Conserving and Restoring the Benefits from Bangladesh Wetlands

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Abstract

Wetlands in Bangladesh, just as elsewhere, were long regarded as worthless wastelands to be converted to agriculture. This study combines a detailed valuation of uses of Hail Haor, a complex heavily exploited 14,000 ha wetland commons in Bangladesh, with assessment of the benefits from conserving and restoring it. Values were estimated from mapping of land uses, surveys and detailed monitoring of all main uses. This revealed that the annual value of wetland products in 2000 was about US$650 per hectare, roughly double the net return from the alternative single rice crop. The main benefits were from fish and aquatic plants that are collected by and provide income or food for the poor. The annual return from the haor at that time was estimated to be just under US$ 8 million. Restoration of fish catches alone raised this by 36% by the year 2005-06.

Since 1999 the MACH project has demonstrated that community based organizations linked up through co-management arrangements with local government could restore wetland productivity and biodiversity by setting limits on fishing, creating wetland sanctuaries, and restoring habitat by excavating deeper areas as fish refuges and planting swamp and riparian trees. In this same area eight community based organizations have taken initiatives that resulted by 2006 in fish catches almost doubling and a 45% increase in fish consumption of farmers and landless. One larger 100 ha sanctuary was established under community management, this serves to conserve fish stocks in the whole wetland system, and populations of wintering waterfowl returned after an absence of some 20 years, creating a community managed conservation area and eco-tourism attraction, the first in Bangladesh.

Property rights in the wetland, institutional and organizational arrangements that have evolved for community based co-management, and their link with wetland benefits are reviewed for wider lessons.

Key words: *community, conservation, fisheries, co-management*

Introduction

Bangladesh wetlands

Bangladesh is traversed by numerous rivers and creeks as it comprises most of the delta of two great rivers – the Ganges and Brahmaputra. About two-thirds of Bangladesh may be classified as wetlands according to the Ramsar Convention definition. About 6-7% of Bangladesh is always under water, and in the monsoon 21% is deeply (>90 cm) flooded and around 35% experiences shallow inundation

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(FAO, 1988). Wetlands in Bangladesh encompass a wide variety of changing ecosystems including mangrove forests, natural lakes, freshwater marshes, reservoirs, oxbow lakes, *haors* (deep depressions in the north-east that coalesce to form a vast inland sea in the monsoon - rainy season) *beels* (permanent freshwater depressions), fish ponds and tanks, estuarine waters, and extensive seasonally inundated floodplains. Bangladesh floodplains are one of the world's most important wetlands and home to hundreds of species of fish, plants, birds and other wildlife. These wetlands support over 260 fish species (Rahman, 2005) and hundreds of thousands of migrating birds (BirdLife International 2004).

These floodplains provide a critical source of income and nutrition for millions of rural Bangladesh's poorest people – intensive use for agriculture, fishing and collection of other aquatic resources helps to support a population of over 800 people per km^2. Inland fisheries are particularly important: the four million hectares of regularly inundated floodplain wetlands form a major capture fishery (Ali, 1997) and source of livelihoods for rural people – these wetlands contribute about 46% of all fish consumed (Department of Fisheries, 2000). Over 70% of households in the floodplains catch fish either for income or food (Minkin et al., 1997; Thompson et al., 1999). In fact the Bangali way of life is defined by use of modified wetlands in the traditional saying "Bhate Mache Bangali" (rice and fish make a Bangali), and about 60% of animal protein consumption comes from fish (BBS, 1999). The poor catch many small fish that are not included in official statistics or policies, and use aquatic plants and animals for food or as feed for livestock.

Unfortunately, the wetland resources of Bangladesh are in decline. Wetlands in the past were thought to be "wastelands" in Bangladesh and government's goal was to drain out and "recover" them for agriculture production (albeit for one crop a year during the dry season). Even in areas that have not been converted to agriculture, wetland ecosystems have been threatened by other pressures:

- Flood embankments and water control structures have blocked many fish migration routes.
- Irrigation has expanded winter rice cultivation but reduced the surface water that aquatic life needs to survive in the six-month dry season.
- The government leases out fishing rights in public water bodies, but short-term leases have encouraged maximum exploitation without giving incentives to protect resources for the next generation.
- Industrial development causes severe local pollution that kills breeding fish populations during the dry season, residual pesticides and agro-chemicals also adversely affect wetland habitat.
- Deforestation and poor land management cause high rates of siltation, often filling in dry season wetlands that serve as fish holding habitat during a crucial time of the year.
- More and more people fish destructively by dewatering or using fine mesh nets.

Out of Bangladesh's 260 freshwater fish species (Rahman 2005), more than 40% are now threatened with national extinction (IUCN Bangladesh 2000) and may soon follow the path of other wetland fauna and flora. Since 1985, natural carp spawn catches have declined by 75% (Ali 1997) and major carp and large catfish have

declined by 50% in national catches. Fish consumption fell by 11% between 1995 and 2000 (but by 38% for the poorest households), and it is estimated that inland capture fisheries catches fell by 38% between 1995 and 2002 (Muir 2003). Despite recent changes in national policies that call for an end on drainage of remaining wetlands (MWR 1999), wetlands continue to be encroached for agriculture, industry, brickfields and aquaculture with no sign of abatement.

There have already been mass extinctions in the last 200 years in Bangladesh. In the mid-nineteenth century there were large areas of reed swamp, wet grassland and flooded forests, particularly in the haors, where One-horned Rhinoceros, Tiger, Swamp Deer and Wild Buffalo all roamed (Sachse 1917). By 1967 large mammals had long since disappeared from the haors, but in Hail Haor "From horizon to horizon the sky was full of wheeling ducks and their clamorous voices could be clearly heard for half a mile" (Mountfort 1969). Yet monthly surveys of Hail Haor in 1992 revealed few migratory ducks (FAP 6 1993); and in 2003 only a handful of wild ducks were seen.

Hail Haor

Hail Haor is located in north-east Bangladesh and is typical of deeply flooded basins in that region known as *haors*. This large shallow lake in a saucer-shaped depression is bounded by the Balishara and Barshijura Hills to the east and the Satgaon Hills to the west, which are covered by a chain of tea gardens and natural forest blocks. Water from these low hills flows into the haor through 59 streams (once 350 were reportedly active). The watershed of Hail Haor covers about 600 km^2 (237 square miles). The river Gopla flows through the wetland from south to north and formerly connected the haor to the north with the plains of the.Kushiyara and Manu Rivers (part of the Meghna system). A series of flood control dikes along these rivers and a sluice gate restrict river flows and fish access to the haor. The haor floods during the rainy season (May-October) when it extends to cover over 13,000 ha, and at the peak of the dry season (March) reduces to around 3,000 ha of water. Land exposed as the water level recedes is converted to rice fields, Table 1 summarises land use in the haor. Much of the haor's surface is covered by grasses, lotus and water hyacinth. The maximum depth of water during the wet season is about 7.5 m.

Table 1 Land use in Hail Haor in 2000

Land use	Area (ha)
Seasonally flooded agricultural land and irrigated land	7,854
Permanent freshwater lakes (over 8 ha)	2,878
Seasonal/intermittent freshwater marshes	1,702
Permanent freshwater marshes and pools (under 8 ha)	136
Permanent rivers/streams/creeks	399
Fresh water tree dominated wetland	20
Aquaculture ponds	84
Settlements	185
Total	**13,258**

Hail Haor is one of the largest natural freshwater wetlands of Bangladesh and is distinctive in Bangladesh for having much of its catchment within the country. It has long been recognized as of international significance on ecological grounds, having been listed in the Asian Wetlands Directory (Scott 1989). More recently it has been listed as one of only 19 Important Bird areas in Bangladesh (Birdlife International 2004), and has been proposed as a Ramsar site. It is nationally important as a fishery, and since 1999 has become a model of community-based co-management

and restoration of wetland biodiversity and productivity. The haor is located in five unions[2] of Sreemongal Upazila and in two unions of Moulvi Bazaar Sadar Upazila of Moulvi Bazaar District. Approximately 172,000 people live in 61 villages around the haor.

MACH project context

The Management of Aquatic Ecosystems through Community Husbandry (MACH) project was formulated to develop new approaches to floodplain and wetland resource conservation and management (MACH 2007) The aim was to ensure the sustainable productivity of all wetland resources – water, fish, plants and wildlife– over an *entire* wetland ecosystem (comprising beels, seasonal wetlands, rivers and streams), not just a single water body and thereby to help ensure food security and increase biodiversity. The project was supported by USAID and the Government of Bangladesh from September 1998 to June 2008. USAID support ended in June 2007, but was complemented by Government of Bangladesh support from July 2002 to June 2008. The projects were implemented by Winrock International, Center for Natural Resource Studies (CNRS), Caritas Bangladesh, and Bangladesh Centre for Advanced Studies (BCAS), working closely with the Department of Fisheries and Ministry of Fisheries and Livestock of the Government of Bangladesh. MACH worked in three large typical wetland systems: Hail Haor and the Turag-Bangshi floodplain (Gazipur District, wet season extent 4,370 ha) from April 1999 onwards, and the Kangsha-Malijhee floodplain (Sherpur District, wet season extent 8,210 ha) since August 2000.

The project fits within a wider context of community based management of commons and conservation that has evolved in recent decades (Berkes 2007), since in addition to a focus on ecosystem sustainability and conservation, it also targeted livelihood development in terms of both alternatives and enhanced incomes from wetland resources. However, Bangladesh wetlands have complex property rights combining elements of: private ownership of seasonally flooded lands used for agriculture, state owned waterbodies where the government leases out fishing rights to individuals or community organisations, and informal seasonal commons in both of these where local people can fish for subsistence or graze cattle. Consequently conservation based management that developed through MACH is very different from typical protected areas and associated conservation and development.

Although the MACH approach was not planned at the outset to be based on co-management, this evolved to play an increasingly significant role. Co-management has been a focus of attention in fisheries and natural resources management in the last two decades. Although IUCN defines co-management as “a situation in which two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources.” (Borrini-Feyerabend et al. 2000), in the case of fisheries it has most often been taken to mean a sharing of responsibility between government and fishing communities. Co-management stretches from government dominated decisions at one end of the range with government

[2] A Union is the lowest administrative level in Bangladesh, typically there may be about 10 unions in a sub-district or Upazila. An elected council or Union Parishad governs each union comprising of representatives from the 10 or so villages within a union.

instructing users, through consultations, to at the other extreme users advising or informing of their decisions for government endorsement (Berkes 1989; Pomeroy and Williams 1994; Sen and Nielson 1996). Co-management has been promoted in the belief that a shift from top-down management to sharing decisions and responsibility between resource users and government would improve the quality of decisions and local compliance with management plans. Therefore the intention of co-management is to empower fishers both as an end in itself and in the expectation of better management (Viswanathan et al. 2003). This requires major changes in institutions, organizations and attitudes.

This paper summarises the MACH approach - how it was applied to community based conservation and co-management in Hail Haor and its impacts. It draws some lessons from this case where co-management has joined ecosystem conservation as the defining features of the outcomes.

Valuation of Hail Haor

Total economic value is now well established as a framework for defining ecosystem, including wetland economic benefits (Barbier et al. 1997). A valuation was conducted in 2000 (Thompson and Colavito 2007) using this approach but focusing mostly on direct values. Many of even these more readily quantified benefits, as well as public benefits, have tended to be ignored and under appreciated in Bangladesh. For example, planners and local residents seem to have been unaware that wetlands maintain the health of the local aquifer, reduce flood severity, and improve water quality.

The approach taken was to estimate the annual value of various economic outputs from the land covered by the wet season water area. The economic output valued was the gross revenue generated by primary activities associated with the wetland resources. An attempt to estimate value added by activity and alternative activities was not attempted. However, it should be noted that since these wetland outputs are either resource extraction or public values the share of value addition will in fact exceed alternative agricultural production activities. This implies that the estimation of relative wetland value is conservative.

With the exception of the value of wetland land use for agriculture, all of the benefits valued are derived from common pool resources and public goods such as flood mitigation. Values were estimated at the early stage of introducing community based management practices, and reflect conditions when the common pool resources were in a degraded condition due to over exploitation linked with inappropriate property right regimes, for example extraction of maximum short term fish catches encouraged by the leasing system, and over fishing where there was open access. Table 2 summarises the potential benefits from the Haor and how they were valued.

Table 2 Potential benefits of wetlands and the valuation estimation approaches used in Hail Haor

Type of benefit	Method/comments
Direct values	
Fisheries	Data collected by MACH from monthly monitoring in sample representative areas. Per ha data was then scaled up utilizing GIS estimates of water area.
Non fish products	A stratified sample household survey was conducted in villages surrounding Hail Hoar. Results were scaled up based on total population of the surrounding villages.
Tea estate vegetation use	Tea estates use water hyacinth as mulch. A quick survey of selected estates was conducted to estimate per ha use, and scaled up by total tea estate area.
Pasture	The area of grazing land was estimated in a GIS as the non-inundated area in each month not cultivated with boro rice. An extremely low value of returns per ha of pasture was then used to scale up.
Boro rice (dry season)	Area was estimated by GIS and a standard value of boro rice production was used.
Transportation	A survey was conducted at key boat launching sites.
Recreation	The value of tourism to the region was partially attributed to the Haor. Data on tourist expenditure patterns was collected through surveys of hotels and tourists
Indirect values	
Flood control	A cost avoidance approach was used. The cost avoided was given by a proposed BWDB flood control scheme proposed for the Haor.
Water quality	Not estimated but will be a significant value as the Haor acts to naturally purify water.
Aquifer charge	Not estimated but will be a very significant value as the Haor acts to maintain the charge of local aquifers that provide critical drinking and agricultural water
Option values	
Value of maintaining ecosystem for potential future uses	Not estimated, other than through biodiversity value (see below)
Existence values	
Existence values	The intrinsic value of the Haor nationally and internationally was not valued, however unlike many smaller wetlands in Bangladesh it is likely to be significant as the Haor is internationally important for its biodiversity.
Biodiversity	Key informants provided information on the value of MACH and other potential projects arising from experience in Hail Haor. The annual cost of these investments was then used as a surrogate measure.

A simple bio-economic model used the 1999 maximum haor extent of 12,300 ha. The annual economic output value estimated for Hail Haor was Tk 454 million (USD 7.98 million), with a net present value (NPV) of this benefit stream over 15 years of Tk 4.6 billion (USD 79.7 million).[3] The NPV of one hectare of this wetland was Tk 373,000 (USD 6,568). Table 3 indicates that the annual value of non-fish aquatic products including aquatic grasses, plants for human consumption, snails, mussels and other products

Table 3 Estimated value of Hail Haor economic outputs in 1999-2000.

Type of good or service	Total returns (Tk)	Value per area (Tk /ha)*	Percent
Commercial fisheries	56,272,200	4,580	12
Subsistence fisheries	83,651,100	6,800	18
Non fish aquatic products**	127,973,300	10,410	28
Boro rice value	63,857,500	5,190	14
Project / biodiversity funds	43,650,600	3,550	10
Pasture value	40,292,800	3,280	9
Flood control	23,443,200	1,910	5
Recreation	7,025,600	570	2
Transportation	8,758,300	710	2
Total (Tk)	**454,924,600**	**37,000**	**100.0**
Total (US$)	**$7,981,100**	**$650**	

Water quality, aquifer recharge benefits and existence value were not valued.
* Total output value divided by maximum water area (12,300 ha in 1999).
** Includes aquatic plants used by local residents and by tea estates.
Exchange rate at that time US$ 1 =Tk 56.9

[3] NPV was calculated for a 15-year period based on a real inflation-adjusted opportunity cost of capital of 6%.

was as high as that of fish. The value of dry season pastureland in the haor was also very significant at Tk 40 million (9% of haor value). The estimates are conservative since a number of important benefits and uses from the haor that are difficult to value were not included. Although boro rice is grown in a significant part of the wetland, it is clear that if the rest of the haor were to be converted to rice production there would be an economic loss to the nation as well as to the local community, since at that time the net return from boro rice was only Tk 18,254 per ha (BBS 1999). This strongly showed that maintaining and improving management of wetland commons offered higher economic benefits than conversion of wetlands to boro rice production, and this was born out by the impacts of conservation management.

Community based co-management and conservation

Institutions and organisations

Like several projects in Bangladesh in the past decade (Thompson et al. 2003; Thompson 2005), MACH worked to establish community based management systems focused on fisheries and has drawn lessons from this. In addition to community organizations for the sustainable use and management of fish and wetland resources, MACH also worked to improve the livelihoods of poor wetland users and to empower them in decision making. The key differences from other projects in Bangladesh are:

1. The Resource Management Organizations (RMOs) established to protect and sustain wetland resources represent all stakeholders.
2. Separate organisations of poor people – Federations of Resource User Groups (FRUGs) – were formed to help diversify and enhance their livelihoods.
3. These community based organizations (CBOs) have been formally linked with local government (both Union Parishads – elected local councils, and Upazila or sub-district administration) through Upazila Fisheries Committees.
4. Separate partner NGOs worked to support each of these types of body and their activities in a collaborative and coordinated way, giving equal weight to conservation and development.

In Hail Haor most of the main dry season water bodies are *jalmohals* (state property where the government leases fishing rights to the highest bidder, 84 jalmohals within the haor covering 1,305.6 ha) and are distant from the many user villages that surround the haor. Here the project directly organized stakeholder representatives including local community leaders from those villages covered by participatory planning into eight RMOs spread around the haor edges. The project then worked to persuade the government to reserve the leases for some of the jalmohals (one or more in each RMO area) for RMOs without competitive tendering. Of these 22 jalmohals covering 472.8 ha have been reserved by the government for management by RMOs. The RMOs then functioned as enlightened leaseholders, sub-contracting fishing to fishers and establishing best wetland management practices in these jalmohals and the neighbouring floodplain. Also about 100 ha has been permanently reserved by the Ministry of Land as a sanctuary known as “Baikka Beel sanctuary” under management of Baragangina Resource Management

Organisation supervised by Sreemangal Upazila Fisheries Committee (see later section).

MACH has established what is best described as **Community based Co-management** of three large wetland systems as a pilot scheme. The key elements of the MACH approach have been establishing community organizations and then embedding within them institutions for sustainable wise use of wetland resources, formally linking these with the existing local government system, and through this making interventions to restore wetland habitats and their productivity and to improve the livelihoods of poor people dependent on these wetlands. Where possible MACH has also addressed land use practices in the watersheds of these wetlands that adversely affect the downstream wetland ecosystems.

The new institutional arrangements and links among local organizations are shown in Figure 1, they comprise in Hail Haor:

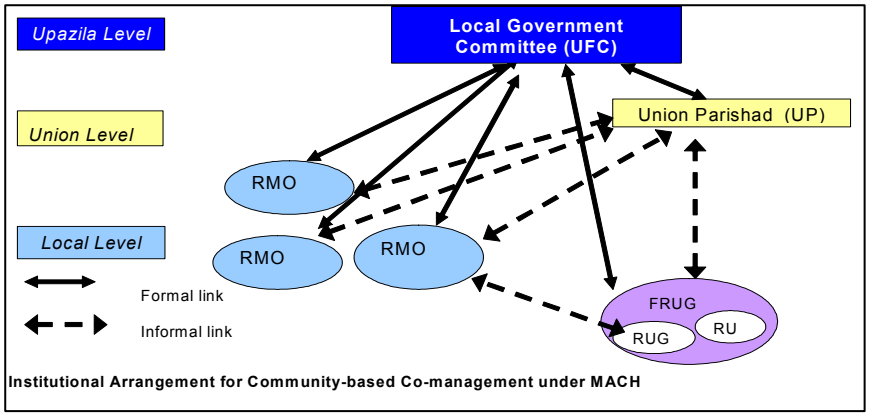


Figure 1 MACH Co-management arrangement

- Eight Resource Management Organizations (RMOs) representing all local people with interests in wetlands and fisheries. The RMOs incorporate all types of local stakeholders – fishers, farmers, landless, local opinion leaders, men and women. They work to protect, manage and restore productivity of their area of wetland and ensure fair access for local poor fishers.
- Five Federations of Resource User Groups (FRUGs) comprising only of poor men and women who previously made use of these wetlands. They operate savings and credit for their members. The members all received training to adopt economic activities intended to enhance their incomes and diversify their livelihoods so that they are less dependent on fishing and are able to comply with restrictions on wetland use set by the RMOs without suffering economic hardship. This helps to counteract the effects of population increase which had resulted in excessive fishing pressure.
- Five existing Union Parishads (UPs, local councils, the lowest tier of government in Bangladesh covering several villages) are involved. The RMOs are now invited to their respective UP meetings.
- Co-management is formalized through two Upazila Fisheries Committees (UFCs, one in each Upazila or sub-district covering the haor) where Government officials at Upazila level, UP chairmen, RMO presidents, and FRUG presidents sit to coordinate and oversee wetland management.

All of these organizations have been recognized by government and are expected to continue to function and maintain the wetland and the lives of poor resource users in the long term. Both RMOs and FRUGs are registered as social welfare organizations under the Social Welfare Department of Bangladesh and have had support to adopt

good governance practices including elections of office bearers, transparent decision making and accounting, they manage modest funds raised from local people through fishing fees, or provided from the project (their performance is discussed later).

Resource management and conservation

Hail Haor is a major sediment trap for its catchment. Poor land management in the neighbouring hills results in serious soil erosion, particularly where pineapple is grown in lines up-down slope. In 1999 it was found that the largest *chora* (hill stream) feeding Hail Haor carried over 200,000 m^3 of sediment just in July. In 2001 silt loads of 22 choras were monitored – they carried 50,000 tons, suggesting that the total of 59 active choras carry over 100,000 tons of silt into Hail Haor each year. Deposition of 8-15 cm of silt in one year was recorded near the outfalls of the choras, suggesting the haor bed rises on average by about 5 cm per year (MACH 2004). With only 2-3 m of water in most of the Haor in the monsoon, Hail Haor is changing rapidly, the fringes of the haor are rapidly filling in, and it could disappear as we know it today.

To address this adverse trend, wetland habitat has been restored by re-excavating canals to improve flows, and re-excavating beels (mostly within areas declared by the RMOs as sanctuaries) to hold water year round. The improved habitat provides better shelter for fish, and facilitates breeding and regeneration of aquatic plants and animals. Though the total area of 13.9 ha of beels and 11 km of canals excavated is modest compared with the total dry season water area, these deeper fish refuges and canal connections directly serve and link with the majority of the dry season water area in the three sites.

Re-excavation of wetlands addresses the outcome of siltation but not the root causes. Land use mapping for two chora catchments flowing into Hail Haor revealed that 46% is under tea estates (which are already reasonably well managed to limit soil erosion), 28% is forest land under the responsibility of the Forest Department (some of which has poor tree cover), and 13% is privately managed pineapple and lemon gardens. The pineapple disproportionately contributed to siltation because the growers habitually grew pineapple in rows running up-down slope accelerating soil erosion. The project brought in expertise on pineapple growing and worked with a few farmers, demonstrating that contour cultivation was not only feasible but resulted in denser planting per ha, reduced fertilizer costs, and generated higher profits (an extra Tk 130,000 (US$ 2,000) per ha over three years), and of course reduced soil erosion. By the end of 2005, 32 farmers had adopted contour planting on 72 plots covering 37 ha, and the Department of Agricultural Extension agreed to promote this method more widely.

Communities felt it was important to plant native trees to mitigate the past trend for loss of tree cover including swamp forest in the wetlands and riparian areas, this is also expected to help reduce the sediment loads in small rivers and channels flowing into the wetlands through bank stabilization. Notably the project has helped to pioneer and demonstrate nursery raising and planting out of native wetland trees - Hijal *Barringtonia aquatangula* and Koroch *Pongamia glabra* – that are adapted to being inundated by a meter or more of water for up to half of the year. This swamp forest is important habitat for fish during the monsoon as well as for other wildlife,

and provides branches for brush piles. In Hail Haor 72,100 swamp forest trees were planted, and 52,000 trees were planted to stabilise the banks for choras and form links with adjacent hills. The swamp forest trees are owned by the RMOs and are not to be felled, but can be used when more mature to cut branches, while the riparian trees are owned on a share basis between adjacent landowners and small groups of poorer local people under agreements made with local government whereby they can eventually be felled for income provided they are replanted.

The main activities of the RMOs have been to protect and sustainably manage fish resources. In Hail Haor the RMOs established 11 wetland sanctuaries covering an area of 109 ha within the waterbodies they manage, to conserve fish especially in the dry season so that they can survive to breed and repopulate the floodplains in the next monsoon. Concrete fish protection devices have been placed there as permanent equivalents of traditional brushpiles that prevent fishing and provide substrata for fish to feed on. The RMOs complement their physical interventions by setting rules and norms covering the larger areas that they manage and influence including an end to dewatering (pumping dry) depressions that hold water year-round, adopting closed seasons for 2-3 months in the early monsoon when fish breed, and banning hunting of birds. The RMOs have also released in Hail Haor with project support about 0.77 million native fishes of seven species as a re-introduction initiative (Table 5).

Table 5 Fish re-establishment: estimated numbers of fish released and caught in Hail Haor

Species and national threat status	Fishing year / Stocking year	1999-00	2000-01	2001-02 / 2001	2002-03 / 2002	2003-04 / 2003	2004-05 / 2004	2005-06 / 2005	Interpretation
Kalibaus (*Labeo calbasu*) EN	released	0	0	2,110	15,210	0	5,630	12,700	Natural fishery, releases may have augmented
	estimated catch	22,780	5,140	7,040	26,450	13,030	145,710	23,810	
Rui (*Labeo rohita*)	released	0	0	0	0	117,250	52,470	0	Natural fishery, releases may have augmented
	estimated catch	13,500	45,650	48,610	105,800	65,260	585,680	174,410	
Ghonia (*Labeo gonius*) EN	released	0	0	13,200	14,350	59,090	305,790	154,460	Natural fishery, releases possibly established self sustaining populations
	estimated catch	18,900	15,980	216,100	402,730	56,330	273,460	212,330	
Deshi Sarpunti (*Barbodes sarana*) CR	released	0	0	4,140	3,600	0	0	3,000	Releases appear not to have established self sustaining population
	estimated catch	0	0	41,510	28,940	0	2,450	2,300	
Chital (*Chital chitala*) EN	released	0	0	0	0	0	0	6,000	Too early to see any impact
	estimated catch	0	0	0	900	150	0	5,390	
Ayer (*Sperata aor*) VU	released	0	0	380	2,930	500	0	0	Catch fluctuates, some evidence of change
	estimated catch	3,300	110	0	39,510	500	5,460	2,550	
Gulsha (*Mystus cavasius*)	released	0	0	0	0	0	0	650	Common with fluctuating population, little impact expected
	estimated catch	366,500	930,070	4,657,990	862,100	285,880	514,980	115,550	
Carps sub-total	released	**0**	**0**	**15,310**	**29,560**	**176,350**	**363,890**	**167,150**	
Total	released	**0**	**0**	**19,830**	**36,100**	**176,850**	**363,890**	**176,810**	

Scientific names and order follow Rahman (2005); threat status is from IUCN (2001): CR = critically endangered; EN = endangered; VU = vulnerable.

It would appear that fish releases have helped to establish valuable populations of carps that were scarce in the haor: ghonia, rui and kalibaus, and for all of these there are observations by fishers of recently hatched fry indicating that releases and protection have restored these fish. Considering the quantities of fish caught by species, the diversity of native fish species caught has increased from the baseline. The indices calculated and reported in Table 7 are based on the weight of fish reported for each species in the catch from monitoring areas in each year and are a measure of the diversity – the higher the number of species and the more even the amount of fish spread across species, the higher the index. It appears that overall diversity of fish in Hail Haor has increased since MACH started.

Table 7 Fish species diversity and biodiversity indices for fish catch (Shannon indices) in Hail Haor

Year	Number of species caught	Shannon index	
		native fin fish	all fish
Baseline	71	2.76	2.80
Impact 1	71	2.88	2.97
Impact 2	69	3.30	3.42
Impact 3	76	3.29	3.41
Impact 4	67	3.24	3.36
Impact 5	81	3.43	3.60
Impact 6	75	3.29	3.43

Years defined as: April to March.
Baseline: 1999-00, Impact-1: 2000-01; Impact-2: 2001-02; Impact-3: 2002-03; Impact-4: 2003-04; Impact-5: 2004-05; Impact-6: 2005-06.

Case study of Baikka Beel

As part of its restoration of wetland productivity and biodiversity in Hail Haor, MACH and the local communities identified an area that could be set aside as a permanent sanctuary within the haor. Baikka Beel, covering about 100 ha, was identified as an area of good habitat that could be protected without disadvantaging poor resource users who could fish and collect aquatic plants in other nearby parts of the wetland. Proceeding upwards from local community through local government to central government, consensus was eventually reached, and on 1 July 2003 the Ministry of Land decided to reserve the three jalmohals that form this beel as a permanent sanctuary, giving up an annual lease income of about Tk 100,000. Baikka Beel is fully managed and protected by a community organisation: Baragangina Resource Management Organization.

A management plan for Baikka Beel sanctuary was developed through a process involving MACH project, Baragangina RMO, and local government. After local participatory planning sessions with different stakeholders, a workshop involving all stakeholders was held in June 2005. Based on this the plan was modified, elaborated and reviewed by the RMO and then by the Upazila Fisheries Committee (the members comprise government officers, local elected councillors and leaders of RMOs). After revisions the final management plan was approved by the Sreemangal Upazila Fisheries Committee and signed by the Upazila Nirbahi Officer (chief administrator at sub-district level) and Upazila Fisheries Officer in 2006, as well as Baragangina RMO.

Baragangina RMO has successfully implemented this plan since it was drafted in 2005. No fishing has taken place, apart from isolated incidents of poaching, and the RMO has been able to impose sanctions on poachers – for example challenging fishers selling large fish in local markets that they were caught in the sanctuary. It makes use of existing local institutions to punish offenders by bringing them before the local village *salish* (traditional court) and in one case a woman member of the RMO played a key role as a neutral arbitrator. The fines set by the salish have been

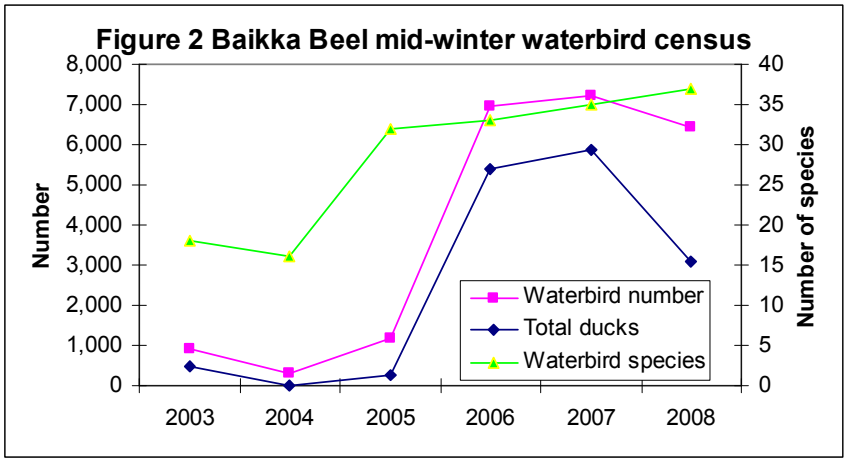
paid to the RMO which uses the funds for charitable work to benefit poor people in the area. Attempts to shoot the wintering ducks that have returned to the area with protection have also been thwarted by the RMO and local community using backing of the local administration and government recognition of the sanctuary.

In Baikka Beel sanctuary the MACH project supported several conservation measures since 2003. Native swamp forest trees – mostly Koroch and Hijal – were planted to restore a habitat that had long since disappeared, and as of October 2006 11,600 trees were surviving here. Local contractors have innovated small scale dredging to deepen some of the silted up areas (just over 3 ha have been excavated). Here submerged concrete hexapods and pipes have been placed to shelter fish, as a deterrent to fishing and to provide substrate for attached plankton (periphyton) growth by substituting for the missing trees that would have occurred in the past and that are slowly growing.

MACH has also constructed a visitor tower with information center, and helped train members of the Resource Management Organization in managing the sanctuary and guiding visitors. Arrangements have been made for guided boat trips. Information boards have been installed, and a video documentary shown on TV. Two guards are employed by the RMO to protect the sanctuary, and this is funded from an endowment fund via the UFC. Already the sanctuary is attracting visitors (local and from Dhaka, Bangladeshi and foreign) who pay modest entrance fees which go towards the RMO's maintenance costs. The attractions are that since 2004 the RMO has banned fishing, hunting, and collection of aquatic plants, resulting in a wetland full of lotus blooms in the spring, and waterbirds in the dry season.

Hail Haor has historically been regarded as an important site for wetland biodiversity in Bangladesh, with relatively more information available on, for example, birds recorded there. However, wintering waterfowl numbers had disappeared from tens of thousands reported in the late 1960s to a handful at the start of MACH. Between 2004 and February 2008, 125 species of birds were recorded within the 100 ha sanctuary. Both numbers and diversity have increased, for example mid-winter census results have risen about 300 water birds of 16 species in January 2004 to 7,200 water birds of 35 species in January 2007 (Figure 2), and with at least 12,000 waterbirds visiting during winter 2006-07. These include large flocks of Fulvous and Lesser Whistling-duck; Northern Pintail, Common Teal, Garganey and Purple Swamphen. Globally threatened species have also returned to the area: several Pallas's Fish Eagle and Greater Spotted Eagle (both Vulnerable) now spend the winter here, as do the near-threatened Black-headed Ibis and Ferruginous Pochard. Overall 147 species of bird had been recorded in Hail Haor up to February 2000, but by February 2008

Figure 2 Baikka Beel mid-winter waterbird census



28 species had been added, the total includes six threatened and seven near-threatened species (P. Thompson personal records; Thompson et al. 1993; Thompson and Johnson 2003).

As a result of sustainable community based management practices in the haor and the success of Baikka Beel sanctuary in particular, Hail Haor is considered by BirdLife International to be an internationally Important Bird Area, and the Ministry of Fisheries and Livestock has recently agreed in principle to propose the designation of Hail Haor as a "Ramsar Site" – a wetland of international importance.

Impacts

Baragangina is just one of eight RMOs established to manage Hail Haor. From 2005 onwards MACH was in a gradual phase out process where it tried to strengthen RMO capacities and at the same time leave the RMOs to operate more independently. To guide this process a system of six-monthly assessments was introduced. Initially these were undertaken by Dhaka based project staff and were used to prioritise support and capacity building by local staff, but from mid 2006 the system was simplified and local officials (Upazila Fisheries Officer and Social Welfare Officer) were encouraged to make the assessments on behalf of the UFC. A set of seven clusters or themes for assessment were developed with over 100 individual indictors used. Assessments involved small focus groups and triangulation between RMO leaders, general members and other villagers. For example, resource management covered indicators such as the existence of a management plan, number of rules in operation, incidences of rule breaking and conflicts; pro-poor looked at the extent of participation in the RMO by the poor and outcomes for the poor and likewise for women's role; organisation performance looked at implementation of RMOs' own constitutions and bylaws such as holding regular meetings and elections; governance covered issues such as elite dominance, views of the poor, and processes such as elections of office bearers; financial management covered appropriateness, fund raising and transparency including audits; and networking covered linkages with government and other organisations. From a three level scoring of each individual indicator a percentage index was calculated showing the percentage of the applicable maximum score achieved by each RMO in each period (Figure 3). In July 2006 the full and the simplified and updated systems were followed hence the two scorings for comparison.

While these assessments show in general the RMOs enhancing their performances over the period, there is some tendency for a decline in the last year when staff inputs were reduced and the RMOs managed most of their activities by themselves. Notably there was some polarisation on the extent the RMOs favoured the poor (all include range of stakeholders but have an aim of protecting the interests of and ensuring full participation of the poor. Similarly one of the RMOs refused to involve women in its activities despite efforts by the project and despite regular meetings between the RMO leaders and some peer pressure. In this regard this is a conservative area but gradually women have found a voice and been well recognised and appreciated for a role in several RMOs.

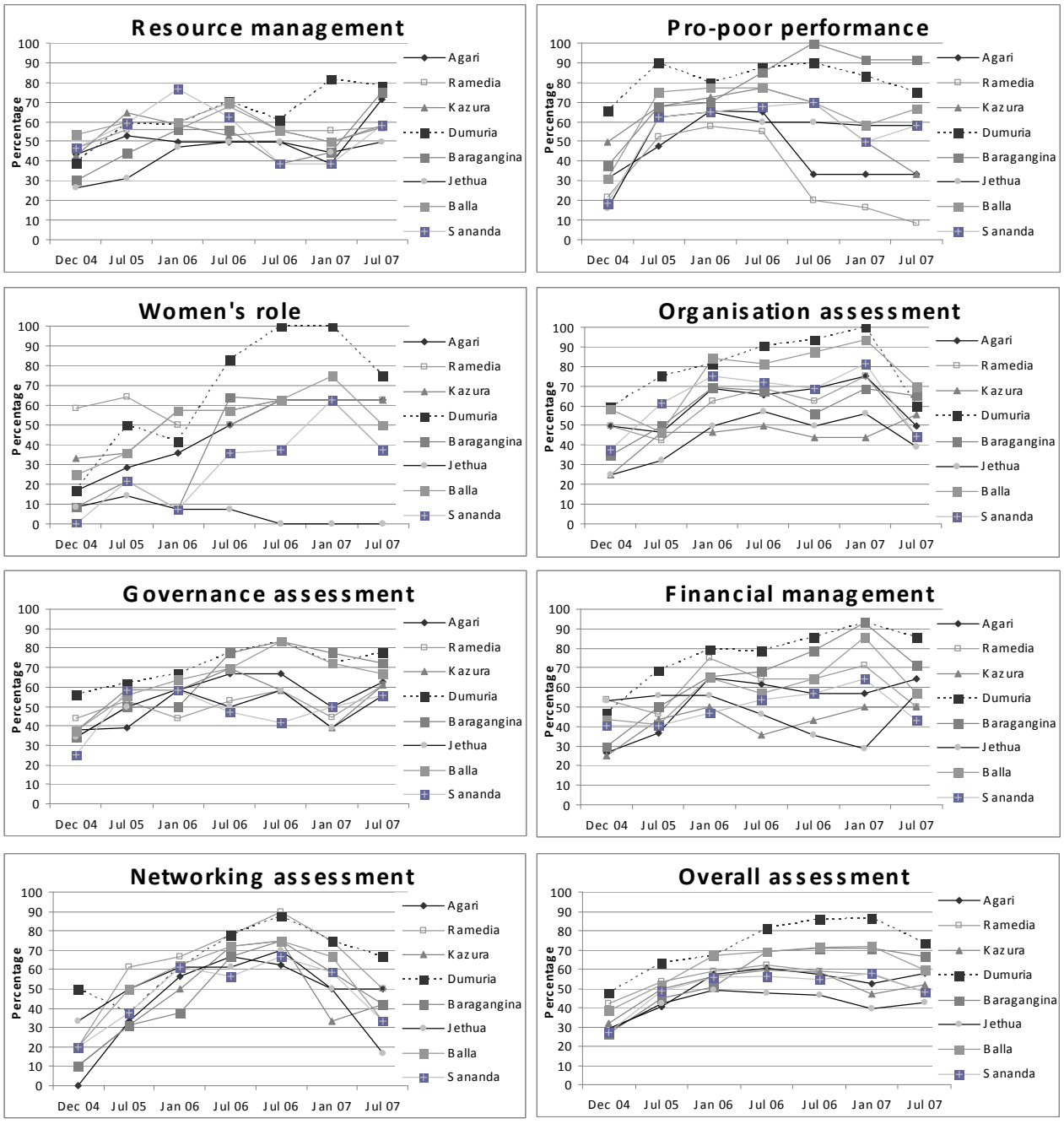


Figure 3 Resource Management Organisation assessments in Hail Haor

Collectively these activities have resulted in fish catches increasing about 88% over the 1999 baseline, from 171kg/ha to 322 kg/ha in the last two years (2004/05-2005/06). Fish consumption of households living in villages around the haor has shown statistically significant increases, and on average increased by about 25-36% in the same period. Detailed household monitoring showed that the landless have in general benefited as much, in terms of increased fish consumption, as larger landowners.

Revolving loan funds worth US$ 0.42 million (Tk.29.1 million) have been transferred to the FRUGs, and training was provided to the group members, when combined

with vocational training provided through the project, this has helped about 5,200 poor households (group members) increase their supplemental incomes by about 50% by taking up a wide range of skills and enterprises (from poultry and cattle raising, to tailoring, mechanics, and small shops). This has also reduced their dependence on fishing by about two-thirds, helping to reduce pressure on fishery resources so that fish stocks could recover. The FRUGs now operate as independent organizations employing their own staff. Handing over of loan fund to the organized poor by a project to operate by themselves is a pioneer in its nature in the country.

By 2006 there had been a 24% increase in the value of the haor, solely as a result of increased fish catches with community based co-management. Moreover an economic assessment of just the directly attributable impacts of MACH on fish catches, alternative income generating activities, trees, pineapple growing estimated a present value of benefits up to 2022 of Tk 2,970 million or US$ 44 million at a 6% discount rate. Compared with a present value of total costs equivalent to US$ 9.57 million, this gives an internal rate of return of 56%, and a benefit cost ratio of 4.7. Moreover, most of these benefits have put more income in the hands and more fish in the stomachs of poor people.

Sustainability, Threats and Lessons

For sustainability the five Upazila Fisheries Committees have been endowed with a total of US$ 0.53 million (Tk 36 million), the annual income from which will primarily be used for continued restoration of wetland habitat by the RMOs, but also to cover the costs of meetings and visits by UFC members to the wetlands. These systems have been successfully tested for two years by providing grants to the UFCs equivalent to the funds they will receive from endowment income. The principal amount of the endowment will remain untouched, so that indefinitely the UFCs and RMOs will have access to funds. This is the first time in Bangladesh that this arrangement has been adopted to ensure continuity of activities after the end of the project period. Even so these arrangements do not cover all of Hail Haor, although there is scope to expand gradually the coverage of the RMOs if jalmohals are switched from competitive leasing to being reserved for sustainable management. Many of the MACH approaches have been taken up in the Inland Capture Fisheries Strategy of DOF (DOF 2006), but while this is an important commitment in principle, implementation will depend to a large extent on the will of the Ministry of Land which controls the leasing system to follow its precedent for Baikka Beel and give up maximisation of short term government revenue, and of elites to give up their power and status attached with fishery leasing. As has been demonstrated conservation areas can be managed by communities when use rights are reserved for them by government on nominal payment (US$ 15 per year in the case of Baikka Beel) and the condition that the area becomes a sanctuary. For a substantial conservation area this can work where it is part of a larger wetland system and users in the rest of the system adopt sustainable harvesting institutions.

Threats to the wetland remain. In the 1980s an embankment project undertaken by Bangladesh Water Development Board with World Bank support was initiated to expand dry season agriculture in the haor it was not completed and did not enclose any areas but it did improve access into the haor and provide an embankment and

ditches that have in recent years been used by richer people with local connections to expand aquaculture enclosing once seasonal common fishing grounds. While these enclosures retain some value for birds, embanking areas for aquaculture results in loss of connectivity and loss of natural fish populations, it also results in loss of aquatic plants and loss of access for local people to what had been common property resources. Other water development projects may also affect the wetland. In 2006 the Local Government Engineering Department installed a rubber dam for water retention and irrigation downstream on the Gopla River (outside of the site). But predictions indicate that this project will likely slightly raise dry season water levels which should be beneficial for the wetland ecology.

These threats arise from overlapping development agencies with their own priorities and a lack of understanding of the overall value of the wetland. They also arise from the ability of politicians and other people with influence and power to gain control over public lands within the haor – in addition to the jalmohals there are public *khas* lands that are seasonally flooded and may be grazing, or converted to agriculture in the dry season.

Economic growth in the catchment also poses a threat: more intensive cultivation (both in the nearby fields and in the tea estates) is typically associated with use of agro-chemicals which could affect water quality in the haor given it has only one outlet, but there is no evidence so far of any impact. In addition to fuel the growth of Sreemangal town one brick field has been established within the site, in the short term this results in loss of dry season shallow flooded grazing lands and air pollution, but in the longer term it may deepen these habitats.

MACH set out to be environment focused but can be seen as being a community based conservation and development programme where resource management and livelihood development had similar weights. Although it did not set out to be a co-management project, this is perhaps its main lesson and impact – showing the effectiveness of a nested arrangement of community based management of local parts of a large wetland, overlapping with livelihood support for poorer households, and feeding into a higher level of co-management body that brings together CBOs, local elected councils, and local administration. This means that there are genuine community representatives in these committees, and there are upward and downward checks and balances.

The value of the fishery and many dispersed users has created an opportunity for community based conservation to generate economic benefits. The Baikka Beel sanctuary may offer a diverse wetland habitat attractive to visitors, but its real value to the communities around Hail Haor is as local people say as a “fish bank” that repopulates the rest of the haor where people benefit directly from higher fish catches.

Acknowledgements

This paper summarises a large team effort over many years. First and foremost the efforts of the local communities, particularly the Resource Management Organisations and Resource User groups, deserve appreciation, along with the

chairmen and members of five Union Parishads, and the government officials posted to Sreemangal and Moulvi Bazar since 1998. Monitoring data has been generated by a team of local women and men supported by project staff. A large team of staff from CNRS, Caritas, BCAS and Winrock International have worked in Hail Haor and the MACH project over the years. Notable guidance to conservation measures in Baikka Beel came from Mokhlesur Rahman and Maizarul Islam. Danial Bhuiyan played a key role in community organisation support and assessments, as did Mujibur Rahman for wider institutional arrangements. Project leadership came from S.N. Chowdhury (national coordinator), Bill Collis and Darrell Deppert. Over the years many officials of Department of Fisheries and Ministry of Fisheries and Livestock played an important role in shaping the project. Lastly the project was generously supported by USAID and Government of Bangladesh which showed a long term commitment to wetland co-management. This paper is based on the author's involvement in the project during 2004-08, but any opinions expressed are the author's alone.

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