a deeper area where fish are known to congregate in the dry season and which holds water throughout the dry season for protection as a year round sanctuary. Other types may also be considered – where fish are most vulnerable to capture and there can be a gain from not catching them there or then. For example, in a khal where fish migrate into a beel a sanctuary could be set up for the migration season by the fishers using that beel so that they have a larger catch later in the year.

10.2 Sanctuary Management

The most important part of a sanctuary is its management mainly the protection against poaching/ illegal fishing. Public management of the sanctuary has proved to be inadequate and poor, often allowing illegal fishing by the guards of the sanctuary in absence of community participation. On the other hand community participation and co-management have in many cases proved to be more effective with higher compliance with rules, provided that the community is properly organized and motivated.

Specific management activities should include:

(1) Placing brush piles /concrete structure

If there is no siltation problem, brush shelters may be placed for protection against poaching and to provide substrata for fish to feed on. Concrete structures (hexapods) have been adopted by MACH in some situations, they are not recommended in rivers or khals, but in the deeper spots in beels they have the advantage of durability – reducing pressure on cutting down trees and the recurrent cost that community organizations and/or government would face for new brush piles each year. They also provide increased surface area where fish food in the form of attached plankton is increased and therefore attractive to fish. The comparative impacts of these structures have not yet been studied.

(2) Guarding the sanctuary

Proper steps are to be taken for guarding the sanctuary against poaching. Community management of a sanctuary can reduce poaching significantly. Larger sanctuary areas tend to need full time guards, especially when they are distant from the communities that have established them or that are in support of the sanctuaries.

(3) Improvement/restoration of sanctuary

If the sanctuary area or the connecting canals are silted up, they should be excavated. If there is suitable higher land (normal monsoon inundation not more than about a meter), native trees adapted to swamp conditions (Hijal and Koroch) can be planted to restore "swamp forest" an important component of the wetland ecosystem that once existed in much of the central and north-east regions of the country and which is a valuable nursing ground for fish.

(4) Community awareness and organization

The community involved in the fishery / sanctuary management should be made aware of the sanctuary benefits and importance, not only in terms of fishery benefits to them but also the wider ecological importance of sanctuaries and their wildlife. They should be

advised on best practices, helped to plan for management including their own local knowledge and experience as well as "expert" advice, and be organized and trained in appropriate skills.

(5) Monitoring and impact assessment

The managers (fishers/community and government) need to see whether a sanctuary is effective. For a sanctuary that is part of a fishery managed by a community for its livelihood security this means generating a benefit in terms of fish stock and fish catches (quantity, value and diversity of species) from the rest of the fishery, and therefore an income benefit for fishers as a whole. Simple techniques need to be developed with the user community for assessing impacts and refining their management plans (including sanctuaries). For a national sanctuary, the co-management authorities need to know what change in biodiversity occurs with the sanctuary, and to see that the environment is restored or remains as intended – data on siltation rate, water quality, wintering water bird counts, as well as information on fish catches in neighboring areas (fish moving out of the sanctuary) will all be valuable, along with records of visitors and of poaching incidents.

11. REFERENCES

Ahmed, K. and Ahmed, M. (2002). Fish Sanctuary: necessity concept practices and prospects. Technological Assistance for Rural Advancement (TARA): Dhaka.

Ahmed, M., Capistrano A.D. and Hossain, M. (1997). Co-management of Bangladesh fisheries. *Fisheries Management and Ecology* **4(3),** 233-248.

Ali M. Liaquat and M. Zahirul Islam (1998). An assessment of the economic benefits from stocking seasonal floodplains in Bangladesh. pp 289-308. *In* Petr, T. (ed.) *Inland fishery enhancements*: papers presented at the FAO/DFID expert consultation on inland fishery enhancements Dhaka Bangladesh 7-11 April 1997. FAO Fisheries Technical Paper No. 374. Rome, FAO.

Ali, M.Y. (1997). *Fish, Water and People.* Dhaka, Bangladesh: University Press Ltd.

Botsford, L.W., Hastings, A. and Gaines, S.D. (2001). Dependence of sustainability on the configuration of marine reserves and larval dispersal distance, *Ecology Letters* **4**:144-150.

DOF (2005a), *Fishery Statistical year book of Bangladesh 2003-2004.* Department of Fisheries, Dhaka.

DOF. (2005b). Draft Inland Capture Fisheries Strategy. Department of Fisheries, Dhaka.

FAO. (2003). Statistical Yearbook 2003. UN Food and Agriculture Organisation, Rome.

Hoggarth, D. (2004). Selection criteria and co-management guidelines for harvest reserves in tropical river fisheries. Central Research Institute for Fisheries (CRIF), Jakarta, Indonesia.

Halpern, B. (in press)**.** The impact of marine reserves: Does reserve size matter? *Ecological Applications*.

IUCN. (2000). Red Book of Threatened Fishes of Bangladesh. IUCN - The World Conservation Union, Dhaka, Bangladesh.

Jhingran V.G. (1983), *Fish and Fisheries of India*. Hindustan Publishing Corporation, India, New Delhi.

Minkin, S.F., Rahman, M.M. and Halder, S. (1997). Fish Biodiversity, Human Nutrition and Environmental Restoration in Bangladesh, published in the book titled "In *Openwater Fisheries of Bangladesh* (Tsai C. and M.Y. Ali, eds.), pp 183-198. Dhaka: The University Press Limited.

MOFL. (1998). *National Fisheries Policy of Bangladesh*. Ministry of Fisheries and Livestock, Government of Bangladesh, Dhaka.

MOEF. (1995). *National Environment Policy*. Ministry of Environment and Forests. Government of Bangladesh, Dhaka.

MOL. (2001). *Land Use Policy of Bangladesh*. Ministry of Land, Government of Bangladesh, Dhaka.

MOWR. (1999). *National Water Policy*. Government of People's Republic of Bangladesh, Ministry of Water Resources, Dhaka.

A project of the Government of Bangladesh

Supported by USAID

Project Partners:

Winrock International
Bangladesh Centre for Advanced Studies (BCAS)
Center for Natural Resource Studies (CNRS)
CARITAS Bangladesh

WEB: www.machban.org

MACH Headquarters:
House No: 2, Road 23A
Gulshan 1, Dhaka 1212
Bangladesh