Integrated Floodplain Management approach in Bangladesh

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Abstract

Floodplains cover over a third of Bangladesh, and significant areas of south-east and south Asia. They are characterised by conflicting uses of complex commons, worsened in the past by dividing development support into sectors. This paper shows how a 'systems approach' can produce win-win outcomes. Communities can organise to modify agriculture, water use and fishing practices to complement one another, increasing joint benefits from floodplains. Integrated Floodplain Management (IFM) recognises the floodplain as a system, where the uses and amounts of surface water in the dry season and monsoon critically affect the two main products – crops and fish.

Piloting in Goakhola-Hatiara Beel, a 350 ha seasonal floodplain in southwest Bangladesh, brought together fishers, farmers and sluice operators. Existing narrowly defined institutions were brought together and formalised through a central committee which successfully facilitated links among community stakeholders and with government agencies to replace previous conflict of interest with cooperation. Farmers made a major change in cropping patterns by replacing dry season irrigated rice with pulses and new crops such as potatoes and garlic on 20% of land. One small-scale farmer commented that while cultivating rice is traditional, farmers had not realised how they could gain, both financially and environmentally, by growing alternative crops. Crops with low irrigation demand are profitable and resulted in more surface water in the dry season, which the community protected as a fish sanctuary. This enhanced fish survival and reproduction, and when combined with adjustments in sluice operation and a closed season, resulted in higher fish catches. The community has improved common water management and accessed government extension services including techniques to reduce water pollution from processing jute fibre. By adopting IFM, farmers and fishers have benefited from higher catches, higher incomes from crops, and greater community solidarity.

Key Words: *fisheries, water management, community, complex commons*

CONTEXT

Bangladesh has a population of about 130 million and a GNP per capita in 2006 of US$ 400. Over 50% of the population is poor (36% are ‘extremely poor’). Much of Bangladesh consists of floodplains of the Ganges, Brahmaputra and Meghna rivers. Agriculture contributes 50% of rural livelihoods. Fishing contributes 3% of GDP, but contributes to the livelihoods of over 73% of rural floodplain households (Shankar *et al*, 2004). Wetlands in Bangladesh have traditionally provided food and livelihood security (agriculture, fish and other aquatic resources) for millions of rural people: landed elites, farmers, fishers, landless labourers and poor women. Access to

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aquatic resources by the rural poor is becoming increasingly difficult. Aquatic products are a major source of essential nutrients in both rural and urban households (Muir, 2003). However, the landed elite has long dominated control over wetlands while the opinions and livelihoods of poor fishers and the landless are seldom valued in management decisions (CARE Bangladesh, 2005).

Bangladesh government policies on wetlands still generally ignore access for the poor and sustainability. Technical and administrative interventions from government and private investments have focussed on irrigation, drainage and flood control for agriculture (particularly rice). This benefited farmers, and to some extent wage labourers. However, drainage, flood control and irrigation have adversely affected floodplain fisheries, which are estimated to have fallen by about 70% in recent years. Participatory assessments indicate that pressure on fish and aquatic resources has rapidly grown and availability per household has fallen. This affects 1.2 million professional fishers (one of the poorest groups in rural society), and the poor in general who have relied on these resources as a subsistence safety net (Huda, 2003).

These floodplains are complex commons. Much of the land is privately owned and farmed and water stands for up to 6 months on the agricultural land. Depressions that hold water year round (called *beels*) and rivers are public or state property mainly regarded as fisheries and sources of government revenue. Fishing rights are leased out by government to the highest bidder in beels, but use of rivers has been made open access. However, in the monsoon (wet season) when all of the floodplains are inundated local people often have customary rights to catch fish and collect other aquatic resources such as plants (food, fodder, fuel, building materials) and snails (feed for ducks and shrimp farming) from both public and private lands. Access to many floodplain natural resources is not clearly defined legally but depends on a process of negotiation, bargaining or conflict between poor and rich. Important common pool resources like fish are found on private land to which the poor have customarily negotiated access. The rich have the right to privatize these resources and exclude others, but this is only practicable in the dry season, and from the perspective of the poor these resources are common.

The dry season is the critical time when water is scarce yet water in this season drives the productivity of a system where water is overabundant in the wet season. Conflicts between farmers and fishers (or in other words rice vs. fish) relating to use of dry season water are a common feature in most floodplains (DOF, 2006). The farmers who are wealthier and influential win the game often, whilst the poor and landless, who make a substantial part of their livelihood from floodplain common pool resources, lose.

Already there have been major changes in the floodplains in recent decades. Many areas have flood control and drainage works, and recent policy has been to increase public participation and even to hand over infrastructure to local people (MWR, 2001). Wherever Bangladesh Water Development Board has built sluice gates or water control structures, the responsibility of managing water is always with the bigger and influential farmers. Under the Department of Agriculture Extension (DAE) farmers field schools were introduced to help farmers adopt new practices and learn but the sustainability of those institutions was limited as they were project based.

Similarly, community based organisations have been established for fishery management through projects, and rights to water bodies have been reserved for these local user organisations, but their resource management systems focus only on the fishery and there was limited follow up after project support ended. Often all these types of development actions have been happening in the same locations, but there was no coordination or cooperation between government agencies or local institutions and actions.

CONCEPT OF IFM

Initial modelling and research investigated the scope to maximise floodplain productivity and returns by taking a more integrated view of the resource base that would better balance agriculture with fisheries for example, and that could at the same time benefit the poorer members of communities who depend more on common pool resources (Shankar *et al.*, 2004). Based on this some "Integrated Floodplain Management" (IFM) strategies were identified, such as dry season refuges for fish, closed fishing seasons in the early monsoon, adoption of less water hungry alternate crops to conserve more dry season water, and modifying sluice gate operation. A project was taken up (CNRS *et al*., 2005) to test implementation of IFM options in representative floodplains through existing organisations of user communities and related stakeholders. As will be seen during this process other relevant options that fit within a systems view of floodplain resource productivity, such as Integrated Pest Management (IPM), and alternative crop processing were identified and tested to address interdependence issues between floodplain production activities.

It was expected that piloting the IFM options would create an opportunity to build consensus among the various users of floodplain resources. Benefits would include protecting and enhancing the open capture fisheries upon which the poor are most dependent. Farmers could also potentially gain through adopting alternative crop management practices that diversify risk, are profitable and that would enhance the fisheries that they use for subsistence. The approach focused effort towards minimising the resource use conflicts between the fishers and farmers through integrated management interventions that maximise joint benefits. This paper summarises the experience and lessons from one of these pilot areas, and updates this by reviewing initiatives to expand on this through an adaptive learning process between floodplain community organisations.

PILOT AREA BACKGROUND

Environment and commons

Goakhola-Hatiara Beel is a seasonal beel covering at its maximum extent around 250 ha and located in Narail District in southwest Bangladesh. It is connected by a natural canal (*khal*) to a river, but local rainfall is the main source of water in the beel. All of the land in the beel is private and is cultivated mainly with paddy. A large part of the area remains under 1.2-1.8 m of water for 5-6 months each year. The beel is protected by a flood control embankment constructed by the Bangladesh Water Development

Board in 1994. The water level in Goakhola-Hatiara and the adjoining beels is now controlled by a sluice gate at the mouth of the canal which is used to prevent high flows entering the beel.

In the monsoon there is open access for fishing for members of the surrounding communities. Both men and women fish mainly for home consumption. Notably women in 90% of households fish in Goakhola area. The main gears used are gill nets, traps, cast nets and hooks. All households fish for 5-7 months in the beel and for 3-7 months of the year in nearby khals and ponds. Fishing with *pata* (low bamboo fences with fish traps set with the landowner's permission) is common. Water management and agricultural changes have had a significant impact in the area (Table 1).

Table 1 Environmental changes in Goakhola-Hatiara Beel.

Period	Change
1960s	Khal silted up but then reopened and had strong current.
1970s	Increased siltation of beel made it shallower by about 1.2 m (1971 to 1998).
1980s	Salinity of river water gradually increased.
1990-1992	25% of the beel area was under water all year, fish species were same as at present. 50% of land was fallow in monsoon season, and 25% was fallow in winter - providing common grazing land and no obstacles for fishing. Irrigation increased in this period.
1994 - 1997	Sluice gate constructed but was opened and closed by the farmers only. Fish disease outbreaks become serious and frequent. All land brought under monsoon rice – traditional mixed aus-aman was mostly cultivated, very little jute - for household use only. All land in winter cultivated (75% under irrigated HYV boro rice, output high but production cost also high. Local kala boro still popular and one third production costs of HYV boro, Sugarcane, black gram, lentil, potato, tobacco, wheat, chilli, sesame, linseed and vegetables cultivated. 8-10 Shallow tubewells (STW) installed but farmers mainly used surface water for irrigation. Pesticide use increased. Village roads muddy. 75% people below self-assessed poverty level.
1998-2000	New HYV boro varieties adopted. Area of non-rice crops decreased. Mixed aus-aman cultivation decreased, jute cultivation decreased. 30-40 STW established, less dependence on surface irrigation, but irrigation cost high. Less incidence of fish diseases; community management of fishery started and fish catches increased due to sanctuary establishment. Roads improved. More production and job opportunities for people, socio-economic condition improved.
2001-2003	New HYV boro varieties were introduced and widely adopted. Community based fishery management continued.
2004-2005	IFM support. Increase in non-rice winter crop cultivation. Very high yielding Hera and short duration BR28 boro rice introduced. Small canal dug with a flap gate to control water on 120 ha. More land cultivated with aus paddy. Jute cultivation increased. Fish production decreased due to poor water quality and sluice not opened during peak jute retting period (August).

Source: group meetings with local people

Social and Economic Characteristics

According to the 2002 household census undertaken by the CBFM-2 Project, there are 380 households living in the five villages around Goakhola-Hatiara Beel, all of them fish during the monsoon, either for income or for food (Table 2). Out of these 380 households, 2% are female headed households. Out of the male headed households only 17% have fishing as a regular source of income. About 35% of households own some cultivable land but are marginal farmers with under an acre

(0.4 ha). About half of the households are better off owning over 1 acre (0.4 ha) of land. Only about 16% of households reported they were deficit in food. All of the five villages around both beels are entirely Hindu communities. Women from 270 of these households were already members of groups organized by the NGO (Banchte Shekha).

Goakhola-Hatiara is unusual compared with much of Bangladesh in the education level of the community. Firstly very few people are illiterate and those are old and poor, more than half of adults have some secondary level education, but higher education is limited to just 2%. Secondly the education level of women is on average higher than that for men: more women than men completed 6-10 years in school.

INSTITUTIONS AND STAKEHOLDERS

The various stakeholders in the beel include: government that has invested in flood control and drainage for agricultural development and that administered the khal as a local fishery; poorer men and women who catch fish from the beel; landowners who farm the beel area when it is not flooded and who also own *kuas* (ditches) in the beel where fish aggregate; Banchte Shekha, a local NGO that works for the betterment of poor people in the area; and local leaders who stand to gain from being associated with development of their area. Access to aquatic resources during the monsoon is free for all from the surrounding villages owning land in the beel. But in the post monsoon period nobody is allowed to fish near the private kuas.

Under the CBFM-1 project (Thompson *et al*., 2003) from late 1997 a Beel Management Committee (BMC) was formed to manage the fishery with representatives of a mixture of professions from the community. Most of them are farmers and fishing is their seasonal activity, the committee has always contained several women, all of the women are members and representatives of the groups formed by Banchte Shekha. Table 2 shows how the committee has evolved since 1999. A starting point was the primary groups of 10-15 poorer women formed by Banchte Shekha 10-15 members. Each of these groups was represented in the BMC. Group members have personal savings and received training on different Income Generating Activities. As Banchte Shekha has no male groups, there is no direct way of supporting fishing households to divert from fishing for an income during a closed season, so credit is disbursed through the female groups. The BMC is a selected body – there are group representatives and then representatives of other stakeholder categories and local leaders who the community and NGO selected to be in the committee. BMC members received training on leadership, waterbody and fisheries management, and accounting. Until 2003, there was an advisory committee composed of local male elites that helped the BMC liaise with local government and coordinate between villages

The main activity of the BMC has been fish conservation measures. The BMC is also responsible for coordination with other stakeholder groups and organisations. They take decisions through participatory discussion with the primary groups. The women members of Banchte Shekha guard sanctuary kuas in the day time while men in the BMC and husbands of the women guard at night. The BMC members aided by public announcements informed the general community not to poach in these kuas.

Table 2 History and composition of Goakhola-Hatiara Beel Management Committee.

Year	General Body		Executive	Office bearers		Advisory
	Male	Female	Committee	Male	Female	committee
1999	19	8	None	President, Vice president, General Secretary, Cashier	Only members	None
2000	19	8	None	President, Vice president, General Secretary	Assistant Secretary, Cashier	5 men
2001	19	8	None	President, Vice president, General Secretary	Assistant Secretary, Cashier	5 men
2002	22	9	None	President, Vice president, General Secretary	Cashier, Communication secretary	5 men
2003	13	14	None	President, Vice president, General Secretary	Cashier, Communication secretary	6 men
2004	16	11	8 men, 9 women	President, Vice president, General Secretary, Assistant Secretary,	Cashier, Communication secretary, Organizing secretary, Women-issue secretary	None

The BMC has succeeded in implementing the local rules that it sets, and claims 90% compliance. Some people who were fishing during the closed season when caught by the BMC members were subject to punishment of different levels. The BMC successfully appealed to the Union Parishad (local council) chairman and got the lease of the canal without any fees to establish a fish sanctuary. The BMC has a small community centre located next to the beel. The land was donated by one of the BMC members. The BMC was registered with the government social welfare department in 2005 giving it a legal identity.

The old sluice gate management committee formed by Bangladesh Water Development Board (BWDB) has not been active for some time. An attempt to merge it with the BMC was made, but this did not work and the gate reverted to being operated by one large farmer. The sluice management committee was intended to operate the sluice to protect crops from flooding and to allow water in when conditions were right for irrigation, it was also supposed to ensure fish could migrate into the khal and beel. However, this has proved difficult since fry and juvenile fish occur in the river outside the sluice in April-June when the gate is closed to keep out floods which would damage standing boro paddy crops.

In 2002-03 representatives from the BMC, farmers, fishers, a farmer field school (formed by Department of Agricultural Extension) and sluice gate operators formed an ad hoc integrated floodplain management (IFM) committee. This addresses a wider set of linked issues that the BMC alone had been unable to resolve, such as balancing sluice operation for crops and fish. This committee coordinates the activities of all these local institutions. The BMC advisory committee was disbanded in 2004 after the IFM committee was formed. In July 2004 the IFM committee was formalised through an open meeting of the community stakeholders where they were asked if they wanted to change members of the ad hoc committee – five committee members were changed through this meeting. The IFM committee comprises of 15 members (six are women from Banchte Shekha's groups): two women and four men are from the BMC, two representatives of the sluice gate committee, three local farmers, and four women from the farmer field school. From 2005 the different local institutions working in this floodplain have been better coordinated as the IFM

committee includes members from the BMC, sluice gate operators (large farmers), Integrated Pest Management farmer field school, school committee, and local theatre group. In effect these different committees and institutions are now operating like sub-committees with coordination of their activities through the IFM committee. The IFM committee has some resource mobilisation ability and collected fees from local community for a pipe-sluice.

AGRICULTURE

Background

In any locality, the prevalent cropping systems are the cumulative result of past and present decisions by individuals, affected also by community norms and information from government agencies and other sources. Decisions are usually based on experience, tradition, expected profit, personal preferences and resources, social and political pressures and so on. In Bangladesh the amount of rice a farmer harvests is a mater of prestige and food security. Even though crops other than rice may be more profitable, traditionally it is accepted that if a farmer has stored rice for the year that household is of higher social strata. Therefore, rice based cropping dominates in the area and farmers adopt new rice varieties faster if they a benefit. The varieties grown have changed rapidly in the last decade (Table 1) and in 2003-5 in Goakhola-Hatiara some 15 varieties were commonly grown in the dry season and 25 other varieties in the monsoon. It is interesting to know that new varieties from India come every year to this area and people try those. They reported that the yield of some of these varieties is very high.

In Goakhola-Hatiara Beel individual plots average about a third of an acre (0.12 ha), and the operated area per household averages 1.3 acres (0.8 ha). There are two distinct seasons: monsoon or *kharif* (May to October), and dry season or *rabi* (October to April). More than 60% of the land is low or very low. In the monsoon all the land goes under water even that categorised as high or medium high. However, the water depth is less in the high land and right after the monsoon water recedes from those plots, whereas in other lands the water stands for a longer period. Because the high and medium lands dry up quickly they need more irrigation (almost everyday in the dry season) if they are to grow boro rice. At the opposite extreme about 10% of the low land remains fallow in the monsoon as the water is too deep for too long for crop cultivation.

Some farmers have also excavated land to make ditches to trap water and fish and a few big farmers built ponds making bunds around fields (*ghers*) to retain water and cultivate freshwater prawns which is changing the soil characteristics.

Cropping pattern changes

About 20 years ago mechanical irrigation was not used and dry season rice was an uncertain crop, so other rabi crops were cultivated in the area and the farmers used to make flour out of *khesari* black gram to make a kind of bread, but by 2003 these crops were no longer popular. Since they started to use irrigation and grow rice as a mono-crop, and it was protected from early floods by the embankment and sluice

gate, farmers have been reluctant to grow these alternative crops. The use of high amounts of chemical fertilizer, low content of organic matter in the soil and monoculture has reduced soil fertility in the high land. Natural silt deposition is low as the area is protected from the river system by an embankment. The clayey soil during February-March splits and paddy crops die of wilting if irrigation is not provided, so more irrigation than average is used in these plots. Previous crops, such as black gram, formed vegetation cover that retained water for longer.

In the past during the monsoon, farmers cultivated mixed aus-aman rice broadcast after rabi crop harvest. Aus rice was harvested before aman varieties which need longer to mature, this was a kind of insurance so that although most years the farmers lost some crop from flooding with luck one of the two types of rice could be harvested. However, the yield of these local varieties was low and the late harvest of aman pushed back rabi crop cultivation.

After the sluice gate was constructed, HYV boro rice become the predominant crop in the dry season (2003 in Figure 1). In the monsoon (kharif) season, mixed aus-aman cultivation fell as it could not be sown in time and there were crop failures. For example, in 2003 86% of land under aus rice experienced crop damage due to flooding.

Problems such as low soil fertility and high costs of production had stressed farmers, so when the issue of changing crops to reduce water abstraction and protect fish was discussed several farmers decided to try alternative rabi crops. They preferred no tillage crops such as black gram with mustard, and also tried sesame, potato, and chickpea. They compared the costs and benefits with highland and lowland rice. During reflective learning sessions the farmers compared actual returns with their expectations and found that several of the demonstration crops had given better returns than expected, with potato yielding a profit much greater than boro rice and the other crops not far behind rice and for a lower investment (Table 3).

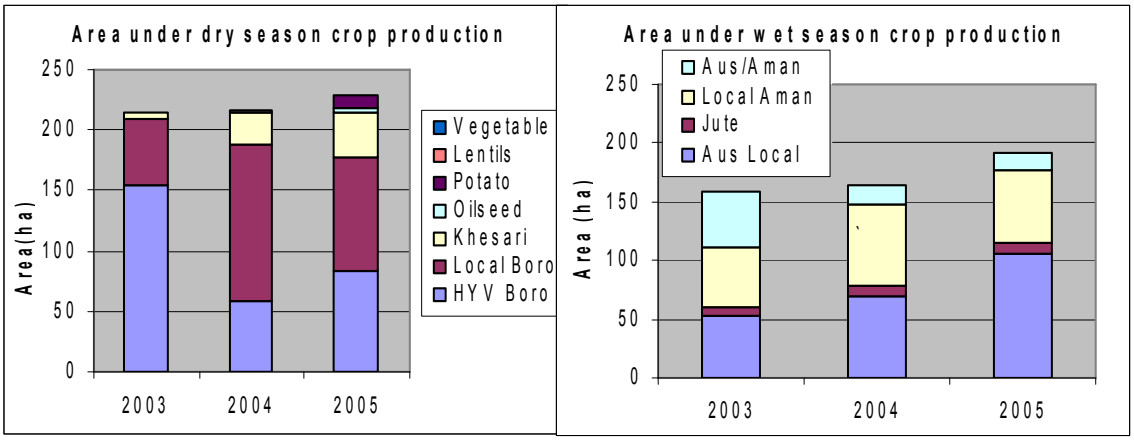
Table 3 Demonstration plot information for dry season 2004

Crop	Area (ha)	Cost (Tk/ha)	Yield (t/ha)	Net return (Tk/ha)
Sesame	0.40	8,420	1.64	22,280
Potato	0.19	22,630	20.22	75,680
Khesari	0.40	1,020	1.11	23,940
Motor	0.18	3,020	1.17	25,534
Boro rice (low land)	0.10	15,440	5.79	30,840
Boro rice (high land)	0.49	14,680	5.31	27,850

Three plots per crop combined in table

During 2003 to 2005 in the dry season a fraction more land came under cultivation, but the area cultivated with less water hungry rabi crops increased (Figure 1). Khesari (blackgram) gained popularity for its low costs, the areas of local boro rice, which also has lower production costs also increased. However, if one farmer cultivates rabi crops that do not require irrigation and on adjacent plots the farmers grow irrigated HYV rice, then the rabi crop farmers lose their crop. In IFM meetings the participants discussed synchronous changes in cultivation for adjacent plots on higher land, and the IFM committee worked to motivate farmers to cooperate.

Figure 1 Changes in cropping pattern in Goakhola-Hatiara Beel



The major change in cropping pattern after demonstrations, open air theatre and reflective learning sessions was the reduction in boro rice cultivation (combining local and HYVs), more land switched to growing local aus rice after HYV boro rice or after khesari. According to the farmers in the last 20 years, they never were able to harvest aus rice properly and so were reluctant to invest much in this crop. In 2004 they cooperated to excavate a small canal and built a flap gate sluice. This contributed in 2005 to a bumper aus rice harvest. Although jute cultivation increased in nearby areas, the IFM committee raised awareness among farmers about the potential negative effects on water quality (jute fibre processing results in poor surface water quality). Despite rising jute prices the farmers agreed that aus rice (which prevents people from fishing in the beel among the growing crop) and maintaining water quality for fish would compensate for the potential income from growing jute. These system adjustments were helped by farmers adopting in 2005 new short duration boro rice with advice from the IFM project, along with an aus rice variety, “ratul”, that is resistant to high water levels and has a good yield.

Returns from main crops

Despite farmers moving some land out of irrigated HYV boro rice, the overall changes maintained their rice production (Table 4) while improving the environment for fish. This has been the result of changes in areas cultivated (notably the adoption of alternative rabi crops and consequently of aus paddy being influenced by the IFM approach. It has also resulted from changes in yields. For example, in 2003 aman paddy was damaged by flooding hence the very low yields. It would appear that boro paddy yields have been increasing, possibly as higher yielding varieties and hybrids are adopted. The cash returns from boro rice more than doubled on average in these three years, and it remained a profitable crop. It is also notable that two of the main alternative rabi crops - khesari and potato had higher yields in 2005 when they were adopted on a larger scale, and this expanding trend has continued.

Table 4 Crop yields and production in Goakhola-Hatiara Beel

Crop	Yield (t/ha)			Total production (t)		
	2003	2004	2005	2003	2004	2005
Dry season						
HYV Boro	6.25	3.96	5.76	901.1	220.2	476.5
Local Boro	4.49	5.13	5.72	269.5	633.8	423.1
Khesari	1.25	1.29	1.88	2.4	28.9	41.4
Other pulses		0.60	0.34		0.2	0.3
Oilseeds		1.55	0.54		0.9	1
Potato		12.96	16.21		12.8	16.8
Vegetable		16.05	10.03			13.3
Monsoon						
Aus Local	1.85	2.74	2.43	169.9	220.8	338.5
Jute	1.41	2.50	2.54	20.9	29.1	28.6
Local Aman	0.87	2.73	2.63	145.1	197.4	174.3
HYV Aman						62.5
Mixed Aus-Aman	0.74	2.61	2.61	96.2	130.3	14.2
Total paddy production				**1581.7**	**1402.4**	**1489.2**

Water use in dry season

Since 2003 dry season water use has reduced due to reduced boro rice cultivation. Integrated floodplain management options such as alternate crop cultivation and dry season water conservation for fish in the canal attracted farmers who have to pay 25% of their irrigated paddy crop production to the owners of irrigation pumps. Moreover, the irrigation pumps run by diesel, the price of which increased in this period. Share croppers and small farmers were most affected by this and they led in switching to less water demanding crops.

The CBFM-2 project had subsidised the BMC to rent some kuas (ditches) as fish sanctuaries, but in 2003 this ended. The community then declared the canal as a fish sanctuary. All the low lift pumps (LLPs) are set in the canal for water abstraction. The farmers using LLPs were then approached by the IFM committee and asked to reduce their abstraction time. These LLPs need more diesel to run but abstract less water than shallow tubewells which pump groundwater. Overall the amount of irrigation fell over the three years – with a reduction from five to four low lift pumps and from 101 to 91 shallow tubewells, and the farmers think that reduced water abstraction has increased the water level in the khal and in kuas. Farmers reported that more rabi crops without irrigation were cultivated in 2005 (20% of the cultivated land area compared with none in 2003).

Consequently the estimated total water abstracted to irrigate boro and rabi crops was 11% less in 2005 than in 2003 (Table 5). Considering the area of crops irrigated by LLP and by traditional means, the amount of surface water abstracted in 2005 may have been less than one third of the amount abstracted in 2003, leaving more water for fish to grow in the dry season. With the changes in crops grown, returns from rabi crops, reduced costs, and good yield of aus paddy in 2005, the IFM approach benefited farmers as well as fishers.

Table 5 Changes in water abstraction for dry season irrigation in Goakhola-Hatiara.

Year	Water abstracted from different sources ($m^{3)}$	Potential area for irrigation (ha) if irrigation water utilized properly	Actual area covered (ha)	Surface water abstracted (m^3)
2003	2,192,400	219.24	206	117,611
2004	2,129,760	212.98	209	86,947
2005	1,962,720	196.27	161	33,105

Water abstraction calculated from numbers of pumps operated and records of operation kept by pump operators.
Potential area that could be irrigated based on Biswas and Mandal (1993) quoted in IFM brochure.
Actual area irrigated from agricultural plot survey.
Surface water abstraction estimate based on crop water needs and areas of crops irrigated from that source

THE FISHERY

Fishery management

As noted earlier the land in the beel is private but forms a seasonal common fishery for local villages in the monsoon. Up to 1993/94 rights to fish in the khal were leased by a local man from the government with the main benefit from catching shrimps when there were seasonal migrations. Under community based management the following fishing rules and management actions have been observed in Goakhola-Hatiara Beel:

Fish sanctuaries: from the dry season in 1997-98 to the dry season of 2001-02 usually five kuas were rented and protected as sanctuaries each year. The individual kuas differed between years, the BMC chose those that the owners were willing to rent to it and that it thought had a good fish population. No fishing was allowed in those kuas. The total sanctuary area was about 0.16 ha out of a total area of kuas of about 2.9 ha. In 2003 to 2005 no kuas were rented as sanctuaries. The BMC designated the whole of the khal as a dry season sanctuary up to and including the early monsoon, but allowed fishing there in the monsoon and post monsoon. The area of the khal in the dry season is about 1-1.5 ha. In the 2004-2005 dry season the BMC bought land and excavated some plots to create permanent sanctuary kuas, but these could have no impact on fish catches until 2006 since they were dry for excavation in the dry season of 2004-2005.

Closed season: each year from 1998 the first three months of the Bangla year (Baishak, Jaistha and Ashar) - mid April to mid-July - have been declared by the BMC as a closed season with no fishing permitted in the beel or khal. This continued with the IFM initiative. Fishing is also not allowed by the landowners in flooded fields that contain aus rice and in 2005 the area cultivated with aus increased, this meant that only fishing with traps was possible for most of July and August – effectively extending the closed season.

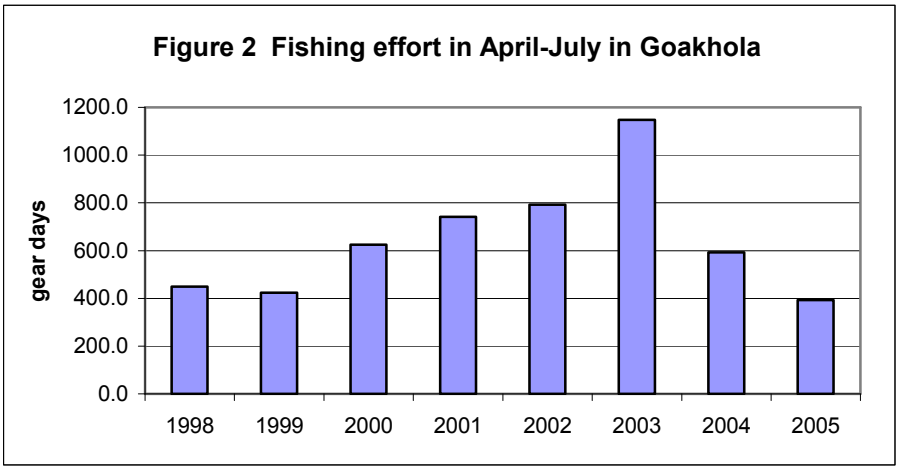
Other fishing norms: some landowners have ditches or *kua* in their land and directly exploit the fishery and hence have an interest in conservation. During the IFM project the issue of dewatering kuas for harvesting and the number of times they are fished out was discussed. Besides the canal the kuas are the only spots that could retain water and fish in the dry season, but they were fished up to three times in a dry

season, and often were pumped out to catch all the remaining fish. It was advocated by the IFM committee that kua owners should leave some water and fish in their kuas at the end of the dry season so that some fish could return to the floodplain to breed. A voluntary good practice that they would not dewater or harvest more than once was promoted in 2004 and 2005.

Compliance with closed season

Detailed monitoring of fishing effort and fish catches was conducted from 1998 onwards. Comparing the estimated fishing effort as gear days for April through to July (four months) in each year shows that up to the start of the IFM project field activities (in July 2003), fishing effort was gradually increasing despite adoption of community based management and in theory having adopted a closed season. In 2004 and 2005 fishing effort dropped in this period indicting better compliance with the closed season (Figure 2).

Figure 2 Fishing effort in April-July in Goakhola



Fish catches

There was no clear trend in overall fish catch, although on average it was higher with longer implementation of community based management (Figure 3), but an impact from changes in agriculture and water use would not be expected until 2005 or later. The total estimated fishing effort and fish catch in 2004 (the last year with complete data) was similar to that in 2000, but much lower than the unusually high catches reported in 2001-02 when catch rates were high especially from lift nets in the Goakhola khal.

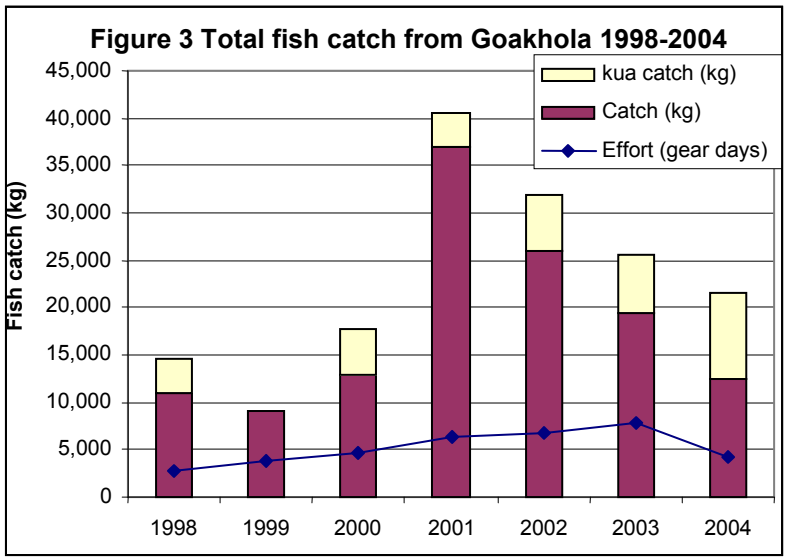
Usually about a quarter of the total fish catch, comes from the many kuas. Before the introduction of IFM, kua catches fluctuated around 50 kg per kua (average water area of just over 7 decimals or about 280 m^2)(Table 6). Kua catches increased in 2002 in line with the increase in fish population in 2001 (the kua harvest takes place in the first months of the year and involves fish left over in the ditches from the previous monsoon). This increase continued up to 2004, in 2005 to conserve some fish no kuas were harvested three times and a few were left un-fished, but the catch remained higher than in the years before IFM (Table 6).

Table 6 Fish catch and returns from kuas in Goakhola-Hatiara Beel.

	1997	1998	2000	2001	2002	2003	2004	2005
Number of kuas	86	86	87	91	91	91	91	91
Mean area of kua (decimals)	7.9	7.9	7.3	7.6	7.6	7.8	7.9	8.0
Total kua catch (kg)	4,420	3,510	5,020	3,600	5,820	6,100	9,100	6,640
Mean (per kua)								
Catch (kg)	51.4	40.8	59.0	45.5	71.0	67.0	100.0	73.0
Gross catch value (Tk)	2,090	1,940	2,310	1,990	2,730	3,190	3,670	3,140
Net income (Tk)	1,770	1,630	2,150	1,840	2,240	2,830	3,380	2,850

Source: kua census.
1999 data not collected

Consequently the total estimated fish catch from the beel remained above 20,000 kg in 2004 (Figure 3), but the kua owners enjoyed a relatively greater share of the catch (42%). This probably continued in 2005 since the kua catch was relatively high and the catch in the early monsoon up to August 2005 was lower than in the previous two years. However, as this was due to increased cultivation of early monsoon crops that still allowed fish to breed and grow in the flooded fields without fishing pressure, local people in participatory reviews in August 2005 anticipated a good fish catch by the end of the year.



Note kua data missing for 1999

Catch composition and species diversity

One of the aims of the community when planning activities under IFM and CBFM was to restore past fish populations of the beel, including species that had become scarce, through conservation and better management. Two sources of data are available on species diversity – from the sample catch monitoring (excluding kuas) and from household monitoring of fish consumption by local women monitors throughout the period. This does not chow any clear pattern (Table 7) annual species diversity probably does not differ greatly, but the species recorded have varied between years, and in 2004 a record number of species were recorded from

catch monitoring. This trend was not shown for species recorded being prepared for cooking by monitored households which appeared to decline over time in Goakhola (although some are caught in neighbouring beels and the number of household days monitored was reduced from 2002 affecting the species counts. Overall just over 60 fish species have so far been recorded in Goakhola-Hatiara Beel, and on average just over 30 species are caught in the beel in a year.

Table 7 Fish species count in Goakhola-Hatiara Beel

Year	Species recorded from catch monitoring	Species recorded from consumption monitoring	Local wild species from consumption monitoring	Wild species only recorded in this year
1997**	30	58	45	3
1998	26	53	38	2
1999	29	57	42	3
2000	33	54	40	1
2001	35	47	35	0
2002*	34	48	37	5
2003*	30	42	29	0
2004*	40	39	28	1
cumulated	62	81	65	15

* *The size of the sample of households monitored for their fish consumption changed to 30 households from 2002, in previous years it was 60 households*

** *data from consumption monitoring is from last 4 months of year only*

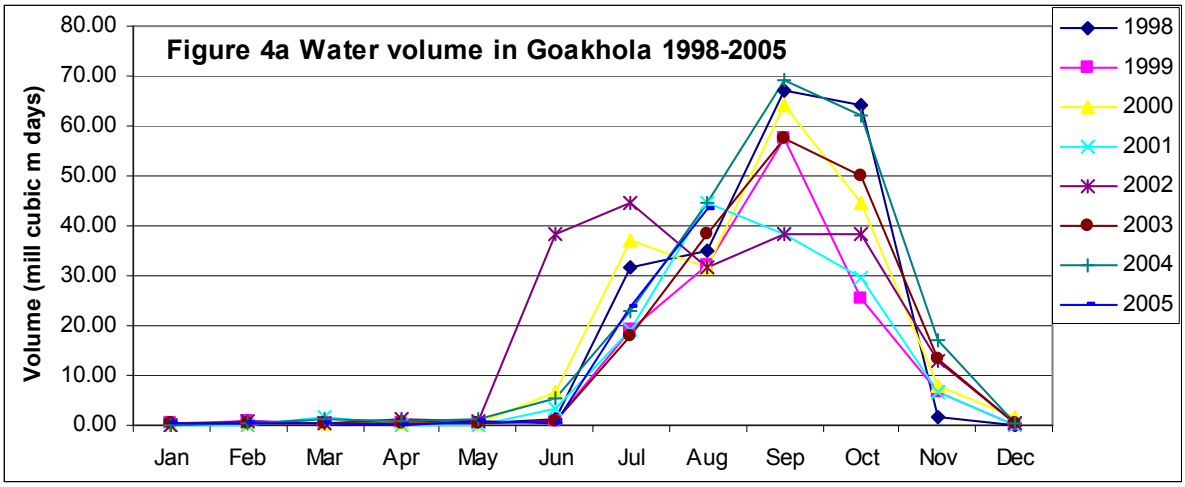
About 30% of the total catch is of one small fish – jatputi *Puntius sophore*, followed by a snakehead (taki *Channa punctata*) and climbing perch (koi *Anabas testudineus*). Many species have fluctuated as a proportion of catch, but two have been restored and returned to the area – meni *Nandus nandus* and pabda *Ompok pabda*. The estimated total quantities of different species caught have changed greatly between years. For example, large quantities of beel resident predatory snakeheads (taki and shol *Channa striata*) were caught in the high catch years along with their small fish prey such as jatputi.

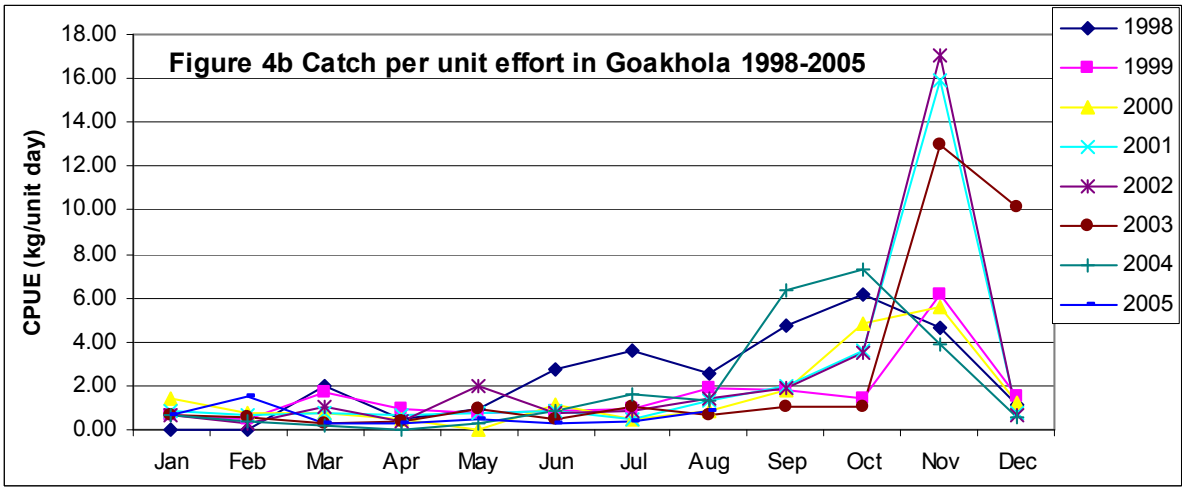
An attempt was made to relate seasonal and annual variations in water (level, area, volume) with fishing (effort and catch) eight years (part in Figure 4). There was considerable variation in fishing effort and catches between years, and fishing was strongly seasonal as might be expected. 2002 was notable for an early monsoon but had less water volume in the later monsoon, while the years with IFM influenced resource management (2004 and 2005) have been typical monsoons for the beel. Annual catch was significantly correlated with water level in the first quarter ($r=-0.75$, $p<0.1$) and third quarter ($r=-0.82$, $p<0.05$), but years with earlier flooding and lower peak water volumes were associated with higher catch rates.

Value of the fishery

The value of fish produced from Goakhola-Hatiara Beel was estimated for 1998 to 2004 based on fish prices reported in local markets, which were usually recorded for several months during the second half of each year. Overall there was an obvious jump in the value of the fish catch from about Tk 400,000 (about US$ 6,000) a year in 1998 and 1999 to four times this in 2001 due to a major increase in catch and an increase in prices, thereafter the value of the fishery during the IFM period in 2004 has remained close to Tk 1.5 million a year which equates on average to around Tk 4,300 per household for negligible individual investment beyond repair of gear and

time, this is the return to collective protection of fish in the dry season. The fish yield has been of the order of 90-160 kg per ha per year since 2001, which is substantial considering that there is so little water in the dry season, and this may increase if more dry season water is maintained through IFM.





WATER QUALITY - JUTE RETTING

Jute (*Corchorus olitorius* and *C. capsularis*) is an annual herbaceous plant, the fibres obtained from the bark of these plants are used for ropes, twine, indigenous cloth and handicrafts. Jute fibres are bio-degradable and farmers believe the leaves form a nitrogenous fertilizer. In the project area jute cultivation increased in 2005 compared with the previous two years due to early rain, the previous year's high jute price, and improved water management. Jute retting in Goakhola-Hatiara Beel was very limited, but jute farmers from the project and neighbouring areas ret jute in the adjacent canal and in Afra River. The river water becomes blackish in colour and a pungent smell spreads in the area. Due to the backflow from the river during high tide polluted water enters into the beel. It was found that dissolved oxygen (DO) in the water in 2005 was much lower than 5-6 mg/L of water which the recommended level for survival of aquatic animals. The conflict of interest between farmers and fishers was a critical issue.

However, the IFM project addressed the problem with an improved retting technique. Ribbon retting is a new technique and can be done with less water. In this process fibres and leaves are separated from the jute stems and then placed under water, instead of the complete stems being submerged. The process needs less water for retting and this can be done in small ditches and containers. Four training sessions were run with help from the Department of Agricultural Extension and Jute Department for about 200 jute farmers. Six metal fibre separators were manufactured locally at a low cost and were given to the IFM committee which allowed farmers in rotation to use them. About 25% of the farmers including women farmers tried the technique.

All the participants in a feedback session thought alternative jute retting was easier, fibre was strong and bright coloured, and finally the price was about 25% more than the traditionally retted jute fibre. A woman farmer said that she spent a bit more time for separating fibres initially but the middlemen gave a higher price for both fibre and sticks. Women said that when used as fuel it burnt for longer than the traditionally retted jute sticks as these sticks were not rotten.

IMPACTS

When separate focus groups were held with both men and women to assess the level of social capital in their community using five indicators and scales in 2002, high scores indicated high general levels of trust and cooperation in this beel presumably reflecting the impact of the Beel Management Committee (BMC) and general community cohesiveness. In general, men scored all of the indicators lower or the same as women, indicating that women may see their communities as more harmonious than do men (Sultana and Thompson 2008). However, by 2005 in a survey of perceived changes in community management, there were significant increases for both men and women in their perceived active participation in decision making over floodplain management and in the wider community, particularly for men in IFM (Table 8).

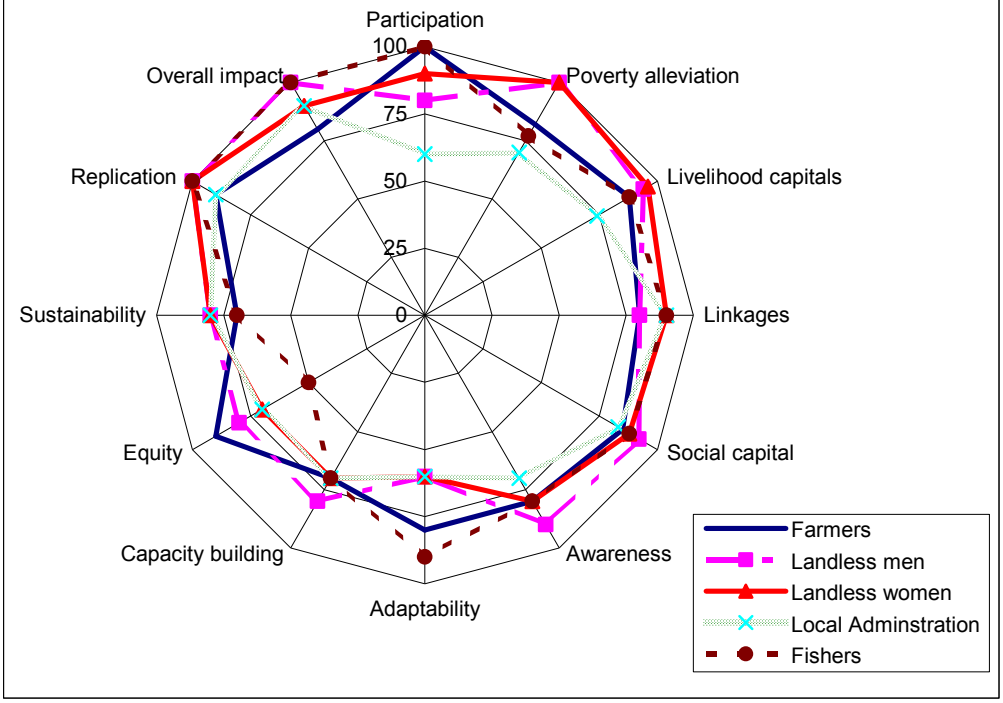
Table 8 Changes in mean scores for community management indicators in Goakhola-Hatiara Beel between 2002 and 2005.

Indicator	Male			Female			Diff
	2002	2005		2002	2005		
Participation in community affairs	3.07	5.57	*	2.36	4.04	*	M
Influence over community affairs	3.19	5.41	*	2.44	4.37	*	
Participation in fisheries management / IFM	2.15	4.63	*	1.63	3.44	*	M
Influence in fisheries management / IFM	1.50	4.35	*	2.08	3.62	*	M
Decision making on fishing rules	2.64	5.64	*	2.75	5.61	*	
Fair access rights to fishery	4.00	5.57	*	4.25	5.61	*	
Active management of fishery	2.86	6.18	*	3.21	6.29	*	
Community compliance with fishing rules	2.93	6.21	*	3.11	6.29	*	

Indicators were scored by respondents on a scale of 1-10 with 1 and 10 defined respectively as the worst and best conditions that the household could imagine for that indicator.
Paired t-tests: * Significantly higher score, 2005 v 2002, $p<0.05$
Diff: M = male score increased more than women $p<0.05$.
Source: Random sample of 30 heads of household (mainly men) and 30 spouse/senior person of opposite gender in same household.

Stakeholders were asked separately through focus groups and key informant interviews to rate the different possible impacts of IFM, and their scores have been converted to percentages of the maximum for each of 11 indicators (Figure 5). Overall the IFM approach was widely seen as being equitable, sustainable and replicable by all the stakeholders, fishers felt it was less equitable than other groups, while the local administration felt that there was relatively less participation and poverty alleviation impact.

Figure 5 Assessment of IFM indicators by different stakeholders (scores converted to percentages).



During reflective sessions to review their experience the participants reported that:

- Labourers have been better able to bargain and raise their daily wage rates and to keep to a standard working day, this is partly because fewer people are seeking labouring work – for example the share croppers said they now have enough production and work in their share cropped fields and so do not go for day labouring.
- An increasing proportion of fish are sold (before 75% was for home consumption according to the focus groups).
- Notably several of the women are now members of various local committees (schools, welfare groups to help the poor, feeding poor children, etc.) and reported that their status within local society had improved.
- Men involved in the IFM committee also are increasingly respected and three are now in the primary school committee, one in the “union forum” (for security), and one in the Upazila education and social development committee.
- Linkages with local government agencies were reportedly difficult earlier, and have now much improved especially with the Department of Agricultural Extension.

- Farmers have found they can save irrigation costs and that alternative rabi crops are viable, but for food security they will continue growing rice.
- Generally less theft was reported, and positive social values had increased.

Changing commons in Goakhola

All of the lands in the beel are privately owned and cultivated through individual decisions, mainly with rice. Up to the late 1990s in the monsoon the beel was under water and fish entered if and when the sluice gate was opened in the early monsoon. Fish were considered as a common resource, and access to aquatic resources during the monsoon was free for all from the surrounding villages owning land in the beel, but in the post monsoon period nobody is allowed to fish near the private kuas. Landowners with kuas trapped fish there at the end of the monsoon and dewatered to catch the fish, leaving no dry season fish refuge.

However, the combination of community based management and IFM has changed local institutions and norms regarding aspects of property rights and these commons. The concept of setting aside some of the most valuable fishing sites as dry season fish sanctuaries, and of a voluntary ban on fishing at the beginning of the monsoon when fish enters into the beel to breed, have been widely accepted and have helped increase fish stocks and restore species diversity. The committee formed for IFM brought together all the ditch owners and explained the necessity of conserving fish in the ditches, and in response owners decided not to dewater ditches completely. Moreover farmers have started to coordinate their cropping choices and water management, recognising that there could be mutual benefits from changing to less water intensive crops on higher land in the dry season where irrigation was expensive. This has been demonstrated to offer comparable financial returns to farmers as irrigated rice and helps to maintain more surface water in the dry season so that fish can survive. Taking a floodplain system view, having a forum where the community can consider the implications of individual actions on the total floodplain resources, and building trust and confidence that people will cooperate and not break rules, have enabled local coordination and adjustment of short term individual interests for wider community gains.

This has been facilitated by almost all of the households catching fish sometime in a year (over a third of the households sell fish, the remainder fish just for their own consumption). But fish are not the only common floodplain resource, there are changes in several others and these will test the extent of common interest in sustaining productivity and ecological balance. Snails are a common aquatic resource here which used to be collected on a small scale to feed ducks. However, with the introduction of shrimp farming on a large scale in nearby areas, snails are now harvested in large quantities from the beel and have become a good source of income for some households. Besides, water lilies are also harvested from the beel by the poor for consumption and sale, and like the snails are declining. The community is now considering whether a closed season for snail collection would help prevent overexploitation of snails.

UP-SCALING IFM THROUGH ADAPTIVE LEARNING NETWORK

During the IFM project, at Government level, a process of incorporating IFM in the national open water fisheries management strategy of the Department of Fisheries (DoF) was initiated through presentations on IFM in multi-stakeholders planning workshops (DOF 2006). Cross-visits facilitated sharing of IFM experiences, and to these were added briefing sessions and exposure visits for Department of Agricultural Extension, DoF and others. Adoption of this approach through government may be a long term prospect, but there are already many existing community based organisations (CBOs) that have graduated from external support through projects and that are managing floodplain resources in Bangladesh but from the perspective of a single sector such as fish or water management for agriculture.

With the view to improving floodplain management and encouraging adoption of IFM options and other innovations for sustainable floodplain management, the IDRC supported project "Integrated Floodplain Management through Adaptive Learning Network" held workshops to help about 150 CBOs share their experiences and lessons, including the Goakhola community who adopted IFM. Adaptive learning offers not only a way to improve resource management in floodplains through systematic comparisons and trials of innovative ideas by CBOs, but at the same time offers the prospect of helping CBOs to form lobbies for the interest of natural resource users and for improved access to commons and government services.

The project is testing, demonstrating and assessing adaptive learning networks for co-production of knowledge to improve the sustainability and productivity of floodplain natural resources through community based management in Bangladesh over two one-year cycles of adaptive learning. The expected strength is that instead of each CBO learning only from its own trial and error, or through external support, there is coordinated sharing of experiences and planning of trials and pilot activities to generate lessons to address knowledge gaps, which is expected to result in more rapid improvements in floodplain resource management and generalization of key findings. As shown in Table 9 many of the pilot activities involve IFM options.

Table 9 Adaptive learning pilot activities for floodplain management in 2007-08.

Activity	Trial/expected benefit identified by CBOs	CBOs testing
Sanctuary (improvement)	Test use of materials that are better for fish aggregation (*Hijol, Gab, Shawra*) where available.	46
Sanctuary (new)	Test sanctuaries in sites that lack them, assess the effect of sanctuaries on the local fish catches and species diversity.	29
Tree planting	To reduce soil erosion, test different species in different wetland locations.	23
Community centre improvement	Poor condition or lack of community centre inhibits CBO activity and additional uses of buildings	20
Duck farming with fish	To add an income from waterbodies	10
Alternate rabi crops	To restore dry season water for fish in the canals and ditches	9
Bee keeping	Could generate income for fishers to reduce fishing pressure	9
Boat	To reduce poaching in larger rivers and waterbodies	9
Fish re-introduction	Test re-introducing fish that once occurred in waterbodies.	6
Aquatic plant re-introduction	To diversify incomes, test planting of *paniphal* and other plants that bear fruit.	5
Awareness (theatre etc)	To promote IFM and management for sustainability	5

Others include: Compost making (using water hyacinth), Fish culture (pen, nursery pond, pond) Embankment / grill, Training women to use local resources, Eco-tourism, Environmental education

CONCLUSIONS

Floodplains cover over a third of Bangladesh, and significant areas of south-east and south Asia. In the past, development support has been divided into sectors, but this case shows that a 'systems approach' can bring greater benefits to floodplain communities. That is, modifying agriculture, water use and fishing to adopt a range of sustainable practices that complement one another, increase overall production and improve links with service providers. In this way, it is possible to increase joint benefits and returns from floodplain commons. Integrated Floodplain Management involves fishing control, and changes in cropping patterns, to maximise total returns from water and sluice gate management. The IFM approach recognises the floodplain as a system, where the uses and amounts of surface water in the dry season or monsoon, critically affect the two main products – crops and fish. Both products are important, and this case shows that overall returns from floodplain systems can be increased.

One small-scale farmer commented that while cultivating rice is traditional, farmers had not realised how they could gain, both financially and environmentally, by growing alternative crops. Instead, dry season crops with low irrigation demand were profitable and resulted in more surface water, which the community protected as a fish sanctuary. This enhanced fish survival, and reproduction, and the community has rejuvenated its local common pool resources through collective action.

The project brought together fishers, farmers and sluice operators in Goakhola-Hatiara Beel, encouraging confidence in the community, and take-up of new ideas and technologies by the neighbouring floodplain communities. Links between community members, government agencies and officials were successfully facilitated, where before conflicts of interest existed. Instead greater use has been made of government extension services, for example access to seeds and techniques to reduce water pollution, such as processing jute fibre. And the Department of Fisheries has incorporated the concept into their Inland Capture Fisheries Strategy for the country, which was approved in 2006.

ACKNOWLEDGEMENTS

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REFERENCES

CNRS, WorldFish, ITAD, and MRAG. (2005). Better Options for IFM: Uptake Promotion. NRSP Project R8306 Final Report. Center for Natural Resource Studies, Dhaka.

DOF. (2006). *Inland Capture Fisheries Strategy*. Department of Fisheries, Dhaka.

Muir, J. (ed.) (2003). Fisheries Sector Review and Future Development: theme study: economic performance. World Bank, Danida, USAID, FAO and DFID, Dhaka.

MWR, 2001, Guidelines for Participatory Water Management. Dhaka: Ministry of Water Resources, Government of the People's Republic of Bangladesh.

Shankar, B., Halls, A. and Barr, J. (2004). Rice versus fish revisited: On the integrated management of floodplain resources in Bangladesh. *Natural Resources Forum* 28 (2004) 91–101.

Sultana, P., and Thompson, P.M. (2008). Gender and Local Floodplain Management Institutions -- A Case Study from Bangladesh. *Journal of International Development* **20**: 53-68.

Thompson P.M., Sultana P., and Islam N. (2003). Lessons from community based management of floodplain fisheries in Bangladesh. *Journal of Environmental Management* **69**(3): 307-321.