Better Options for Integrated Floodplain Management in Bangladesh: Uptake Promotion

NRSP Project R8306

Final Technical Report
Annex B-2

Piloting of IFM Options:
Narail site

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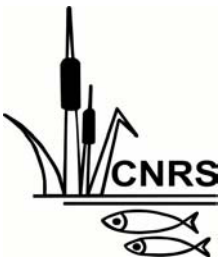
September 2005



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Centre for Natural Resource Studies, House 14 Road 13/c, Block E, Banani, Dhaka, Bangladesh

WorldFish Center, House 22B Road 7, Banani, Dhaka, Bangladesh.

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CHAPTER 1: BACKGROUND AND CONTEXT

Goakhola-Hatiara Beel April 1998

1.1 Choice of Location and Other Project Support

In Narail Sadar Upazila, Narail District, southwest Bangladesh two adjacent and connected floodplain beels (seasonally flooded depressions or wetlands) were selected for pilot IFM activities: Goakhola-Hatiara Beel and Maliate Beel. The primary reason for their selection was that both beels are under the DFID supported Community Based Fisheries Management Project phase 2 (CBFM-2), and in addition Goakhola-Hatiara Beel was under the first phase of CBFM (CBFM-1) from the end of 1996. Therefore, already there was substantial information available on the sites and local community institutions for fishery management existed. The additional reasons were that the area comprises seasonal floodplains under private ownership. Participatory Action Plan Development in 2000 in an adjacent beel (Kathuria) under the consensus building project (R7562) had indicated interest in a range of floodplain management measures and the team assessed that there was scope to pilot and adapt recommendations from the project R7868 to this area which has very little water in the dry season and therefore contrasted with the other pilot location in Charan Beel, Tangail District (where there is a large beel holding water year round). Also while women are involved in management of both beels, in Maliate the management committee only comprises women, so extending IFM into that adjacent area gave an opportunity to compare institutional and participatory arrangements.

The objective of CBFM in Goakhola-Hatiara Beel has been to conserve and enhance the natural fishery by ending the complete harvest of fish after the monsoon, by protecting fish in the dry season in ditches, by enabling more fish to move into the beel from the river, by reducing fishing pressure in the early monsoon, and by helping the households compensate for any short-term loss of income or food by developing supplementary income sources such as poultry and aquaculture. To achieve this a regional NGO partner of CBFM-1 and CBFM-2 -

Banchte Shekha - mobilized and expanded its all-women groups[1] in 1997, but realized that coordination with all stakeholders was necessary. From late 1997 the formation of a Beel Management Committee (BMC) was facilitated, the 27-member BMC and a separate sluice management committee were formally constituted in March 1998. The latter did not prove effective and in January 1999 it was disbanded and the BMC was reformed. In 2002 just before the IFM project started work there, the BMC comprised nine female group members and 22 men (including fishers, landowners, and union parishad – local council - representatives), which was revised to comprise 14 women and 13 men in 2003.

Under CBFM-2 this same site has continued to be supported through the same NGO, but CBFM has been spread to the neighbouring connected beels (Afra, Bakri, Kathuria and Maliate) with the aim of developing coordinated fishery management among this cluster of seasonal beels. Fishery management measures by the community within Goakhola-Hatiara Beel had already shown some successes. However, as a seasonal floodplain with little to no dry season water and where most households depend both on agriculture using water for irrigation and catching fish, there was obvious scope to work with the community to see how floodplain use could be improved in terms of the overall returns and balance in returns from water for crops and fish.

The IFM project's purpose is to develop and promote improved pro-poor methods for the implementation of integrated floodplain management (IFM) for which the main elements are community participation (that is inclusive of the poor) and integrated attention to both the land and water components of floodplain resources.

1.2 Physical Characteristics

Goakhola-Hatiara Beel is a seasonal beel generally regarded as covering at its maximum extent around 250 ha. It is 17 km from the headquarters of Narail District in southwest Bangladesh. The beel is connected by Goakhola Khal to Afra Khal (a secondary river), which connects to Bhairab River some 3 km downstream of the beel, 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 is under up to 1.2-1.8 m of water for 5-6 months of the monsoon 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 located at the mouth of Goakhola Kha which is used to prevent high flows in Afra Khal entering the beel. Maliate Beel is a similar seasonal floodplain of about 100 ha immediately east of Goakhola, in high flood years water connects between the two beels.

Both beels are seasonal and 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 97% of NGO participant households and in 68% of non-NGO participant households fish in Goakhola area. The main gears used are gill nets, traps including fences with 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* is common (low bamboo fences with fish traps set with the landowner's permission).

[1] Banchte Sheka only includes poor and destitute women in its groups.

Table 1.1 Environmental changes and trends 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 aman (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 and was operating well but was opened and closed with the consent of the farmers only, but fishery not changed. Fish disease outbreaks become serious and frequent. All land brought under aman cultivation - mixed aus and aman was mostly cultivated, very little jute - for household use only. All land in winter cultivated (75% under irrigated HYV boro paddy - BR3, BR79, Socket-4 introduced, output high but production cost also high, local kala boro still popular and one third costs of HYV boro, Sugarcane, black gram, lentil, potato, tobacco, wheat, chilli, sesame, linseed and vegetables cultivated). 8-10 STW, farmers used LLP to irrigate dry season paddy. pesticide use increases. Village roads improved - less muddy. 75% people were under poverty level.
1998-2000	Ratna, BR28, Socket-4, Sabana and Nayanmoni popular boro varieties. Area of crops other than paddy decreased, tobacco, wheat, chilli cultivation stopped. Mixed aus-aman cultivation decreased, jute cultivation decreased. 30-40 STW established, less dependence on LLP, but irrigation cost high; Sluice gate was managed properly. Less incidences of fish diseases; fish catches increased due to sanctuary establishment. More production and job opportunity for people, socio-economic condition improved.
2001-2003	New HYV boro varieties - GS-1, BR 29, Kajal lata, Jagoroni were introduced. Most farmers cultivated GS-1 and BR-29
2004-2005	Small canal was dig with a flap gate to control water on 300 acres which in monsoon was cultivated with low yielding mixed aus-aman or was fallow. More rabi crop cultivation. Very high yielding Hera and short duration BR28 boro were introduced. More land cultivated with aus paddy. High production of paddy. Jute cultivation increased. Fish production decreased due to high pollution in the river and sluice not opened during peak jute retting period (August).

Source: group meetings with local people

1.3 Social and Economic Characteristics

1.3.1 Present population 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 1.2). 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 who own 0-100 decimal land, rest are non fishers and slightly better off. Among female headed households half of the households are better off but only one fishes for an income. All of the five villages around both beels are entirely Hindu communities

Table 1.2 Household census for Goakhola-Hatiara in 2002.

Category of household by poverty/ landholding level and fishing involvement	% of total households	
	Male-headed	Female-headed
Landless fishers	2	0
Landless poor	3	20
Marginal fishers	15	10
Marginal non-fishers	22	20
Better-off	58	50
Total households	**371**	**9**

***Landless fishers**: No agricultural land, depend fully on fishing; **Landless poor**: Do not fish depend fully wage labouring; **Marginal fishers**: Have 0-100 dec agricultural land, fish for income; **Marginal non-fishers**: Own 0-100 dec agricultural land, not depending on fishing for income; **Better-off**: Own more than 100 dec land, business, job-multiple sources of income etc.*

There are relatively few absolutely landless households in this area, Table 1.2 shows that even the NGO participants own on average over 0.6 ha). There has been no change in landholding among participants and non-participants between 1996 and 2001, except some people excavated ponds for fish culture. Landowners mortgaged out land and the amount of land sharecropping increased.

Total population in the project area is 2516, having household size of 5.62 (Table 1.3). The percentage of female population is about 51%.

Table 1.3 Household members and size

	Frequency	Percent	No./household
Male	137	48.75	2.74
Female	144	51.25	2.88
All	**281**	**100**	**5.62**

Goakhola-Hatiara area is unusual compared with much of Bangladesh in the education level of the community in two regards. Firstly very few people are illiterate and those are old and poor, more than half of the people have some secondary level education, but higher education is limited to just 2% (Table 1.4). Secondly the education level of women is on average higher than that for men with more women than men having completed 6-10 years in school.

Table 1.4 Education level of population by gender (percentage).

Years in education	Male	Female
None	10.95	7.64
1-5yrs	24.09	14.58
6-10yrs	32.85	45.83
11-12 yr	7.30	6.25
>12 yr	2.19	1.39
Can sign only	12.41	19.44
Infant, not in school	10.22	4.86
Total	**137**	**144**

The main occupation of the household members is agriculture. They grow two crops now and the production rate is higher than the control area. More than 40% of the population are either student or not illegible for work.

Table 1.5 Percentages of household members involved in different occupations/income earning activities

Income source	Male	Female
Cultivate own land	37.23	
Cultivate own and sharecrop other's land	8.03	0.69
Sharecropper only	7.30	0.69
Fishing	2.19	
Handicraft		0.69
Petty trade	0.73	
Other employee		1.39
Teacher	1.46	
Government service	0.73	
Housewife	0.73	50.69
Livestock	0.73	
Beggar		0.69
Other specify	0.73	0.69
Student	24.09	30.56
No activity	16.06	12.50
Unemployed		1.39
Total persons	**137**	**144**

1.3.2 Recent trends in livelihoods

This section summarizes comparisons of socio-economic surveys covering the same households in 1996 and 2001 undertaken for CBFM-1 project. There are relatively few absolutely landless households in this area, Table 1.6 shows that even the NGO participants own on average over 0.6 ha). There has been no change in landholding among participants and non-participants between 1996 and 2001, except some people excavated ponds for fish culture. Landowners mortgaged out land and the amount of land sharecropping increased.

Table 1.6. Changes in landholding (land in decimal) in Goakhola-Hatiara Beel, 1996-2001.

Land type	NGO		Non-NGO	
	1996	2001	1996	2001
Homestead land	14.7	11.2	16.8	14.3
Own pond	0.4	11.8	0.6	12.7
Own cultivated land	146.3	132.8	209.5	135.5
Other's land used	54.7	77.7	44.3	45.5
Own land rented/mortgaged out	0.2	11.1	3.2	39.2
Total own land	**161.5**	**166.9**	**230.1**	**201.7**

Areas – 100 decimal = 1 acre = 0.4721 ha
Source: baseline and impact surveys, CBFM and CBFM-2 projects.

Household welfare has been improving in the area in general but the participants from CBFM-1 have caught up with other (previously better off households). For example, Table 1.7 shows that more participants own more household assets such as radios and beds than before. Beds are an essential household asset for the floodplain area as during the monsoon earthen house floors remain damp most of the time.

Table 1.7. Change in asset ownership (% of households owning asset), Goakhola-Hatiara Beel.

Asset	No owned	NGO				Non NGO			
		1996	1997	1998	2001	1996	1997	1998	2001
Bed	0	17	13	12	3	14	14	10	7
	1	37	27	37	17	24	21	18	23
	2+	47	60	52	80	62	66	72	70
Watch	1+	45	50	58	66	65	69	70	67
Radio	1+	32	33	33	60	40	37	45	40
Cycle	1+	47	59	63	50	50	57	64	60
Boat	1+	14	19	53	43	19	21	45	37

Source: baseline, monitoring and impact surveys, CBFM and CBFM-2 projects.

Most of the people already have access to tubewell drinking water. More than 80% have a sanitary latrine which is a major change since 1996 (Table 1.8).

Table 1.8. Changes in water and sanitation in Goakhola Hatiara.

		NGO			Non-NGO		
		1996	1998	2001	1996	1998	2001
Latrine %	None	37	16	3	25	13	7
	Not water sealed	47	34	10	48	34	27
	Water sealed	17	50	87	27	54	67
Change in latrine facility	Worsen		10	11		13	18
	No change		38	43		48	46
	Improved		52	46		39	36

Source: baseline, repeat and impact sample surveys, CBFM and CBFM-2 projects.

Over 50% of the NGO participant households and 40% of non-NGO households said they were usually or occasionally food deficit in 1996 (Table 1.9). The situation has changed and by 2001 only 16% of NGO participants were still deficit in food, while a majority of households reported being food surplus in 2001. It is obvious that between 1998 and 2001

respondent households' overall food situation changed dramatically. In their own assessment, only 33% of participants improved their food security between 1997 and 1998, but 72% improved status between 1998 and 2001. As there was no growth in local industry or other job opportunities between these years except for fish culture (ponds) and better management of the beel fishery, it is assumed that this change arose through these initiatives.

Table 1.9. Changes in reported food security in Goakhola-Hatiara Beel 1996-2001.

		NGO				Non NGO			
		1996	1997	1998	2001	1996	1997	1998	2001
Food consumption (%)	Usually deficit	15	12	5	3	13	10	3	0
	Occasional deficit	42	38	35	13	27	34	22	3
	Break even	30	30	47	20	28	29	51	47
	Surplus	13	20	13	63	32	26	24	50
Change in status between years	Worse		25	30	7		29	19	17
	No change		35	37	21		40	52	17
	Improve		40	33	72		31	29	67

Source: baseline, repeat and impact sample surveys, CBFM and CBFM-2 projects.

The frequency of fish consumption has increased a little since 1997-98 (Table 1.10). More cultured and captured fishes are now available than before. People eat more cultured fish species and small fish than other types of natural fishes (Fig. 1.1). Larger wild caught fish have a higher value and households tend to sell those rather than eat them. Comparatively cultured fish species are less expensive than the captured fish and poor people buy cultured fish such as silver carp to save money. Among the natural fishes, several species of small fish notably puti were eaten by the respondents more than other fishes (Table 1.11). By weight cultured fishes are in the top position but small fishes were eaten on more days than other fishes.

Table 1.10. Frequency of eating protein rich foods (No. of days/household/month) in Goakhola-Hatiara Beel.

Food type	1997-1998	1998-1999	1999-2000	2000-2001
Fish	17.3	19.7	20.2	19.6
Pulses	5.7	4.4	5.6	5.0
Meat	1.6	1.2	2.0	1.9

Source: household monitoring under CBFM project, 60 households monitored 7 days per month, 30 NGO and 30 non-NGO households are combined here as there were no significant differences between the two samples. Years are for 12 months, actually 1997-1998 is September 1997-August 1998 and so on.

Fig. 1.1 Fish consumption in Goakhola-Hatiara Beel by type of fish, 1997-2000.

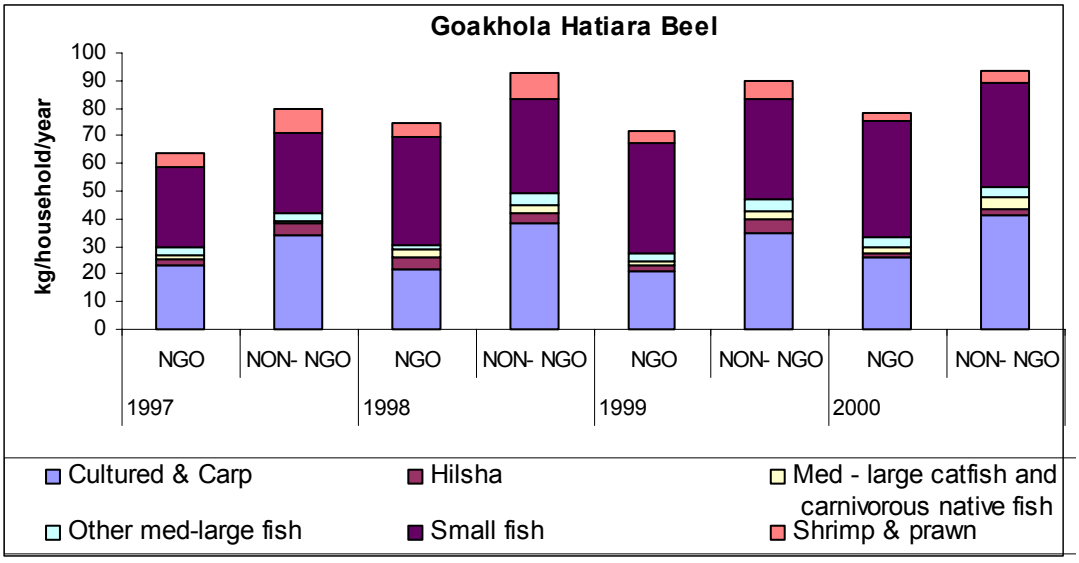


Table 1.11. **Ranking of fish species (by local names) consumed in Goakhola Hatiara Beel during 1997-2001.**

Rank	Weight consumed (raw pre-cooked)	No. of days eaten	No. of households eating
1	*Silver carp*	**Jatputi**	**Taki**
2	**Jatputi**	**Taki**	*Silver carp*
3	**Taki**	*Silver carp*	**Jatputi**
4	**Gura icha**	**Gura icha**	**Gura icha**
5	*Ruhu*	Kakra	Kakra
6	Kakra	Baila	Baila
7	Ilish	*Ruhu*	**Guchi baim**
8	*Thai sarputi*	**Guchi baim**	**Tara baim**
9	Shol	**Tara baim**	*Thai sarputi*
10	Baila	Ilish	**Bajari tengra**

Note: only the top 10 species are shown for each site and by each criterion
Weight consumed: total weight eaten on survey days by all households.
No. of days eaten: total household days on which a species was eaten combining all households and survey days
Bold = *small indigenous fish species (SIS) and shrimps,* plain text **=** *wild caught medium-large fishes*, *italic = cultured species including all major carps.*
Source: household monitoring under CBFM project, monitored 7 days per month.

1.4 Stakeholders and Existing Local Institutions

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; people who catch fish from the beel; landowners who farm the beel area when it is not flooded and who also own *kuas* (catch-ponds) in the beel where fish aggregate; Banchte Shekha, an NGO with headquarters in Jessore 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.

Under the CBFM-1 project from late 1997 the formation of a Beel Management Committee (BMC) was facilitated, the 27-member BMC and a separate sluice management committee were formally constituted in March 1998. The latter did not prove effective and in January 1999 it was disbanded and the BMC was reformed. The BMC then comprised eight female members of Banchte Sheka groups and 19 men (including fishers, landowners, and union parishad representatives. The subsequent development of the local institutions is discussed in detail in Chapter 4.

CHAPTER 2: STUDY METHODOLOGY

Taking water sample, August 2005

2.1 Integrated Floodplain Management Approach

For the project's first main element, community participation, the project team drew upon a participatory method named Participatory Action Plan Development (PAPD) that was developed in a previous NRSP-LW project, R7562 (*Methods for consensus building for management of common property resources*). For the second main element, the findings of the preceding LW project, R7868 (*Maximisation of joint benefits from multiple resource use in Bangladeshi floodplains*) have provided a major guideline for decision making on measures (options) that could improve floodplain management. In addition, the work of CBFM-2 and past and on-going research of the Bangladesh Rice Research Institute (BRRI) and the Bangladesh Agricultural Research Institute (BARI) assisted decision-making on testing of alternative technologies and management regimes.

2.2 Overview of Project Activities

The project started in mid 2003 and a wide range of activities were undertaken and various methods have been adopted for data collection in Goakhola-Hatiara site. The key project activities for piloting IFM and their timing are summarised in Table 2.1.

Table 2.1 Project activities for extending IFM practices in Goakhola Hatiara and Maliate Beels.

Date/Month	Activities
July 2003	Planning workshop held (PAPD)
July 2003	Formation of IFM Ad-hoc committee based on former IPM groups
Sept 2003	Planning for demonstrations
Dec 2003-May 2004	Demonstrations on 1.7 ha (4.3 acres) of following dry season crops (Potato, Sesame, Khesari, Motor, paddy) involving 10 farmers (project provided advice)
March 2004	Open/field days held with community members to see demonstration plots
March 2004	Review workshop with demonstrators and government to identify issues and plans for remainder of project period.
March 2004	Small drainage canal with a flap gate built by the community
February 2004 and 2005	Exposure visit for 2 groups of farmers to Charan and Chalan Beels to observe cultivation of rabi crops with low water needs.
May 2004 and August 2005	Open air theatre to raise awareness on IFM issues, using script developed by project and local community theatre group previously trained through CBFM-2: twice
June 2004	Dhaincha (Sesbenia) demonstration on one acre with seven farmers
July 2004 and July 2005	Training on improved jute retting techniques to reduce pollution (twice)
July 2004	Sluice committee reformed.
July 2004	Formation of IFM committee comprising 15 persons
January 2005	Planning meeting for aus season 2005.
March 2005	One day workshop with DC Narail and local officials where IFM committee presented experience and findings and requested support to address remaining issues
May 2005	Social Analysis: FGD with 7 stakeholder groups
July-September 2005	Impact assessment of jute retting on floodplain aquatic life and human being : water quality analysis &experiment and impact study
August 2005	Reflective learning session and attitudinal changes focus groups
August-September 2005	Study visits for IFM participants and stakeholders – farmers and officials – to see rice-fish system (Proshika supported) in BrahmanBaria and water management cooperative (IFAD/LGED supported) in Magura
September 2005	Final report preparation

Note: throughout the period one field investigator of WorldFish Center was posted to the area and frequently interacted with the community as part of the monitoring programme. In addition staff of the CBFM-2 partner NGO – Banchte Sheka - were promoting fish conservation measures.

As an action research project, monitoring and participatory assessment activities were an integral part of the project field activities, they are summarised in Table 2.2. The methods involved are explained in more detail in the following sections.

2.2 Summary of data collected from Narail pilot site

Type of data collected	Status
Quantitative	
Household baseline survey	Early 2002: sample survey of 30 households undertaken by CBFM-2 project covering assets, income, fishing and other activities
Household impact survey	August 2005: Sample survey of 30 households to detect impacts and extent that IFM was pro-poor with impacts assessed separately for both men and women
Household (farm) survey, covering by plot land characteristics, crops grown, inputs and outputs	Early 2003: detailed survey of 50 farmers around the khal (365 plots); 2004: all landowners within area (620 farm households); 2005: all landowners within the area: recall survey to assess changes in cultivation practices and cropping pattern in Goakhola-Hatiara and in control area (CBFM site with no IFM activities)
Irrigation units/pumps	Census (101 pumps, mostly STW), locations, mapped, monitored for water use (by crop) and operations in 2003-04 and 2004-05 dry seasons
Sluice operation	Dates operated and decisions on operation recorded 2004 and 2005
Pilot plots - crop input and output data	Early 2004: data collected from detailed monitoring of 3 acres of dry season crop demonstrations Monsoon 2004 data collected from detailed monitoring Sesbania demonstration on 3 acres
Farmer Knowledge-Attitude-Practice (KAP) survey	Interviews with 69 respondents, before and after drama show on IFM in May 2004
Fishing effort	CBFM-1&2 monthly monitoring (since 1997)
Fish catches	CBFM-1&2 monthly monitoring (since 1997)
Water level	Observational records from gauge marks inside and outside the sluice gate, taken about weekly by CBFM/project staff from 1998 to August 2005
Hydrological regime and GIS	1. Identification of water flow system and characterization of wetlands in November 2003. 2. Analysis of satellite radar images to estimate flooded areas (CEGIS) 2. Water area mapping in field in August 2004. 3. Field survey and construction of Digital Elevation Model (DEM) in August 2004 (CNRS).
Water quality analysis	Water quality from selected sites tested to determine basic parameters and assess if jute retting could affect water quality sufficiently to affect fish population August 2005
Qualitative	
Workshops/feedback/PAPD with stakeholders	Planning workshop late 2003, modified PAPD Mar 2004
Field staff diaries of events and changes	General diary since April 2005, structured monthly reports from Jan 2005
Report card assessments of selected indicators by groups of stakeholders	From Jan 2005, undertaken by CNRS staff
Exposure visit	30 IFM committee members and 20 farmers, 7 officers from concerned departments in the upazila during project period in 4 different sites to observe Rabi and Kharif crops and fishery management
Reflective learning and experience sharing workshop	15 IFM committee members and 8 officers of concerned departments in the upazila in March 2004, 30 IFM committee members, 70 other farmers and officers at the end of the project period.
Focus Group Discussion to understand livelihood impacts	Social analysis done separately with fishing households, farmers, and landless non-fishers in April-May 2005

2.3 Survey and Monitoring Designs

2.3.1 Socio-economic surveys (baseline and impact)

A census of all households in the area was conducted as part of CBFM-2 in early 2002 and resulted in a sample frame that distinguished households by their poverty level and involvement in fishing. Household impact surveys covered the same random sample of households:

- Baseline survey (in early 2002 from CBFM-2)
- Repeat final impact survey (in IFM project year 3 – mid 2005).

The baseline survey design was the same one done in CBFM-2 in general. For each water body in a cluster such as Goakhola-Hatiara, the sample size was as follows:

- 5 randomly selected poor fisher household (who fish for income or both for income and food, no other occupation than labouring, possess no agricultural land, house type thatched).
- 5 randomly selected poor household (who does not fish for income, have no agricultural land, have occupation type labouring or petty trade but not service or professional jobs.
- 5 moderate category households (who fish for income, have land less than 100 decimal (1 acre or 0.4 ha) agricultural land, primary occupation includes labour or petty trade but not in service or in professional jobs).
- 5 moderate category households (who does not fish for income, have land less than 100 decimal).
- 5 better off category households (who may or may not fish for income, have land more than 100 decimal, in service or business or in professional jobs, hire fishers for fishing, have houses well built).

Women members of the same households were interviewed with a separate supplementary questionnaire.

The impact survey in August 2005 repeated interviews with the same respondent households to compare some basic indicators from the earlier survey.

2.3.2 Agriculture

Given the paucity of information on local agriculture, the first step was to collect information required to finalise the IFM strategy. A recall survey was conducted in 2003 with 50 farm households who have plots near the canal, part of which is used for irrigation and part for dry season fish sanctuary surrounding the khal area. Information was collected on:

- Ownership information on the surrounding plots.
- Basic socio-economic information on owners.
- Cropping pattern for each plot.
- Elevation – low medium or high.
- Plot size
- Planting and harvesting dates.
- Water cover at discrete points during the year.
- Irrigation status (where water was drawn from)

In 2004, 620 farm households (all landowners within the area) in Goakhola-Hatiara and Maliate were interviewed covering their land uses by plot for the whole area. In 2005 as part of the impact survey detailed cost and returns data were collected from a sample of households by plot. In addition the same households as in 2004 were interviewed to evaluate the impact of IFM interventions in terms of cropping pattern changes the area.

Water abstraction for irrigation was also covered as part of the agricultural surveys, along with the irrigation status of the plots. In addition all shallow tubewells and low lift pumps were censused in the area. In the 2004 dry season the operators of all 109 STW and LLPs operating in the beel agreed to keep records were of the days operated, number of hours operated per day, cross checked with fuel use, and areas irrigated. From this, and the capacity of the pumps, estimates of the volume of water abstracted could be made.

2.3.3 Water resources

While the land resource within the floodplain is a fixed area, the extent, depth and volume of water, and its quality, vary between seasons and even between days. The project attempted to generate sufficient information on water resources in the beel to compare with fish catches, to test the models developed in the earlier project (R7868) and to see if changes in water uses for agriculture affected the remaining water available for fish and other aquatic resources. Ideally the following would be monitored/estimated (ideal frequencies in square brackets):

1. Sluice gate operations and settings (including purpose) [daily]
2. Water height (inside and outside the sluice gate) [daily]
3. Estimates of flooded area (and volume) [at least monthly]
4. Estimates of volume of water abstracted from dry season water bodies [at least weekly].
5. Salinity (inside and outside the sluice gate) [daily]
6. Water quality at critical times for fish (dry season sanctuaries, during jute retting period in monsoon) [as needed].

In practice this frequency of detailed monitoring was not feasible. Water height and sluice operations were recorded weekly from mid 2003, but flooded area and volume can be estimated monthly. Salinity levels were not recorded or included in the assessments. There were no changes in floodplain management and practices that would have affected salinity levels within the beel.

Water depth, extent and volume

Water levels were recorded at the Goakhola sluice from 1997 but at variable intervals prior to this study. Mostly 2-3 readings were taken in a month, but intervals of up to 50 days occurred. From mid 2003 four readings a month were taken. All measurements were taken by the same investigator. In addition from mid-2003 whether the sluice was open or closed was recorded.

The modelling component of the project ideally required weekly estimates of flooded area at each study site.

Prior to the start of this project CBFM-1 and CBFM-2 had recorded water level at the sluice since 1997, but no area estimates were available. During the monsoon, most areas are frequently covered by clouds making normal satellite imagery unusable for estimating water area. However, radar sensor is able to penetrate any type of weather conditions. CEGIS working for CBFM-2 project analysed 21 RADARSAT SAR ScanSAR Wide (SCW) images for the area from 29 July 1997 to 2 November 2003 chosen to coincide as closely as possible with water level readings that had been taken. The nominal resolution of these radar images was 100 m x 100 m and the pixel spacing was 50m x 50m. Following ground truthing during 2003 monsoon, images were classified into “water” and “other”, and the water area within the beels as defined from local usage was estimated. The maximum water extent in any one image recorded was 165 ha.

At Goakhola-Hatiara Beel only twenty-one estimates of flooded area were available corresponding to a period between July 1997 and November 2003.

However, corresponding water heights, both inside and outside the flood control compartment were also available for the period April 1998 and June 2003 measured at a frequency of up to every 10 days.

It was concluded that if the variation in flooded area could be adequately described using the water height data corresponding to the same period, then weekly estimates of flooded area could be predicted from the relationship.

The time period between each observation of water heights was however also highly variable, often with periods of up to 50 days between each observation. Daily water heights were therefore estimated from a 50 day moving average (see Fig. 2.1).

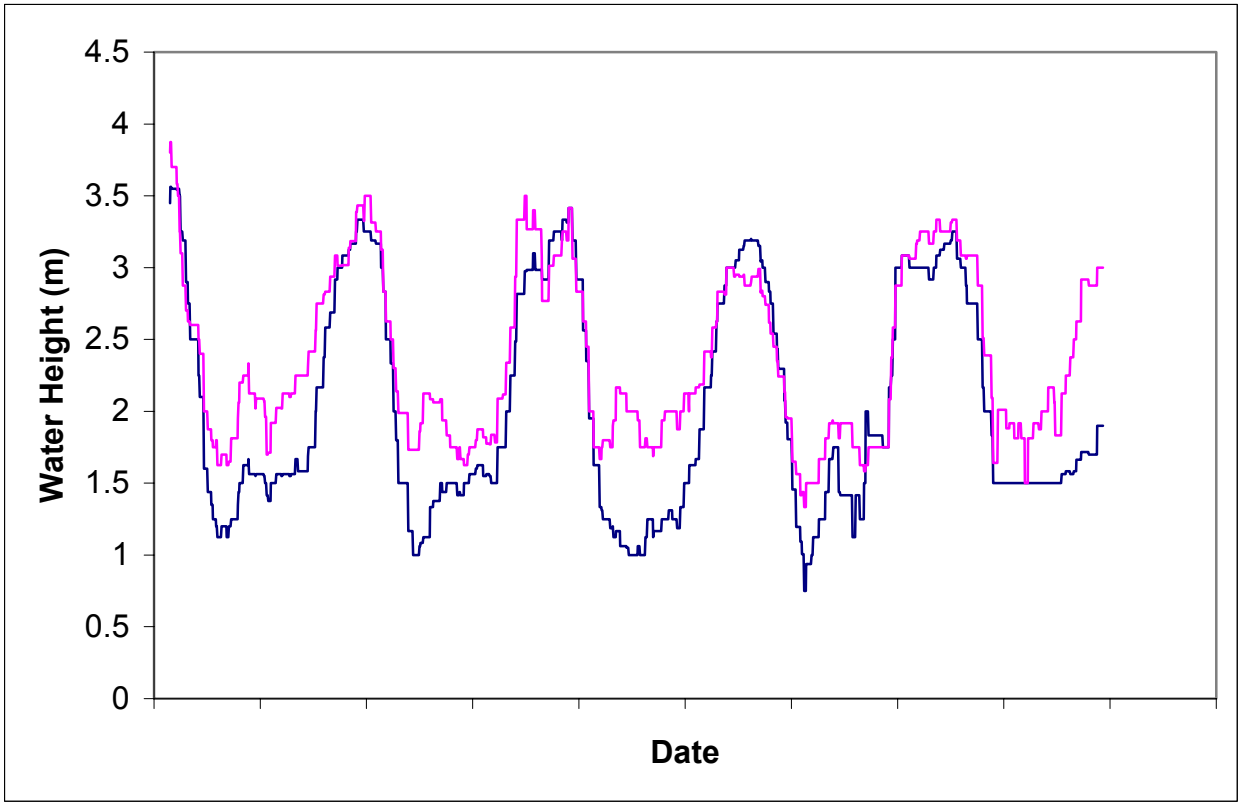


Fig. 2.1. 50 day moving average water height values at Goakhola Beel measured inside and outside the flood control compartment.

The flooded area estimates were then plotted against corresponding water height estimates recorded both inside and outside the flood control compartment. A power function of the form $y = ax^b$ using the outside water height estimates provided the best fit, explaining nearly 60% of the variation in flooded area (Fig. 2.2).

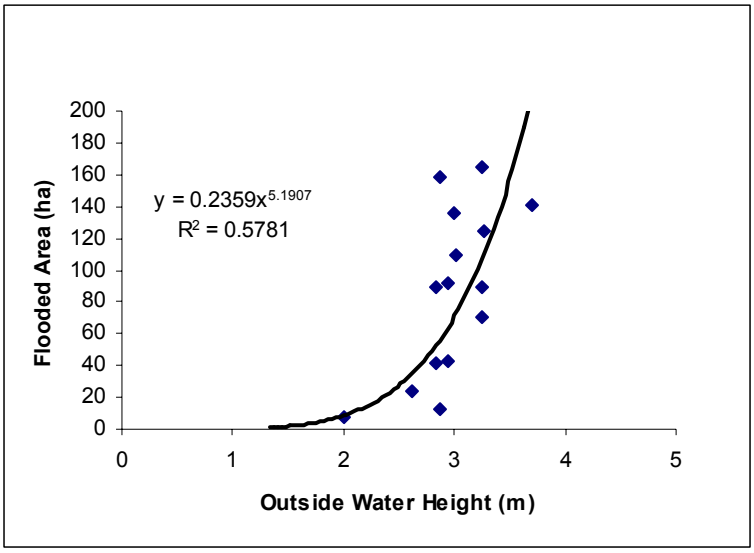


Fig. 2.2. Goakhola Beel flooded area plotted as a function of outside water height with fitted power function model.

Daily, and then weekly estimates of flooded area were then predicted (Fig. 2.3) from the daily outside water height estimates using the fitted power function:

$$\text{Flooded Area} = 0.2359(\text{WaterLevel})^{5.1907}$$

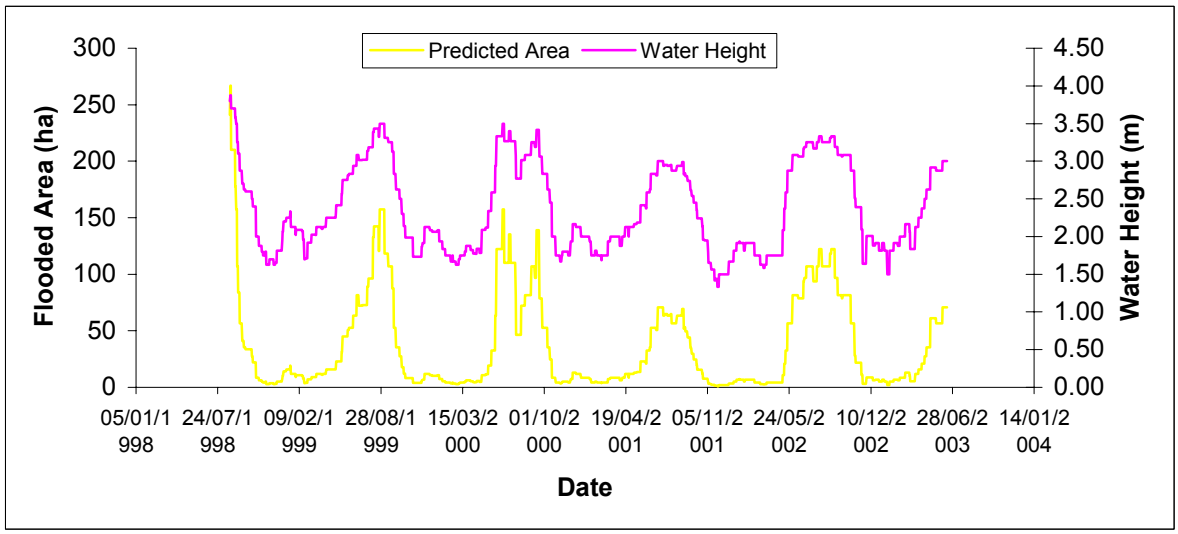


Fig. 2.3 Estimated daily flooded area and outside water height at Goakhola Beel.

Subsequently it was decided to improve on these estimates by constructing a basic digital elevation model (DEM) for Goakhola. In August 2004 a team from CNRS made a field survey by boat recording the depth of water at the intersection points on a 50 m grid for all of the area with navigable water in the beel, using a GPS to fix locations and bamboos to measure water depth. This was related to the water level at the sluice to create a relative land elevation map digitally and from this the area, depth and hence volume of water could be estimated for each date with a water level record. Note that this tends to underestimate the area and volume of water because the fringe areas of the beel were not accessible by boat, and areas flooded by higher water levels than on the survey date were not identified. In addition the grid was not sufficiently fine to record kuas in the floodplain, or to delimit very

precisely Goakhola Khal, and hence dry season water will also be somewhat underestimated.

Water quality

During participatory assessments and reviews the community frequently identified water quality and the effects of jute retting as an issue in the Beel. In 2004 with the help of local officials some initial training and attempts at adopting alternative methods of retting jute were discussed and tried. However, in 2005 larger areas were planted to jute (due to high prices in 2004) and with lower than usual water levels problems of fish kills were reported to the research team. Therefore in August 2005 it was decided to undertake basic water quality analysis for selected parameters that might determine any impact of jute retting on fish.

Water samples were collected twice during the jute retting period. Seven locations were selected for sampling where jute retting processes were continuing. These locations namely Sholuar Beel, Sholuar Khal, closed/stagnant water near Sholuar, Chitra River, Chitra Sanctuary, Afra River, Goakhola Beel, and Goakhola closed/stagnant water, are all in Narial district. In each location three grab samples were collected. Each grab sample contained 1 litre of water and was collected in a laboratory grade plastic sample bottle. Temperature was recorded onsite and other water quality parameters (pH, conductivity, dissolved oxygen (DO)) were checked one hour after sampling with a field test kit. In addition BOD, COD, nitrate, sulphide and total hardness were analysed in the laboratory of Bangladesh University of Engineering and Technology in Dhaka for two water samples. Note that all the locations are in open water bodies except for the Goakhola and Sholua closed/stagnant water samples which were from ponds with jute retting. Also all of the samples came from waters where there was jute retting in the vicinity in the first round of samples. The second batch of samples came from the same locations.

2.3.4 Fish

Under the IFM project the fish catch monitoring that had been operating under CBFM-1 project since 1997 was continued using the same study design, this involved the same field investigator each week recording for one day:

- Gear census by gear type
- Assessment of catch from sample gears of each type (first four operating then every fourth), including weights by species, gear characteristics and duration of fishing.

In addition there was a census of Fish Aggregating Devices (kuas) in the dry season recording their catch and frequency of fishing, and catch composition was recorded for a sample of kuas.

From this data it was expected that potential impacts of IFM through improved techniques of allocating access and effort in fishing, might be assessed covering the following:

- Biodiversity, species composition and seasonal variation:
    - Variation in species abundance and their contribution in the fishery.
    - Seasonal abundance and variation in the catch.
- Changes in fishing pressure, use of gears including destructive ones, indiscriminate fishing activity, pollution, siltation, and other manmade obstacles.
- Fish catch patterns and trends
- Exploitation by different types of fishers and organizations

2.4 Consultations, participatory assessments and reviews

Process documentation and institutional monitoring and monitoring of effectiveness of the IFM Committee were also done. This is reported separately.

The main consultations and participatory assessments conducted in Narail and discussed in this report were:

- PAPD at the project outset - July 2003 (Chapter 3)
- Planning by ad hoc IFM committee to implement main solutions identified in PAPD - September 2003(Chapter 10)
- Exchange visits – February 2004 (Chapter 9)
- Review of demonstrations – March 2004 (Chapter 10)
- Social analysis – May 2005 (Chapter 10)
- Reflective learning – August 2005 (Chapter 9)
- Exchange visits – August-September 2005 (Chapter 9)

CHAPTER 3:
PARTICIPATORY ACTION PLAN DEVELOPMENT (PAPD)

Group work, PAPD July 2003

3.1 Introduction

The PAPD methodology developed in Bangladesh for consensus building involves holding a series of linked local workshops where different stakeholders in a wetland or fishery participate separately and in plenary. Through this the stakeholders are expected to identify from among their problems and possible solutions ones that are common to different stakeholders and can be agreed to be win-win options[1], taking into account the interests of different stakeholders. Through this they form a management plan for the common aquatic resources they use which is expected to improve the condition of the resource base and lives of users (Barr and Dixon, 2001). Many methods such as Participatory Rural Appraisal (PRA) aim to raise individual awareness of resource management problems; PAPD raises collective awareness of the problems and is a process leading towards collective action that can tackle them effectively.

PAPD was originally conceived as a two-stage process comprising a problem census (listing and ranking of problems by different stakeholder groups) followed by stakeholder and plenary planning workshops. However, through application PAPD is now part of a three phase process

[1] Actions that are agreed by all stakeholders to be beneficial to the community and do not make anyone worse off. However, this may not arise in locations which are strongly factionalised for other reasons, and even when there are is a consensus there may be a need for negotiation and compromises over the implementation of the plan where some people would lose in the short term (Sultana and Thompson 2004).

that leads to long-term participatory resource management. Overall thirteen different stages in the process have been identified (Sultana and Thompson 2004). The first eight steps are detailed below:

I. Scoping phase (*Stages one to three)*
   1. Situational analysis (summarizing local knowledge)
   2. Stakeholder identification and analysis (through key informants)
   3. Household census and invitations to a random sample of households to PAPD (stratified by stakeholder categories)

II. Participatory planning phase - PAPD (*Stages four to eight)*
   4. Problem census (with each individual stakeholder group)
   5. Compilation of problem rankings by facilitators (combining stakeholder group rankings)
   6. Plenary with stakeholders and local leaders (to review and agree on main problems for solution analysis)
   7. Solution and impact analysis (with each individual stakeholder group)
   8. Plenary with stakeholders and secondary stakeholders (to present the process, identify feasible solutions, discuss institutional arrangements and next steps)

The steps after the PAPD proper relate to institution building and implementation of plans. In addition to the primary stakeholders as detailed in Section 3.2, representatives from different government departments participated in the PAPD process plenary sessions. Among those were Department of Fisheries, Department of Agriculture Extension, Bangladesh Water Development Board, Local Government Engineering Department, Jute Department, local Union Parishad (elected council) and one local NGO.

A feature that binds the main elements of IFM is that all members of the community-based process of PAPD should relate to the decisions and technical and social actions that are agreed to for improving IFM. An example of this could be that an individual in a particular community, whose main livelihood activity is fishing, has an understanding of the rationale behind promotion of alternative crops to *boro* (dry season) rice with farmers of the same community. PAPD should enable such a person (commonly amongst the poorest of the community) to appreciate that less demand for water for agriculture (land side) can favour the water and associated fish production side of the floodplain ecosystem. The reverse also applies. While the main driver for a farmer's crop change may be that a new alternative crop is more profitable, the dialogue of PAPD should enable that farmer to develop an understanding of the benefits to the water resources of the floodplain system that can arise from a change in cropping pattern.

3.2 Outcomes of PAPD in Goakhola-Hatiara Beel

Tables 3.1 to 3.6 summarise the analysis of the highest priority problems identified by the six stakeholder groups in the PAPD held in July 2003.

Table 3.1 Group: Farmers

Rank	Problem	Reason	Impact	Solution	Affected group
1.	High cost of production	• Low value of crop • High cost of seed, fertilizer • High cost of pesticide • High irrigation cost	• Farmers' income decreasing • Low sale value/ can't sell at fair price • Have to sell at low price during harvesting period • Have to sell in advance through Dadon	• Reduce price of fertilizer and seed • Reduce price of fuel for irrigation • Government has to buy crop at fair price	None
2.	Lack of quality seeds	• Mixed seed, low germination rate, longer growth period	• Late planting, late harvest, low production, risk of flash flood	• Make short duration crop seeds available.	None
3.	Continuous HYV paddy cultivation	• High use of fertilizer and pesticide	• Soil fertility reduced • Crop yield reduced	• Alternate crop cultivation	None
4.	Water level lowered	• Continuous abstraction of ground water	• Dry boreholes, cost of irrigation water high, production cost high	• Alternate crop cultivation	None
5.	Serious deficit in natural fish stock	• Catch of brood fish • Catch of fingerlings • Fish disease • Fishing by dewatering • Fishing by trapping with large net (Boishak-Jaishtha) • Use of current jal/ destructive gear	• Fish consumption decreasing • Fish price increasing	• Stop trapping fish by using net at the mouth of the river • Stop dewatering of Kuas • Stop catching brood fish in Boishak-Jaishtha • Establish sanctuary • Reduce use of current jal	None
6.	Insufficient water discharge through sluice gate	• Khal has been filled up due to erosion of the banks • Not enough vents in the sluice gate • Waste of jute retting, straw and other rice by product is filling up the canal • Narrow sluice gate • Water flows slowly through small mesh size net and polythene	• Cannot harvest crop in proper time due to water logging • Only one crop (boro) grows in beel • Problem in drainage system	• Make the sluice gate wider • Canal re-excavation • Bottom of the sluice gate has to be the same to that of canal • Excavate joining canal between Rameswarpur khal and Suluar khal	None
7.	Water lily, snails are collected; birds come in fewer number	• Amateur hunters kill birds with gun • Lilly and snails are sold in the market • Hogs eat snails	• Two years ago it was possible to collect 100 sacks of snail/day in the monsoon. But now only 10-15 sacks is possible • Lilly has decreased • Price of Lilly has increased • Income has decreased • High demand for Lilly	• Reduce foraging of hogs in the beel • Have to conserve root/seed of Lilly • Stop collection of snails in breeding period	None
8.	Lack of social and environmental awareness	• Limited knowledge • No exposure to outside the area • No training.	• Each stakeholder thinks of individual interest	• Exposure visit • Training • Folk theatre	None
9.	Lack of electricity	• Electricity department does not cover all villages. • Electricity supply is very irregular where there is electricity.	• Students suffer. • Agriculture suffers. • Paddy crushing cost has increased. • Poor communication with other parts of the world.	• New area should come under electricity supply. • Establish uninterrupted electricity supply.	• Farmers. • Business-men

Table 3.2 Group: Fishers

Rank	Problem	Cause	Impact	Solution	Affected group
1	Lack of coordination between farmers and fishers	• Fishers have a committee to manage fish, but there is no emphasis on crops	• Community water management is more for crops. • Water pollution.	• Integrated approach for floodplain management	• Fishers
2	Lack of integrated approach for water resources management and floodplain management	• Lack of understanding • Lack awareness and facilitation	• Fish production lower than potential. • Dependency on the rich. • Outsiders forcibly fish here. • Fishers and others don't cooperate.	• Need organizational support.	• Comm-unity.
3	Jute retting in beel water	• Lack of awareness • Lack of alternate approaches for jute retting	• Pollutes water and kill fish	• Training on alternate retting system • Easily available and easy to use machine for raw jute fibre extraction to avoid leaf fall	• Comm-unity
4	Improper operation of the sluice gate.	• There are no rules and regulations for operating sluice gate. • During fish migration (May to July) sluice gate closed by the operator. • Sluice gate opened suddenly during high tide (inundates the standing crop).	• Sluice gate operation causes crop damage by over flooding and drainage congestion. • Fish can't migrate in.	• Employ government sluice operator. • Regulate sluice properly.	• Farmers. • Fishers.
5	Lack of knowledge on alternate crop and fishery	• No exposure to places outside the area • Support from agriculture department low.	• Dependence on the same crop for years	• Exchange visit • Workshop for exchange of knowledge • Open air theatre	• None
6	Fish disease	• Use of excess fertilizer	• Fish dying and scarcity of protein	• Less fertilizer demanding crop cultivation	• Fishers • Comm-unity

Table 3.3 Group: STW owners/operators

Rank	Problem	Causes	Effect	Solution	Affected group
1	Cost of irrigation high due to high cost of running STW	• High cost of diesel • Electric supply not regular	• High production cost	• Use surface water	• Farmer
2	Water logging :irrigation problem due to sluice.	• There are insufficient sluice gates.	• Water congestion and crop damage.	• Increase Banahati to Hatiara road. • Complete construction of 'Shashan' sluice gate.	• Farmers.
3	Scarcity of natural fish.	• Beel bottom is rising due to siltation and beel is drying up. • Use excess pesticide to grow more paddy. • More people involved in fishing.	• Scarcity of protein food. • Expenditure increasing. • Children have been suffering by malnutrition.	• Re-excavate khal canal. • Re-excavate private owned ditches.	• Fishers. • Small farmers. • Farmers.
4	Siltation of the canal.	• Due to the deposition of natural silts. • Garbage of agriculture goes into the canal.	• Carrying of paddy from field becomes problematic. • Scarcity of irrigation water. • Over flooding. • Fish habitat reduced.	• Canal re-excavation. • Garbage of agriculture should be converted into compost so that it cannot go into canal.	• Farmers. • Fishers.
6	High price of fertilizer and pesticides.	• There is no fertilizer and pesticide dealer in this locality. • Transportation problem. • Lack of government control.	• Due to increasing price of fertilizer they cannot apply sufficient fertilizer. • Crop yielding decreasing.	• Recruit local people as fertilizer dealers. • Government should control fertilizer price.	• Farmers.
7	Low water table	• Many STW running during dry season • Lack of surface water for irrigation	• Part of khal dries up	• Establish a government primary school at Benahati. • Develop road.	• The poor.
8	Scarcity of quality seed.	• Problem of seed preservation. • Transportation problems.	• Less production.	• Build seed preservation center locally.	• Farmers.
10	Scarcity of Electricity.	• The electricity department does not cover all villages. • Electricity supply is very irregular where there is electricity.	• Cost of irrigation high • Agriculture suffers. • Paddy crushing cost has increased.	• New area should come under electricity supply. • Establish uninterrupted electricity supply.	• Farmers. • Business men.

Table 3.4 Group: Kua Owner.

Rank	Problem	Causes	Effect	Solution	Affected group
1	Sluice gate does not regulate properly. (Area: starting point of canal and west side of Hatiara).	• There is no gate man. • Construction work of gate not yet been completed.	• Occurred crop damage. • Fish cannot enter into the beel. • Water pollution due to congestion.	• Form committee for regulating sluice gate. • Repair sluice connecting road.	• Farmer. • Fisher.
2	Fish catch in breeding period.	• Due to poverty. • Fish price becomes higher during this season.	• Fish production decreasing. • Fish consumption decreasing.	• Work united. • Establish sanctuary in khas land. • Do not catch fish by drying canal.	• Fisher.
3	Cannot produce multiple crops in low laying area.	• Lack of knowledge about alternate crop • Low laying area. • Do not regulate sluice properly. • Due to the siltation of Hatiara canal water cannot drain out properly.	• People are not getting income from crop. • Fish production has been increasing.	• Re-excavation of Hatiara canal. • Regulate sluice gate properly. • Construct two-pipe sluice on the both side of Hatiara road.	• Farmer.
4	Fish disease.	• Diseased fish come to beel from unplanned aquaculture and affect other fish in the open water.	• Fish have been decreasing due to the ulcerative diseases. • Fish production decreasing and price has been increasing.	• They need assistance from fisheries specialist. • Need training to prevent diseases.	• Fishers. • Fish farmers.
5	Low flow in the canal due to siltation of internal canals	• Due to the deposition of silt and garbage of the cultivation.	• Problem in water movement. • Less crop production. • Less fish production.	• Re-excavate canal from Hatiara to Kamlapur where it is needed.	• Farmer. • Fisher.
6	No electricity	• No supply of REB electricity. • Official complication.	• Irrigation problem. • Problem of using T.V and Radio. • Problem in education.	• Supply REB electricity each hh of the village. • Coordinate with the authority.	• Farmer.
7	Lack of unity.	• Due to different faction group among the villagers. • Scarcity of honest and devoted organization. • Lack of self-respect among villagers.	• Constraints in developmental work. • Conflict among each other.	• To form society. • Uplift awareness. • Motivate people by mutual understanding. • Take initiative by the local people. • Involve cooperating agency.	• Poor people.

Table 3.5 Group: Women

Rank	Problem	Causes	Effect	Solution	Affected group
1	Fish and aquatic resources decreased	• Polluted water • Less rainfall	• Income decreased • Protein intake decreased	• Stop jute retting in the beel and river • Alternate jute retting process	• Women • Fishers
2	Fish diseases.	• Unknown.	• Income from fish has been declining. • Fish have been decreasing.	• Do not know.	• Fishers.
3	Lack of unity.	• Lack of cooperation. • Differences between the poor and the rich.	• Poor people are oppressed by other people.	• Organise poor and strengthen them • Establish groups by organizing themselves.	• Poor people.
4	Lack of education.	• Scarcity of good teachers. • Cannot afford to buy books and other educational material.	• People are guided by superstition. • Lack of unity.	• Government should provide same facilities to boys like girls in education. • Provide experienced teachers.	• Private tutors might be affected.
5	Unemploy-ment problem.	• Lack education. • Scarcity of industries. • Scarcity of capital. • Poor people cannot afford bribe for jobs.	• Financial problem.	• Increase education level. • Set up rural industries	• Poor people.

Table 3.6 Group: Landless men (includes sharecroppers)

Rank	Problem	Reason	Impact	Solution	Affected group
1	Lack of work in monsoon season	• Less land use in monsoon season • Less production • No alternate job	• Low income	• Better production • Alternate livelihoods	• Labour
2	Natural fish in the beel declining	• Polluted water • Low water level • Operation of sluice gate in favour of agriculture	• Decrease income from fishing • Decrease fish consumption	• Stop catching brood fish • Stop catching small fish from the month of Chaitra to Jaishtha • Jute retting outside beel • Find methods to stop fish disease	• Labour
3	High cost of cultivation	• Lack of electricity in the area • High cost of fertilizer and pesticide • Low quality seed	• Low return	• Training on alternate crop cultivation • Demonstration	• Landless sharecrop per
4	Lack of land for residence	• Number of people/increasing population • Low income • Decrease land due to too many shareholders/ inheritors	• No space for cow and goat grazing • No space for duck or chicken rearing • No space for trees	• Generate income • Distribute Government land	• Landless people
5	Lack of medical services	• Lack of charitable medical service • Cannot go far for treatment due to lack of money	• Do not get treatment of critical diseases	• Require physician and medicine near • Require Govt. hospital • Provide cheap or free treatment and medicine	• Landless poor
6	Lack of latrines	• Cannot buy sanitary latrines due to lack of money	• Spread germs • Increased incidence of diseases	• Increase health consciousness • Supply sanitary latrines at cheap price	• Landless poor

3.3 Summary of outcomes from PAPD

Based on the separate stakeholder discussions a common set of potential management actions was identified and ranked according to the views of the different stakeholders (Table 3.7).

Table 3.7 Priority management actions for Goakhola-Hatiara floodplain from 2003 PAPD.

IFM options	Ranking on the basis of scores (average of groups)
Cultivate alternate crops	1
Use of local/indigenous knowledge	2
Rehabilitation of locally extinct species	3
Communication and linkages with other institutions	4
Ribbon retting and jute retting in places other than beel	5
Integrated Pest Management	6
Establish fish sanctuary	7
Excavation of canal	7
Sluice gate operation	8
Closed season	9
Drainage optimisation	9
Maintain surface and ground water level	10

1 = top rank overall, etc.

This indicated a high interest in trying alternative crops and in making better use of existing local knowledge. Direct fishing effort interventions ranked lower (for example closed season and fish sanctuary), but this is probably because they were already being implemented and observed by the community through CBFM project, the one exception was re-introduction of indigenous species which had not been supported by CBFM project (some species have increased naturally but scare species have tended to fluctuate in the catch (see Chapter 7).

Proposed rules and norms for **aquatic resources management** can be summarized as follows:

- Fishing and collection of snails should be prohibited in Boishak-Jaishtha-Ashar
- Cannot fish more than twice by dewatering kua in Falgun-Chaitra
- Cannot use current/destructive net or gear with mesh size less than one inch
- Cannot fish by using flap gate (a gate made of bamboo and plastic which moves with the height of water) in the canal
- Cannot use pata jal (bamboo fences)
- Cannot use set bag net at the mouth of the canal.

Proposed rules and norms for **crop management** can be summarized as follows:

- Cultivate more short duration crops
- Cultivate more crops other than paddy in high and medium high lands
- Use ribbon retting of jute and also ret jute outside beel
- Open sluice gate earlier.

The top 12 IFM options were assessed in more detail by the stakeholders in the PAPD. Their different assessments did not differ much between stakeholders and have been consolidated in Table 3.8.

Table 3.8 Consolidated assessment of IFM options by different stakeholder groups (in priority order).

|IFM options	Benefits	Disbenefits	Disbenefited groups	Solutions	Way forward
Alternate crop cultivation (dry season)	♦ Less irrigation ♦ Less cost of production ♦ Soil fertility increases ♦ Low investment, high return ♦ Less demand for water ♦ Less competition among different water users ♦ Timely opening of sluice gate for fish recruitment ♦ No environmental pollution due to less pesticide use ♦ Less family labour engagement	None	None	None	♦ Crop demonstrations ♦ Find sources of good seed ♦ Training ♦ Awareness raising
Local/ indigenous knowledge	♦ Local knowledge based technique use ♦ Low cost ♦ Sustainable ♦ Adaptive to the local condition	Don't like to use new technologies until they are demonstrated successfully	None	Changes in practices should be based on existing local knowledge and technologies first	Old peoples' decision should be reassessed and recognised
Rehabilit-ation of locally extinct fish species	♦ Biodiversity increases ♦ More fish production ♦ More income	None	None	None	♦ Procure natural fish, conserve and take care ♦ Build awareness
Communica tion and linkages with other institutions	♦ Exchange of knowledge ♦ Good relationship ♦ Conflict resolution ♦ Coordination among neighbouring beels	None	None	None	♦ Workshop ♦ Newsletter ♦ Network ♦ Exchange visit ♦ Guidelines for IFM ♦ GO cooperation
No jute retting in beel	♦ Beel water will not be polluted ♦ No fish disease ♦ No occurrence of diseases ♦ No environmental pollution	♦ Source of water for jute retting is limited ♦ Economic loss of the jute farmers (few) ♦ Fuel crisis	Jute farmers	♦ Provide technology for retting jute in small closed areas ♦ Alternate crop for fuel and fibre	♦ Awareness raising ♦ Demonstration plots ♦ Training
IPM	♦ Low pollution level ♦ Less production cost ♦ Natural fish remains healthy ♦ Food quality will increase ♦ Less health hazard	None	Pesticide dealers	None	♦ DAE arrange training on IPM ♦ Farmers field school
Fish sanctuary	♦ Natural fishes increase ♦ Fish diversity increases ♦ Protect natural fish and brood fish species ♦ Easy to take care/protect	None	None	None	♦ Awareness raising through workshop, miking, local theatre, leaflets ♦ Everyone should keep an eye on the sanctuary to identify any problem in the sanctuary

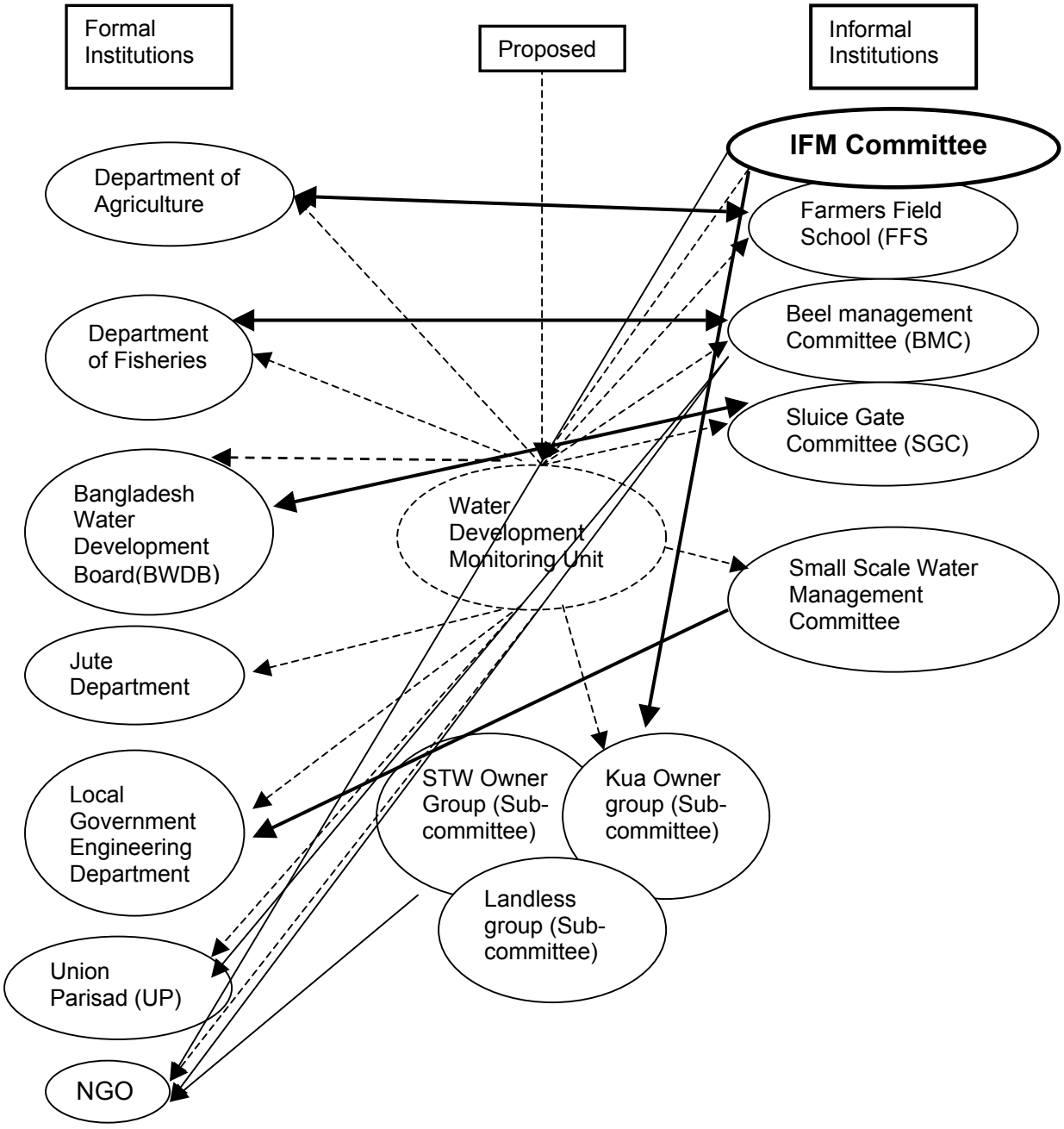
IFM options	Benefits	Disbenefits	Disbenefited groups	Solutions	Way forward
Excavation of canal	♦ More water retention in the canal for fish and irrigation ♦ Internal water transport improved ♦ Less drainage congestion	None	None	None	LGED involvement
Sluice gate operation	♦ Sluice gate should be operated by the fishers and farmers joint committee ♦ Share of necessary quantity of water for all users ♦ Sluice gate operation when and where necessary ♦ Water drains out in time ♦ Water enters in the beel in time ♦ Crop cultivation on time	♦ Big farmers may not cultivate crop according to their own interest, they have to synchronize their cultivation with the others ♦ Conflict	Farmers	A committee should be formed with all types of water users	BWDB should form the committee
Closed season	♦ Natural fishes increase ♦ Fish can breed ♦ Can catch bigger fish after closed season ♦ Income of the fishers increase ♦ More fish for consumption/more protein	In closed season: ♦ Traditional fishers lose income ♦ Fish supply in the local market decrease ♦ Fish price increases	Traditional fishers	♦ Raise awareness ♦ Provide alternate income generation sources	Local fishery rules need to set conditions/ punishment if there is any rule breaking
Drainage	♦ Timely drainage of water ♦ Crop cultivation on time ♦ Less loss from flood	Quick drainage may hamper fish harvest	Fishers	Compatible drainage	LGED involvement
Maintain surface and groundwater (decrease irrigation)	♦ Availability of ground water for all users ♦ Rabi crop cultivation with less water ♦ No risk of arsenic and salinity ♦ Economic benefit ♦ Water level decreasing	♦ HYV rice may not be possible to cultivate ♦ Do not have experience in other crop cultivation	♦ HYV rice farmer ♦ STW owners	♦ Training on new crops ♦ Demo plots ♦ Awareness workshop ♦ Leaflet and posters	♦ Cultural change ♦ Acceptance of the new cultivars ♦ Food habit change

As can be seen, out of these options fish sanctuaries, cultivating alternative dry season crops, IPM, reintroduction of fish species, improved linkages and communications, and canal excavation were seen as having no harmful effects for any local stakeholders and therefore should be easier to implement. However, a closed season would need some compensating support for fishers during that time, there was concern that reducing water abstraction for irrigation would affect present HYV boro cultivators would might not be able to adapt or would need convincing to change crops, and jute farmers might lose if alternative retting systems could not be found. Perhaps most significantly it was perceived that large farmers might not agree to change their agricultural practices to support changes in water management that the majority of the community were interested in, and that they could come into conflict over sluice operation. Drainage remains an issue without a clear solution from the PAPD – the conflicting interests in draining out water for cultivation after the monsoon and keeping more water for fish were recognised but it was not clear from the PAPD if a "compatible drainage" plan could be developed.

Lastly the stakeholders in the PAPD considered what local organisations and institutions might be involved in improving management of the floodplain and how they should interact. It

is notable that most local informal committees and institutions had links only with one or at best two sponsoring formal bodies/government agencies (Fig 3.1), and were seen as acting in an uncoordinated way by the participants[2]. The proposal at this time from the participants was to form a water development monitoring unit that would include representatives from or links with all of the stakeholders and institutions and could then help coordinate activities. However, as will be seen the eventual outcome in 2005 was that the IFM committee took on part of this role by comprising of representatives from the other local institutions and stakeholders, and having good links with all the concerned government departments at the local level.

Fig 3.1 Institutions and linkages assessed in plenary through PAPD in 2003.



[2] Note that the small scale water management committee under LGED is active in the nearby Kathuria Beel but so far has not had any influence in Goakhola-Hatiara or Maliate Beels and so is not a factor in the remainder of the IFM activities in these beels.

3.4 IFM Implementation Planning (September 2003)

In a workshop in September 2003, the ad hoc IFM committee decided in detail how it would try to implement the main outcomes of the PAPD held in July 2003. The decisions are shown in Table 3.9.

Table 3.9 Decisions for undertaking activities to promote IFM in Goakhola-Hatiara Beel, September 2003.

Decision	Activities/process	When	Responsibility
Form formal IFM Committee	Discussion among ad-hoc committee members and farmers	15 July 2004	Ad-hoc committee
Register the Community Based Organisation (IFM Committee)	Discussion among executive committee members and farmers and with cooperative department	By June 2005	IFM Committee
Committee meeting	Discussion among members	1st Sunday every month	IFM Committee
Demonstration plots	Select farmers and cops after discussion with farmers	September 2003	Farmers and staff
Continue observing closed season		Continue	
Excavate a canal with flap gate to regulate water and make 300 acre land productive	Take permission from BWDB Discussion with the land owners	Nov 2004	IFM committee Fund raising
Impose punishment for rule violations		Continue	
Establish permanent sanctuaries		By Feb 2005	
Ban use of harmful gears (e.g. monofilament net, long line etc) and fixed gears (enclosure, fences)		By June 2004	
Stop catching brood fish		Continue	
Stop dewatering kuas (ditch) and catch fish once in a year	Discussion with kua owners	October 2004	
Re-stock endangered and rare species (Pabda, Khalisa, Meni and Sarpunti)		July 2005	IFM committee
Open account	Discuss with the bank	5 Jan 2004	
Exchange visit	Discussion with officials	5 Feb 2004	
Awareness campaign (open air theatre, miking, video	Discuss with local theatre group	July 2004	
Training on rabi crop cultivation, jute retting	Discussion with officials	July-August 2004 and Nov-Dec 2004	IFM committee

CHAPTER 4: INSTITUTIONS AND APPROACHES

Officers of government agencies discussing IFM with community representatives, March 2004

This chapter discusses the existing community based organisations established through the CBFM project in the beels, linkages among institutions, and the development of other institutions involved in IFM.

4.1 Goakhola Hatiara Beel

As all the land is private, farmers dominate in the area and as this is a floodplain and the community is a Hindu farming community, the number of professional fishers is very negligible. Access to aquatic resources during the monsoon is free for all from the surrounding villages owning land in the beel. Anyone can fish anywhere in the monsoon, but in the post monsoon period nobody is allowed to fish near the private kuas. In the nearby Bhairab River high competition for fishing exists and the Hindu community do not feel comfortable fishing there throughout the year. Therefore, poor including landless poor do not depend always on fishing.

4.1.1 BMC

The institutions involved in CBFM activities here start on one side with the NGO primary groups. In the case of Banchte Sekha all the primary group members are female. Each primary group has 10-15 members. Each group has a chairperson, secretary and cashier. The female groups have their own income generating activities and are not necessarily involved in fishery activities. As Banchte Sekha has no male groups, there is no direct way of supporting fishing households to divert from fishing for an income during the closed season, so credit is disbursed through the female groups for those poor fisher households. Female group

members have personal savings and they also receive training on different Income Generating Activities (IGAs) through Banchte Sekha.

The Beel Management Committee (BMC) was formed in 1997 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 Sheka. Table 4.1 shows how the committee has evolved since 1999. Representatives of two villages, Goakhola and Hatiara, dominate in the committee.

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 meet every month but if there is an emergency they meet any time. They received training on leadership development, waterbody management, fisheries management and accounting. All the members are literate and they have some technical knowledge. Women members also received training on different IGAs and most of them are running individual enterprises.

The main activity of the BMC has been to take up fish conservation measures and it tried unsuccessfully to extend to water control (see below). The BMC is also responsible for coordination with other stakeholder groups as well as different organisations. They take decisions through participatory discussion with the primary groups. The women members of Banchte Sekha 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 4.1 History and composition of Goakhola-Hatiara Beel Management Committee.

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

To keep coordination between villages there is an advisory committee composed of elderly people and local elites. The advisory committee is responsible for providing necessary support to the BMC and to keep liaison with the local government for back-up support.

The BMC has succeeded in implementing the local rules that it sets, and claims 90% compliance. Some people who were fishing illegally during the closed season when caught by the BMC members were subject to punishment of different levels. They have a joint bank account with the NGO staff member supporting their activities. Each member makes contributions to the fund. The CBFM project provided some revolving fund and grants, and

all of this fund was deposited in the account. Moreover, the BMC successfully appealed to the UP chairman and got the lease to the khal (canal) without any fees for making it into 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, and structure built through CBFM-2 grant.

For proper identity and formal recognition, registration of the BMC is needed, however this has not been done yet as the Social Welfare Department ended new registrations in 2005.

4.1.2 Other institutions

There was a sluice gate operation committee which was separate before, then it was decided to merge it with the BMC. However, this did not work and the gate reverted before the IFM project started to being operated by one large farmer. The old sluice gate management committee formed by Bangladesh Water Development Board (BWDB) has not been active for some time.

The sluice management committee was intended to operate the sluice 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.

The BMC leader is also invited to the Upazila Jalmohal Committee where he can raise issues and let the committee know about the problems related to the waterbody. The BMC also resolves local conflicts and appeals on problems to the judiciary department. They organise rallies, street drama for raising awareness among the local people as well as the neighbours. The BMC liaises with all local level officials and the NGO.

For IFM an ad hoc committee was formed based on a local farmer field school plus representatives of other stakeholders in 2003 after the initial PAPD. This was revised in July 2004 into a formalised IFM committee through an open meeting (facilitated by the project) 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 Sheka's groups): two women and four men are from the BMC, it also includes 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), IPM 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 collected fees from local community for the pipe-sluice.

4.2 Maliate Beel

The institutional arrangement for CBFM in Maliate Beel is similar to that for Goakhola-Hatiara Beel, with the important difference that the BMC only comprises of women from Banchte Sheka's groups, they have taken a lead in fishery conservation and management in the beel. As shown in Table 4.2, the women felt the need to involve some men at least in an advisory committee.

Table 4.2 History and composition of Maliate Beel Management Committee.

Year	General Body		Executive	Office bearers		Advisory
	M	F	Committee	M	F	committee
2002	0	24	none	None	President, Vice president, General Secretary Cashier, Communication secretary, Organizing secretary, Women-issue secretary	7 male, 1 female
2004	0	24	17 members	None	President, Vice president, General Secretary, Cashier, Communication secretary, Organizing secretary, Women-issue secretary	5 male

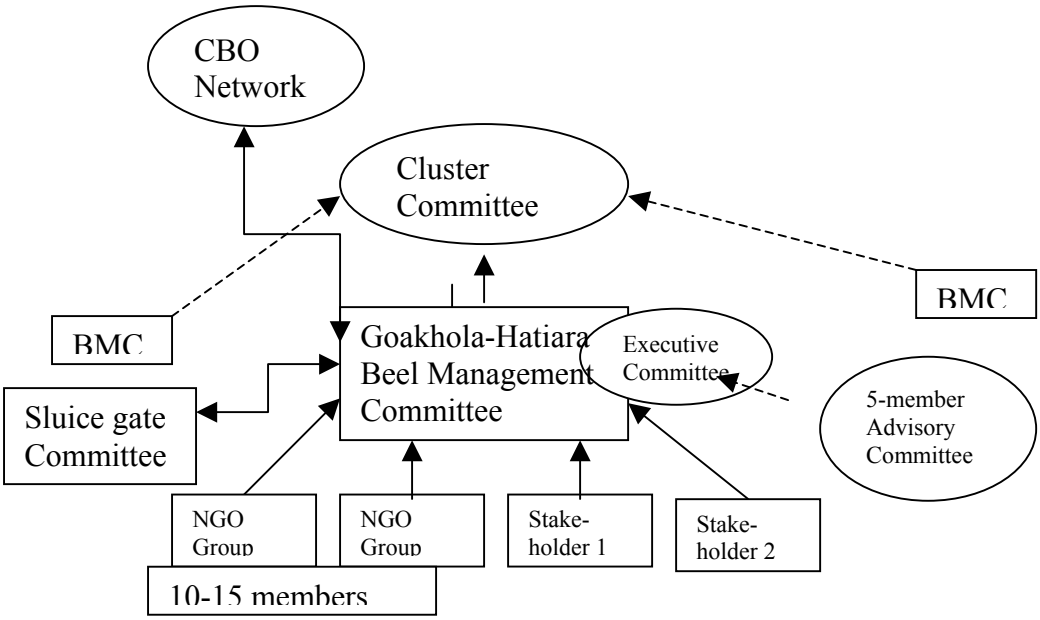
Because it is adjacent to Goakhola-Hatiara Beel and links with it in the monsoon, this has functioned as an extension of IFM in Goakhola. The BMC members and farmers have been invited to IFM project activities such as field days, participatory assessments and exchange visits. After seeing the IFM committee in Goakhola in Maliate the community also formed a similar 15 member IFM committee, but most (nine) of its members are women and come from the BMC and most of the men come from its advisory committee.

4.3 Beel Cluster Committee and Links with Other Institutions and Stakeholders

The general links for co-management under the CBFM-2 project are shown in Fig 4.1. At the field level the fishing community is represented by the Beel Management Committee (Community Based Organisation – CBO) that is supported by the NGO (Banchte Shekha), with technical advice from Department of Fisheries (DoF), all partners receive advice and facilitation from WorldFish Center as needed. Wider linkages for the committee are into a network of similar CBOs and with local government – the Union Parishad mainly.

Under CBFM-2 the BMCs from the adjacent beels formed in 2003 a cluster committee. The cluster committee is composed of 7 members, one from each beel plus a member from DoF. This cluster committee and other similar committees in the area are expected to form a Central Committee after formation of all cluster committees. The cluster committee was formed to strengthen all the individual BMCs and to help them develop a unified action plan so that all the waterbodies in the same connected cluster benefit from one another's management activities equally. It acts as local conflict resolution body. This committee also works as pressure group for any fisheries policy implications.

Fig 4.1 Institutional Structure and Linkages in Goakhola Cluster

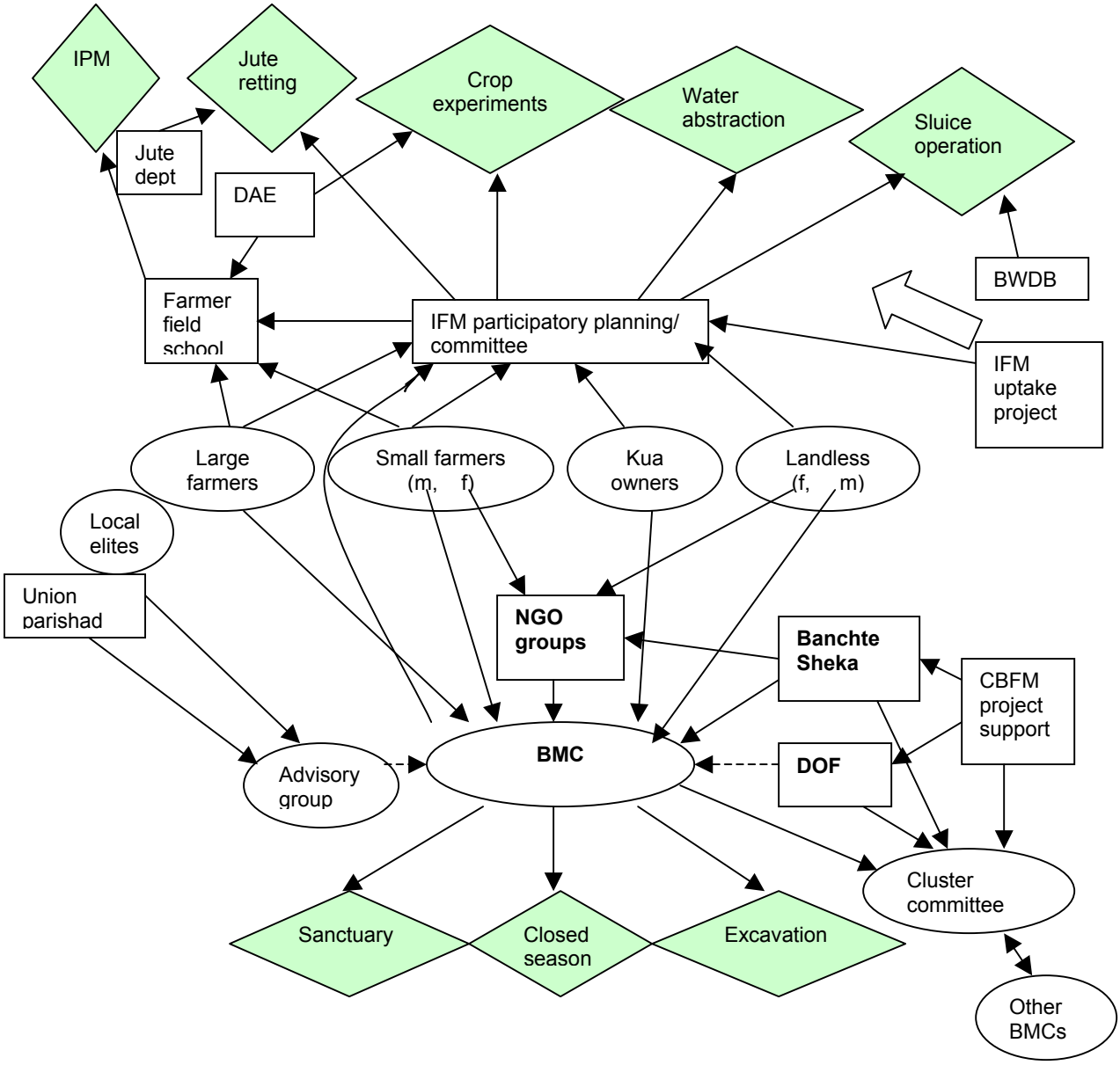


4.4 Linkages between institutions, stakeholders and interventions under IFM

Fig 4.2 summarises the linkages between BMC, IFM committee, and other local institutions and government service providers, along with the two projects active in the area. It is important to note that for piloting IFM this project has made little direct investment other than facilitation of the IFM participatory planning and learning process, plus facilitating links with the other government agencies which have then extended advice and training to the community. In addition exchange visits and workshops have been funded, and the initial crop demonstrations were underwritten by the project.

In consequence four main activities have been taken up by the community related to agriculture and water management/use that complement the fishery management activities also undertaken by the community with CBFM support. As will be seen from the participant assessments and progress reported in the following chapters this has brought some direct benefits to individuals and the community as a whole, most notably improving linkages with local agencies and service providers, and enhancing the overall productivity of the beel.

Fig 4.2 IFM uptake processes and linkages in Narail



IFM action/option (shaded – already taken up)

Issues: links between dry season water volume and fish catches
links between fish migration and fish catches
links between monsoon water extent and fish catches
costs and returns of alternative crops and practices
employment for different crops
links between agricultural pollution and fish catches
seasonality of work and incomes
total returns from system with different IFM options

CHAPTER 5: CROPPING PATTERN MANAGEMENT

Harvesting potato from demonstration plot, March 2004

5.1 Introduction

In any locality, the prevalent cropping systems are the cumulative results of past and present decisions by individuals, affected also by community norms and by governments and their agencies. These decisions are usually based on experience, tradition, expected profit, personal preferences and resources, social and political pressures and so on. Although the climatic, edaphic and socio-economic diversity of the project area crop-production scene is dotted with many cropping patterns, only a few usually dominate. In Bangladesh the amount of rice production and harvest is considered to be the scale of prestige as well as food security. Even though crops other than paddy may be more profitable, farmers are not yet ready for the change. Traditionally it is accepted that if any farmer has food in his/her store for the year that household is considered to be in higher social strata. Therefore, rice based cropping system dominates in the area and farmers adopt new varieties faster if they see the effect.

Socio-economically, there is a range from relatively affluent farmers who operate with a high input intensity to subsistent farmers and share-croppers. Between these two extremes, various intensities of cultivation are practised. The general picture in Goakhola is that 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).

Cropping activities go on all the year-round in Goakhola-Hatiara, provided water is available for crops or water is not too much for the crop. In the project area, there are two distinct seasons, *kharif* (July to October), and *rabi* (October to March). Among the rabi season

crops, HYV Boro paddy varieties, together with local paddy predominate. Several varieties exist in this area (Table 5.1), but most of the farmers grow two or three varieties depending on their preference. In the Kharif season again rice is the main crop. 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.

Table 5.1 Rice varieties (and other crops) grown in Goakhola-Hatiara Beel in 2003-05.

Seasons	Crop varieties
Rabi	Rice: Ratna, Biplob, GS-1, Hiraton, Br-28, BR-29, BR-79, Indian variety-144, Sonar Bangla, Soket-4Chinese, Jagoroni, Kajaql lata, Nayan moni, Minicat, Sabana Other Rabi crops: Blackgram, Sesame, Linseed, Mustard, Raprseedand some vegetables, potato
Kharif	Rice: Ratul, Birpala, Palbira, Monohar, Gambir, Dheapo, Has, Hasa, Shada dhada, Mach Ranga, Naroy, Ghosa, Buru Laxmi, Kochui, Amanchala, Kaladhla, Lathilawa, Tepadangi, Kalclist,Sribalien, Digha, Asam boro, Balam, Komliraish,Kaliburi

5.2 Land Characteristics

Goakhola-Hatiara Beel has typical floodplain features and is mostly low lying land that experiences relatively deep inundation each year. More than 60% of the land area falls under low and very low land categories (Table 5.2). In the monsoon all the land goes under water whether categorised as high or medium high. However, the water level remains less in the high land and right after the monsoon rain stops water recedes from those plots, whereas in other lands the water stands for a longer period. Because the high lands dry up quickly they need more irrigation (almost everyday in the dry season) if they are to grow boro paddy. The medium high land has similar characteristics to high land. At the opposite extreme about 10% of the low land remains fallow in the kharif season as the water level in those plots remains too high for too long for crop cultivation.

Table 5.2 Area of land by level and soil type in Goakhola-Hatiara Beel.

Land characteristic	Number of plots	Mean plot size (decimals)	% of total cultivable area
Land level			
High	167	24	7
medium high	678	29	33
Low	1,013	33	56
Doba (ditch/very low)	118	22	4
Total	1,976	30	240.83 ha
Soil type			
Clay	605	29	29
Clay loam	1,129	32	61
Sandy loam	240	25	10
Sandy soil	2	16	0
Total	**1,976**	**30**	**240.83 ha**

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. Although the area remains under water for about 4 months of the year, natural silt deposition is low as it is protected from the river system by an embankment. The clayey soil (29%, Table 5.2) 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. Some alternative crops, such as khesari (black gram), form a vegetation cover that retains water for longer. But these crops were no longer popular in the area. About 20 years ago these rabi crops were cultivated in the area and the farmers informed that they used to make flour out of black gram and used it to make a kind of bread

to feed themselves. Then the paddy crop was uncertain and was dependent on rainfall and early flooding (mechanical irrigation was not used). Since they started to use irrigation and grow paddy as a mono-crop they have been reluctant to grow these alternative crops. Only in a small area near the river side that is sandy loam had farmers continued to grow other crops.

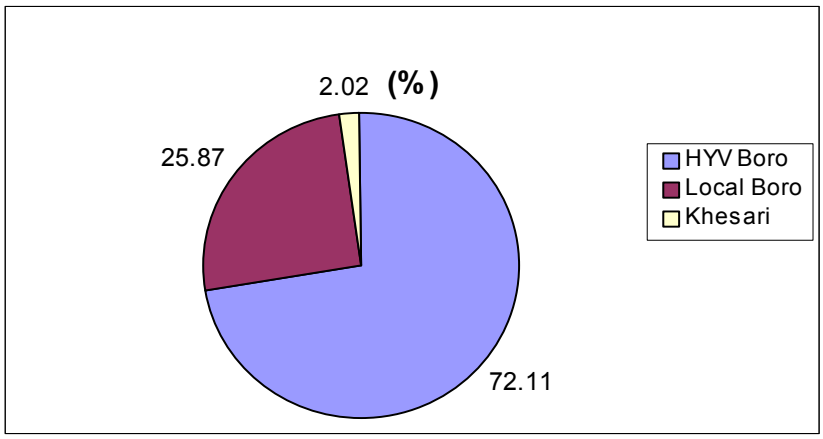
Some farmers had also excavated land to make ditches to trap water and fish and a few big farmers built ponds making bunds around fields (ghers) to cultivate freshwater prawns which is changing the soil characteristics because fertilizer use is different in the ghers.

5.3 Pre-project Cropping Pattern

As noted above, before the sluice gate was in place, people were growing blackgram, chickpea, chilli, vegetables, tobacco and wheat. Sugarcane was also cultivated. Local boro paddy was cultivated in the rabi season. There were 8-10 shallow tubewells (STW) for irrigation. Most of crops were rainfed and late varieties were used to avoid shortage of water. However, the risk of early monsoon flooding restricted crop harvest and drying. Quality of paddy was low as sometimes paddy sprouted due to heat and high moisture content and farmers were unable to dry paddy properly due to lack of space and sunshine in the early monsoon period. Farmers were also using low lift pump (LLP) from the canal and river to irrigate crops during dry season.

During the monsoon, farmers were cultivating mixed aus-aman paddy. These varieties are local variety and were 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 paddy could be harvested. However, the yield of these local varieties was low and the late harvest of aman pushed back rabi crop cultivation. Farmers were also cultivating a little jute but only for domestic use.

After the sluice gate was constructed HYV boro paddy become the predominant crop in the dry season (Fig 5.1), with some local boro and khesari (blackgram). Farmers invested in STWs to irrigate HYV boro paddy which replaced other rabi crops. In the Kharif season, mixed aus-aman cultivation was also reduced due to continuous crop failure. For example, in 2003 86% of aus paddy land experienced crop damage due to flooding.



5.4 Issues, Demonstrations and Awareness Raising for IFM

High irrigation water demand, low soil fertility, lack of quality seeds and high cost of production have stressed farmers and made them think about alternate crops. So when the IFM approach raised the issue of changing crops to reduce water abstraction and protect fish and suggested that alternative rabi crops could be tried, people at the ad hoc IFM committee meeting in 2003 decided to have some demonstration plots on crops that might be suitable and might give a higher return but would needs less or no irrigation water. They also preferred no tillage crop such as blackgram with mustard. Accordingly, technical support was given to the farmers willing to use their plots as demonstrations. The crop demonstrations included sesame, potato, blackgram, and chickpea, and also paddy to compare costs and benefits with highland and lowland rice. The demonstration and cost-benefit calculation from it showed the farmers the ultimate returns from a hectare of land under different crops. During the reflective learning session for the demonstration the farmers calculated possible returns, but after demonstrations were completed and harvested and the cost and return were calculated, it was found that several of the demonstration crops had given better returns than expected with potato yielding a profit much greater than boro paddy and the other crops not far behind paddy and for a lower investment (Table 5.3). During open air theatre this issue was raised and people learned the facts.

Table 5.3: Demonstration plot information for dry season 2004.

Crop	Replication	Area (dec)	Total cost of production (Tk.)	Yield (kg)	Yield (mt/ha)	Total return (Tk.)	Net return (Tk.)	Net return (Tk/ha)	Return (Tk/ha) expected from farmer assessment*
Sesame	1	33	1173	225	1.68	4,200	3,027	22,657	10,703
	2	33	1105	201	1.50	3,745	2,640	19,760	
	3	33	1095	233	1.75	4,354	3,259	24,393	
Potato	1	12	1075	975	20.07	5,000	3,925	80,790	57,788
	2	20	1995	1688	20.84	8,200	6,205	76,632	
	3	15	1235	1200	19.76	5,500	4,265	70,230	
Khesari	1	48	210	225	1.16	2,790	4,790	24,649	17,239
	2	25	100	103	1.02	5,000	2,400	23,712	
	3	26	100	120	1.14	2,500	2,400	22,800	
Motor	1	10	198	47	1.16	2,500	854	21,094	12,865
	2	20	200	103	1.27	2,550	2,350	29,023	
	3	15	152	66	1.08	1,598	1,446	23,811	
Paddy	Low land	24	1500	562	5.79	4,496	2,995	30,827	14,151
	High land	122	7250	2625	5.31	21,000	13,750	27,838	

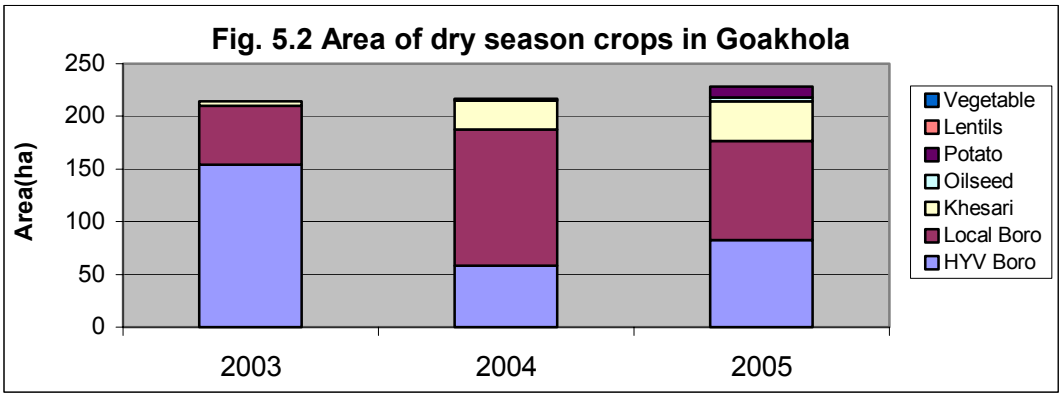
* Participatory assessment of demonstrations by crop, see Chapter 10.

5.5 Changes in Cropping Pattern

5.5.1 Dry season

During the period 2003 to 2005 in the dry season a fraction more land came under cultivation, and was cultivated with rabi crops. In 2004 local boro was cultivated widely (Fig. 5.2) due to the high irrigation cost, but farmers did not get a good enough return. In 2005 dry season farmers sowed equal proportions of land to HYV and local boro. Blackgram is gaining popularity again as a replacement for lentils and mung dal which are more expensive to grow. Mustard was grown before for oil but with the imported soyabean oil in the market mustard oil could not compete and production fell. In 2005 a few farmers started to cultivate mustard as the price of imported oils is becoming higher day by day. The farmers discuss issues in the IFM meeting and they meet other people in the community centre during their

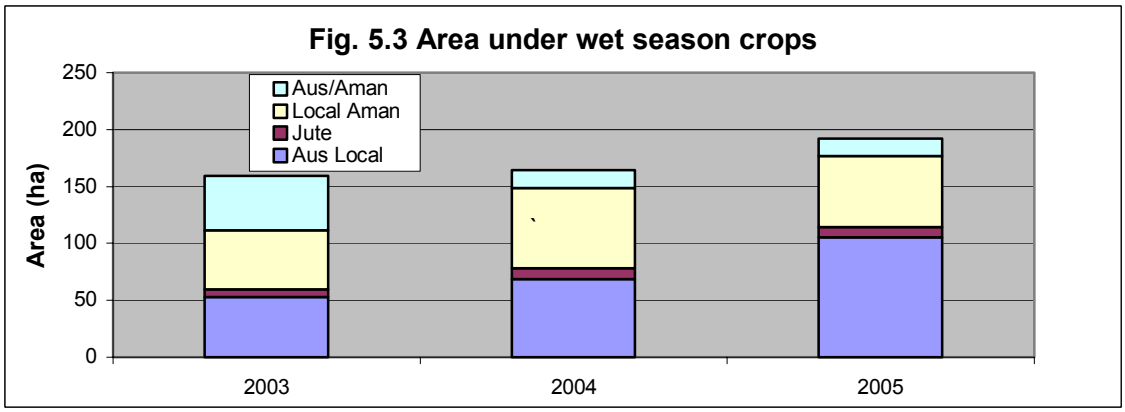
leisure time and then decide their strategies. Some of the farmers have discussed wheat and garlic production which also need less water. But before adopting crops new to the area they would like soil tests, training (from successful farmers from other regions) on cultivating new crops, demonstration plots and quality seeds. The DAE officials agreed to provide some information but will not be able to help them fully due funding limitations.



Some of the rabi crops need very little water and are grown in high land. However, if one farmer cultivates rabi crops that do not require irrigation and on other adjacent plots the farmers grow irrigated HYV paddy, then the rabi crop farmers lose their crop. In recent IFM meetings the participants raised this issue. Synchronous cultivation as well as similar type of cultivation in the adjacent plots in high land is the solution. For this the committee decided it needs to be stronger and confident and needs to have more awareness raising activities in the area. Although each member of Goakhola and Maliate Beel IFM committees decided to motivate and influence five other farmers, it will take some time and facilitation.

5.5.2 Wet season

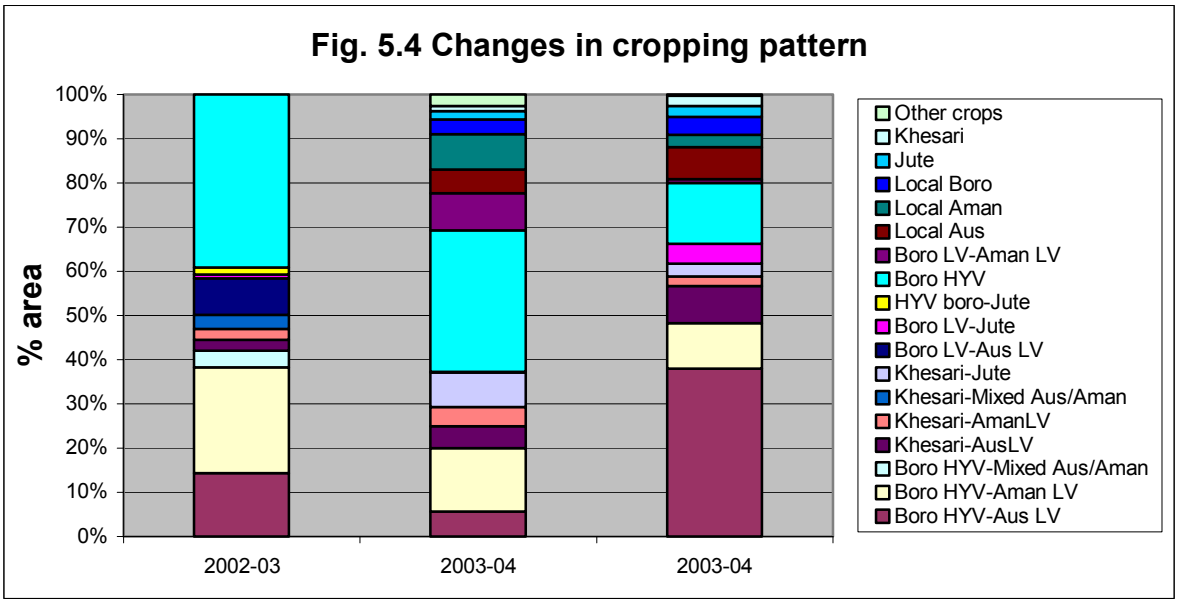
Monsoon season crop cultivation has increased during 2003-2005 (Fig. 5.3). In 2005 after the aus harvest the entire area was full of paddy and more paddy. Roads were used as threshing floors as well as drying yards. Although jute cultivation increased in other areas, the IFM committee has successfully raised awareness among farmers and although some jute was grown whatever amount they cultivated they tried to process using ribbon retting and tried to reduce water pollution from jute retting (see Chapter 6). In 2004-05 the jute price became high but farmers in Goakhola think they will be able to compensate their lost income from not growing jute from the good aus crops plus catching bigger fish this year (2005) as people were not been able to fish in the beel in the early monsoon due to most of the land being under aus paddy.



5.5.3 Overall cropping pattern changes

The major change in cropping pattern after demonstrations, open air theatre and reflective learning sessions was the reduction in boro cultivation (combining local and HYVs), more land switched to growing local aus after HYV boro or after khesari (Fig. 5.4). According to the farmers in the last 20 years, they never were able to harvest aus properly and due to this reason they were reluctant to invest more in cultivating monsoon crops. In 2004 they excavated a small canal and built a flap gate sluice with the support from local community and project people. This has changed the cropping pattern during the monsoon in about 26 ha of land.

Fig. 5.4 Changes in cropping pattern



In 2005 farmers have adopted new short duration paddy for which the project has initiated the idea and helped with the technical assistance and linkages to the DAE. This short duration crop has facilitated growing another early crop such as mustard. Mustard has low input costs and can be cultivated along with other rabi crops. However, cultivation of aman paddy has reduced drastically in the three years. The reason that the farmers mentioned is that aman needs almost six months to grow and do not have enough time to cultivate boro paddy after aman. Instead an aus paddy variety, “ratul, that is resistant to high water levels and has a good yield has been adopted.

5.6 Returns from Main Crops

The census surveys undertaken each year not only covered the crops grown in each plot but also the production estimated by the farmers. Table 5.4 shows that the expected total paddy production including estimated production of aman paddy plus reported actual production of aus paddy should achieve close to the 2003 level after falling by 11% in 2004. 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 (Table 5.5). 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. 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 than in 2004 when they were largely grown on demonstration

plots with IFM support. This suggests that there are good prospects for continued expansion of their area.

Table 5.4 Total crop production (mt) from Goakhola-Hatiara Beel

Crop	2003	2004	2005
Dry season			
HYV Boro	901.1	220.2	476.5
Local Boro	269.5	633.8	423.1
Khesari	2.4	28.9	41.4
Other pulses		0.2	0.3
Oilseeds		0.9	1.0
Potato		12.8	16.8
Vegetable			13.3
Total paddy	**1170.6**	**854.0**	**899.7**
Monsoon			
Aus Local	169.9	220.8	338.5
Jute	20.9	29.1	28.6
Local Aman	145.1	197.4	174.3
HYV Aman	0.0		62.5
Mixed Aus-Aman	96.2	130.3	14.2
Total paddy	**411.1**	**548.5**	**589.5**
Total paddy	**1581.7**	**1402.4**	**1489.2**

Table 5.5 Crop yields (mt/ha) in Goakhola-Hatiara Beel

Crop	2003	2004	2005
HYV Boro	6.25	3.96	5.76
Local Boro	4.49	5.13	5.72
Khesari	1.25	1.29	1.88
Other pulses		0.6	0.34
Oilseeds		1.55	0.54
Potato		12.96	16.21
Vegetables		16.05	10.03
Local Aus	1.85	2.74	2.43
Jute	1.41	2.5	2.54
Local Aman	0.87	2.73	2.63
Mixed Aus-Aman	0.74	2.61	2.61

Changes in reported gross returns (value of crop) per hectare (Table 5.6) reflect the yield increases and also increasing prices for crops during the project period. This indicates that actual cash returns from boro paddy have more than doubled on average in three years. It also indicates that despite the reports and assessment from the demonstration farmers (Chapter 10), that boro is still profitable (although the sample farmers had not grown potato vegetables appear to give as good a return as boro).

Table 5.6 Total return from the sample household's crop cultivation (Tk/ha).

Crop	2003	2004	2005
HYV Boro	34,056	21,883	53,888
Local Boro	21,287	29,466	74,692
Khesari	15,674	25,533	28,748
Other pulses		25,556	13,413
Oilseeds		15,792	18,748
Potato		36,697	
Vegetables		.	70,341
Local Aus	13,626	16,594	25,538
Jute	13,953	15,558	40,828
Local Aman	7,791	12,050	23,028
Mixed Aus-Aman	7,829	21,123	20,570

5.7 Water Use in Dry Season

Since 2003 dry season water use has reduced due to reduced boro cultivation. Integrated floodplain management options such as alternate crop cultivation as well as dry season water conservation for fish in the canal attracted farmers who have to pay 25% of their irrigated paddy crop production to the shallow machine owners. The irrigation pumps run by diesel, the price of which increased and hence the cost of irrigation increased. Especially the share croppers and small farmers are highly affected by this system and they are switching to other less water demanding crops.

From 2003 the CBFM-2 project withdrew payment provision for renting kuas (ditches) as fish sanctuaries. The community then declared the canal as a fish sanctuary. All the LLPs are set in the canal for water abstraction. However, the farmers using LLPs were then approached by the IFM committee and asked to reduce their abstraction time. These LLPs need more diesel as these are quite big (12 HP), but abstract less water than STWs. The farmers complained that they cannot wet their land even from operating pumps for a reasonable time. They reduced the more powerful machine last year.

Some shallow tubewells become inactive due to lowered water level and reduced water demand by the farmers (Table 5.7). One less LLP is also used as part of the canal is now protected as a fish sanctuary. In the dry season most of the plots become very dry as the soil type is clayey and it needs more water for irrigation. In the area there are no pucca channels for irrigation. Water spillage and conveyance loss is high. Overall, farmers think that reduced water abstraction has increased the water level in the khal and in kuas (see Section 11.2).

Table 5.7 Number of irrigation machines used in Goakhola-Hatiara Beel.

	Irrigation equipment	2003	2004	2005
	LLP	5	4	4
Number	STW	101	98	91
	LLP	5.5	9.6	4.4
	STW	201.1	200.3	156.8
Area irrigated (ha)	Total	206.6	209.3	161.2

Table 5.8 shows the area of different crops irrigated by different irrigation equipments. Very little or no land was left without irrigation in the dry season in 2003 and 2004. Farmers reported that more rabi crops without irrigation were cultivated in 2005 (20% of the cultivated land area compared with none in 2003).

Table 5.8 Area (ha) of dry season crops irrigated by source of irrigation

Crop	Irrigation source	2003	2004	2005
HYV Boro	STW	135.20	53.57	78.39
	LLP	9.07	1.20	0.00
	Traditional (Swing basket etc)	0.00	0.77	0.30
	No irrigation	0.00	0.00	4.03
Local Boro	STW	57.37	116.95	69.60
	LLP	1.42	5.24	2.36
	Traditional (Swing basket etc)	1.28	1.43	0.02
	No irrigation	0.00	0.00	1.96
Potato	STW	0.23	0.41	5.53
	LLP	0.00	0.13	0.00
	Traditional (Swing basket etc)	0.00	0.18	3.32
	No irrigation	0.00	0.00	1.47
Other crops	STW	0.00	0.00	0.41
	LLP	0.00	0.00	0.00
	Traditional (Swing basket etc)	0.00	0.00	0.02
	No irrigation	0.00	26.74	41.87
Total land cultivated		**204.56**	**204.56**	**206.63**

Consequently the estimated total water abstracted to irrigate boro and rabi crops was 11% less in 2005 than in 2003 (Table 5.9). 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 has benefited farmers as well as it is expected to benefit fishers.

Table 5.9 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 in Table 5.8.

CHAPTER 6: JUTE RETTING AND WATER QUALITY

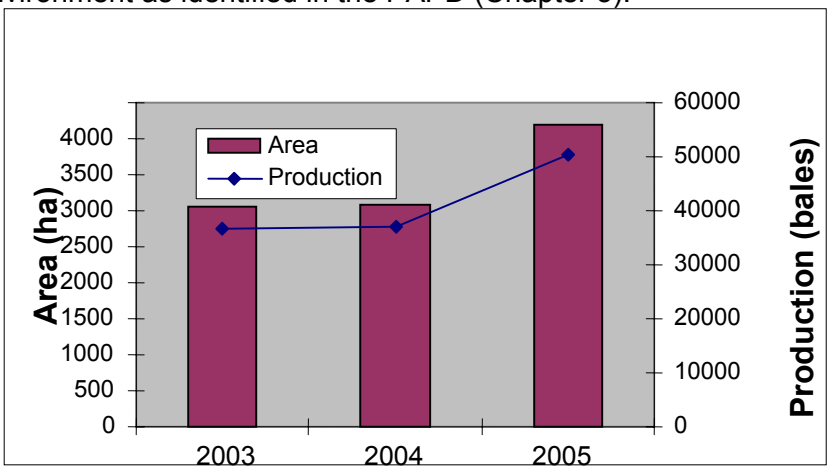
Jute retting in Chitra River near Goakhola Beel, August 2005

6.1 Introduction

Jute (*Corchorus olitorius* and *C. capsularis*) is an annual herbaceous plant mainly cultivated in South and Southeast Asia. The word “jute” is commonly used to refer to the name of both the plants and the fibres obtained from the bark of these plants. Traditionally jute is used for ropes, twine, indigenous cloth and handicrafts. In certain parts of Bangladesh and India, jute leaves and roots are also used respectively as a vegetable and a medicine. Jute cultivation involves, sowing, weeding/thinning, harvesting, defoliation, retting (decomposition of non-fibrous matter from the jute stems by aquatic microbes), fibre extraction, washing and drying. The process of jute retting, fibre extraction and washing has drawn some concerns regarding water quality, aquatic environment and human health hazards.

Jute used to be called the golden fibre of Bengal. In the past jute fibre brought a huge amount of foreign exchange, but with the advent of the plastic era, the economic value of jute decreased. Plastic ropes are a lot more durable and strong. On the other hand plastics do not degrade easily and have been seen as an environmental problem, whereas natural fibres eventually decompose. Moreover, jute not only provides fibre but also provides jute sticks which are an important fuel for cooking purposes, and are used for construction. Some people believe that jute leaves, when rotten, become a nitrogenous fertilizer. Jute retting in the nearby flowing river or canal was a common practice. Farmers believe that the colour of the fibre depends on the quality of water. In the flowing river fibre colour becomes bright golden, whereas in ponds or floodplain it is dull blackish.

Jute is particularly grown in the south-western districts of Bangladesh. With the diversion of water due to the Farraka barrage, normal dry season flow of water in the nearby rivers and canals decreased. People have now started to rot jute in more enclosed waters (beels) which pollutes water and turns the water colour black. It is claimed that this water contains more carbon dioxide which causes death of many fish. Jute was once sold at a high price as there were jute mills in the area. After several mills closed, the fibre business went down. But farmers were still interested to grow jute for the sticks and for fibre for their own consumption and if they had an excess they could make some money. The jute price was low for the last few years. But the Bangladesh government banned use of polythene bags which raised the demand for jute for fibre bags, and in 2004 the jute price tripled compared with a few years earlier, and the farmers again started to grow more jute. Jute production the project area is shown in Fig. 6.1. However, retting jute has become a big problem and hazard for the environment as identified in the PAPD (Chapter 3).



6.2 Agricultural Practices and Implications for Water Quality

Farmers in the project area cultivate High Yielding Varieties of paddy, but use very little pesticide as they are aware of the potential harm for fish and have followed integrated pest management (IPM) from 2003. As they have both the fish sanctuary and freshwater prawn ponds in the fields, the farmers do not want to use pesticide.

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 in the area. 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 water enters into the beel and pollutes the beel water. In 2004 in July-August there was more water in the beel than in 2005 due to high rainfall and water pollution was less.

6.3 Jute - Alternatives and Extension Effort

In the 2004 monsoon through the IFM project some farmers were influenced to cultivate *dhaincha* or sesbania (*Sesbania canabina*) instead of jute and the demonstration plots were shown to other farmers. Sesbenia is a leguminous crop that fixes nitrogen in the soil, works as green manure and provides sticks which can be used for fuel wood (home use or sale), but it does not produce any fibre. Farmers complained that it is difficult to get seeds and the plant has no use except as fuel. However, the demonstration plot owners said that they had sold the sticks to betel vine farmers at a high price as sesbania sticks are very strong and durable.

33 dec land? Tk. 3,900. How much do they make from the same plot? Tk. 6,500. Is it not profitable?

The second effort under the IFM project to address the problem of jute retting, was to try 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 stick before placing under water. The process needs a smaller space for retting a bigger volume of jute fibre. Four training sessions were run in two jute growing seasons (2004 and 2005) with about 200 jute farmers. Six metal fibre separators were manufactured locally at a low cost and were given to the IFM committee. Farmers in rotation used the technique. About 25% of the farmers including women farmers tried the technique. Staff from the Department of Agricultural Extension and Jute Department provided technical support and are willing to help the farmers further in future.

6.4 Uptake Experience

All the participants in a feedback session opined that the alternative jute retting process is easier, fibre was strong and bright coloured and finally the price was about 25% more than the traditionally retted jute fibre. The female participant farmer said that she spent a bit more time for separating fibres initially but the middlemen offered to give a higher price for both fibre and sticks when processing finished. All the farmers opined that the stick is very strong. Women said that when used as fuel wood it did not burn instantly like the traditionally retted jute sticks as these sticks were not rotten. All the farmers will try the technique next year with a larger volume of jute. Some farmers from other areas also reported interest in using the technique now and in future.

6.5 Water Quality Results

As noted in Chapter 2, to determine if the levels of jute retting in the open water fisheries in Goakhola Beel and in comparable beel and river sites were sufficient to case the known loss of dissolved oxygen and poor quality of water for fish, samples were taken in August and September 2005.

Results of the study showed that pH levels of different locations were within the limit of national water quality standard and suitable for fish (Table 6.1). Dissolved oxygen (DO) levels were much lower than national standard limit except for Goakhola Beel. DO plays a vital role for survival of aquatic plants and animals as it is essential for their respiration. If any material is added in water which uses oxygen will interfere with natural growth of the aquatic organism. At least 5-6 mg/L of DO is essential for fish to survive (BCAS, 1999). In the samples from sites with jute retting on 19 August 2005 except for Sholuar Khal, DO level was much lower than the above limit. Two weeks later on 2 September more than 3 weeks after the peak of jute retting, DO was returning to acceptable levels – for example in Goakhola Beel.

Table 6.1 Water quality tests in Narail in 2005

	Sample No.	19/8/05				2/9/05			
		pH	Dissolved mg/l	Conduc it	Temperatur e (^{0}C)	pH	Dissolved mg/l	Conductivit	Temperatur e (^{0}C)
Sholuar Beel	1	7.6	3	661	31	8	6	348	31
	2	7.7	3	662	31	7.9	6	347	31
	3	7.6	3	661	31	7.9	6	349	31
Sholuar Khal	1	7.3	5	348	30	7.9	4	316	32
	2	7.4	5	340	30	7.9	4	322	32
	3	7.3	6	351	30	7.8	4	317	32
Closed water - Sholuar	1	7.7	3	401	31	7.4	2	729	32
	2	7.7	3	364	31	7.4	2	730	32
	3	7.6	3	368	31	7.5	3	731	32
Chitra river	1	7.4	3	367	31	7.9	4	358	32
	2	7.4	3	370	30	7.8	4	359	32
	3	7.4	3	373	30	7.9	4	354	32
Chitra Sanctuary	1	7.2	1	336	31				
	2	7.1	1	343	31				
	3	7.2	1	340	31				
Afra River	1	7.7	3	396	31	7.8	4	359	32
	2	7.7	3	365	31	7.8	4	367	32
	3	7.7	3	398	31	7.8	4	357	32
Goakhola Beel	1	7.1	3	477	31	7.0	5	343	32
	2	7.3	2	478	31	7.1	7	344	32
	3	7.2	2	486	31	7.1	8	346	32
Goakhola closed water with jute retting	1	6.8	1	673	31	7.5	3	550	32
	2	6.8	0.8	670	31	7.5	2	540	32
	3	6.9	0.8	669	31	7.4	2	548	32

National water quality standards: pH 6.5-8.5, DO $\geq$6.

BOD level was also higher in Sholua and Chitra than the national maximum acceptable level (Table 6.2). BOD level could not be assessed for other open water locations as no samples were collected and resources for the analysis in Table 6.2 were limited. Low DO and high BOD level are indications of pollution. It is clear that all the locations of the study area had water in August that would make survival of fish difficult. The water quality was much poorer in closed or stagnant water with jute retting than in open water bodies.

Table 6.2 Water quality test results for two samples from Shuluar and Chitra Rver 2 Sept 05.

Sl.No	Water Quality Parameter	Unit	National standard	Concentration present	
				Sample-1 (Shuluar)	Sample-2 hitra)
1	Nitrate-Nitrogen, NO_3-N as N	mg/l	<10	0.30	0.20
2	Total hardness as $CaCO_3$	mg/l		110	114
3	Biochemical Oxygen Demand (BOD_5)	mg/l	<2	22.0	40.0
4	Chemical Oxygen Demand, COD ($K_2Cr_2O_7$)	mg/l	400*	60.0	102.0
5	Sulphide, S^{-2}	mg/l	2*	0.017	0.015

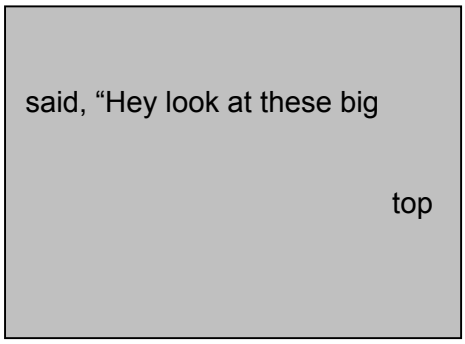
** for wastewater*

Water tests conducted by BUET

Jute retting in both open and stagnant water is responsible for this situation. Usually when stems of jute are put in water for retting, two stages of changes are observed. In the first stage, the organic matter in the green plants is dissolved and it produces plenty of nutrients for the growth of microbes. In second stage, the microbes start using up the DO of the water. As a result, the BOD level increases (Haque et al. 2002).

6.6 Experiment on Role of Snails in Water Quality

During the reflective learning session it was learned that when people were rowing boats 10 years back in the beel boats were making crackling sound from bashing freshwater snails (*Pila globosa*) in the water. The participants said at that time water was clean, people could use water for bathing, washing and even for drinking purposes. With the increase in freshwater prawn cultivation in the area demand for snail as feed increased several times. People are selling snail flesh at Tk 14 per kg. Someone in almost every household is collecting snails. Now during the monsoon people cannot step in the water due to bad smell and dirty appearance. People said that people coming in contact with this water start to itch and have skin diseases.



To test whether indigenous knowledge that snails helped to maintain better quality water, an experiment was conducted using a set of identical round earthenware water troughs of approximately 21 litre capacity. These were sited in a shelter close to Goakhola Beel and members of the IFM participant community helped to maintain records and to aerate them occasionally by hand (same for all troughs). Four treatments were used: water on its own, water with snails, snails and fish together, and fish with no snails. The water came from Goakhola Khal where there had been some jute retting and at the start of the experiment had DO below the level required for fish and more or less representative of water with some jute retting. The fish used were small jat puti *Puntius sophore* the most common species in the beel. The experiment showed that snails can clean water and help to increase dissolved oxygen in the water – with and without fish. The water with snails was habitable for fish after two weeks but was hardly changed where there were only fish or where there were no snails or fish (Table 6.3). When fish and snails were released in the khal water from jute retting it was observed that 55% of the fish survived over a period of two weeks. However, almost all the fish (94%) released in the same water with no snails present died within a week (Table 6.4). The density of snails in the field has not been measured, but all beels in the area are affected by snail collection, it seems likely that the combination of loss of snails and increasing jute cultivation are adversely affecting the fishery during the IFM period.

Table 6.3 Water quality in experimental troughs with and without snails and fish.

Treatment	Replicate					2/9/05			
		pH	Dissolved en mg/l	ty (mmho)	re (^{0}C)		Dissolved en mg/l	ty (mmho)	erature (^{0}C)
No snails or fish	1	7.8	2	477	32	7.6	2	472	31
	2	7.8	1	478	32	7.7	2	475	31
	3	7.7	2	476	32	7.6	2	473	31
Snail only	1	7.8	2	477	32	7.4	7	515	31
	2	7.8	1	478	32	7.2	8	482	31
	3	7.7	2	476	32	7.3	9	490	31
	4	7.8	2	477	32	7.2	7	471	30
	5	7.8	1	478	32	7.3	7	630	30
	6	7.7	2	476	32	7.4	9	518	30
Snail + fish	1	7.8	2	477	32	7.2	7	547	30
	2	7.8	1	478	32	7.5	8	586	30
	3	7.7	2	476	32	7.2	9	546	30
Fish only	1	7.8	2	477	32	7.4	3	537	30
	2	7.8	1	478	32	7.4	2	531	30
	3	7.7	2	476	32	7.5	3	496	30

Table 6.4 Survival of fish and snails in different experimental troughs.

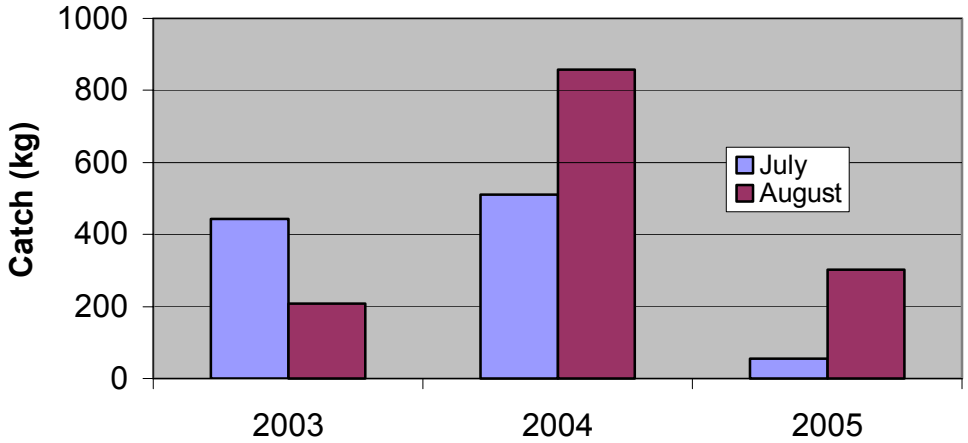
Replication	Snail		Snail –Fish		Fish	
	Introduced	Died	Introduced	Died	Introduced	Died
1	20	1	Snail (20)- Fish (30)	6 snail 15 fish	30	30
2	20	2	Snail (20 Fish (30)	4 snail 12 fish	30	29
3	20	1	Snail (20) Fish (30)	4 snail 13 fish	30	26
4	20	0				
5	20	0				
6	20	0				

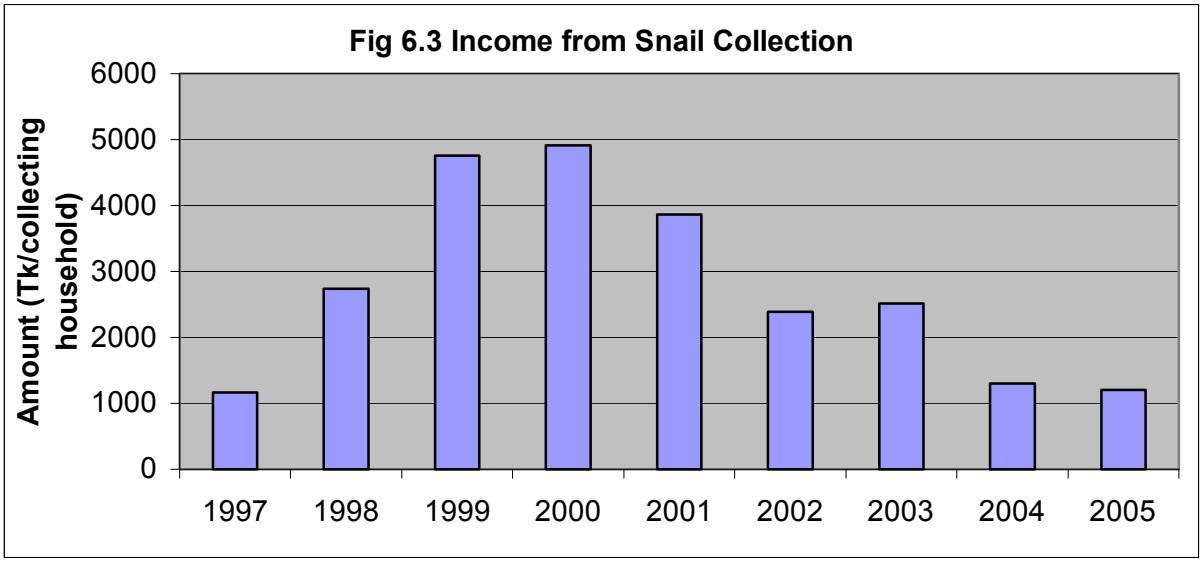
6.7 Environmental Change and Aquatic Resources

In 2005 during the jute retting months (July-August), fish catch in Goakhola decreased tremendously compared with the previous years (Fig. 6.2). People opined that due to polluted water in the connecting river fish did not enter into the khal and beel. Moreover, due to increased area under Aus paddy cultivation, people have not been able to enter the fields and catch fish. Even they were not able to use any big nets/gears in the field. Income per household from snail collection decreased in recent years (Fig. 6.3). Women who collect snails told that they are not getting much snails from the beel now and have to move to collect snails from distant beels. This is risky for them as residents of communities around other beels do not allow outsiders to collect snails from their beels. Sometimes these women are mishandled during outside snail collection.

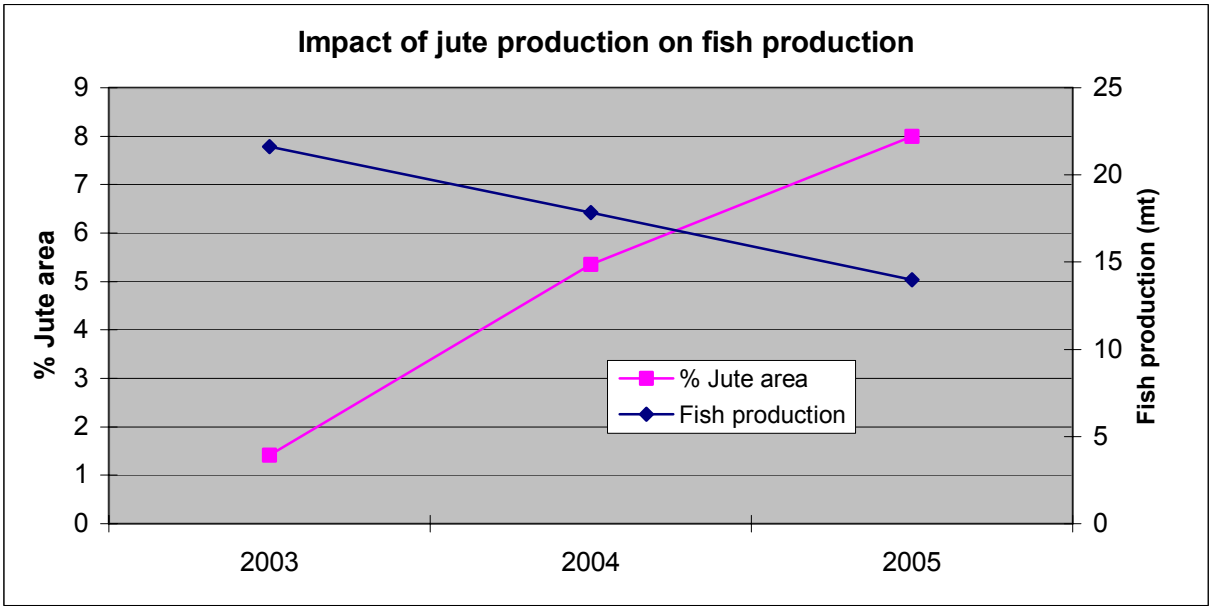
Farmers reported that due to high production of Aus rice, water lilies did not grow so much this year. Those who are earning an income from selling aquatic plants lost their livelihood from this resource. Although fish catch decreased with the increase in Aus and jute cultivation and production it is not clear whether this is due to jute retting or not, how it is affected by loss of snails, or whether the fish catch will compensate in the late monsoon.

Fig 6.2: Fish catch during jute retting months in Goakhola Hatiara Beel.





Note: income is average for those households collecting snails



Note: 2005 is predicted fish catch based on total catch up to August and trend in past years.

CHAPTER 7: FISHING EFFORT CONTROL

Members of Maliate BMC maintaining their fish sanctuary

7.1 The Fishery

As all the land is private, farmers dominate in the area and as this is a floodplain and the community is a Hindu farming community, the number of professional fishers is very negligible. Access to aquatic resources during the monsoon is free for all from the surrounding villages owning land in the beel. Anyone can fish anywhere in the monsoon, but in the post monsoon period nobody is allowed to fish near the private kuas. In the nearby Bhairab River high competition for fishing exists and the Hindu community do not feel comfortable fishing there throughout the year. Therefore, poor including landless poor do not depend always on fishing.

Both men and women fish mainly for home consumption. All households in the area catch fish at some time in the year. Notably women fish in 97% of NGO participant households and in 68% of other households. The main gears used are gill nets, traps including fences with 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* is common (low bamboo fences with fish traps set with the landowner's permission).

Previously the khal was leased out for fishing. The last leaseholder was a local man who paid Tk 7,000 to the district administration in 1993/94. He reported that his main benefit was from using three *behindi jal* (set bag nets) in the khal that on some nights in the monsoon could catch up to 500-600 kg of shrimp.

7.2 Fishery Management Interventions

The following fishing rules and management actions have been observed in Goakhola-Hatiara Beel.

7.2.1 Fish sanctuaries

From the dry season in 1997-98 to the dry season of 2001-2002 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 average kua is about 7.8 decimals in area, indicating a total sanctuary area of about 0.39 acres (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 not more than about 1-1.5 ha.

In the 2004-2005 dry season the BMC excavated some plots that were bought by CBFM-2 project to create permanent sanctuary kuas, but these will not have any impact on fish catches until 2006 since they were dry for excavation in the dry season of 2004-2005.

7.2.2 Closed season

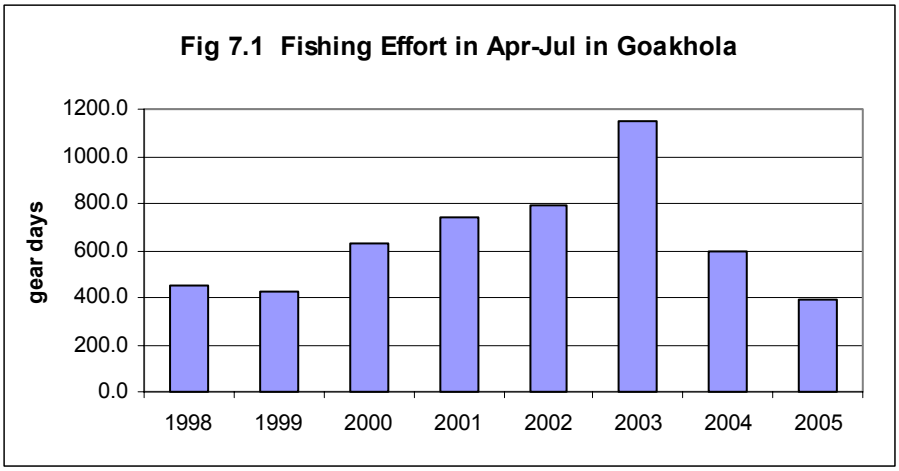
Each year from 1998 the first three months of the Bangla year (Baishak, Jaistha and Ashar) - mid April to mid-July have been declared by the BMC as a closed season with no fishing permitted in the beel or khal. This has not been changed under IFM activities. However, fishing is not allowed by the landowners in flooded fields that contain aus paddy (early monsoon) and in 2005 the area cultivated with aus increased and also there was more jute grown (Chapter 5), this meant that only fishing with traps was possible for most of July and August – effectively extending the closed season.

7.2.3 Other fishing norms

Kua owners are a sub-category of landowning stakeholder who have a direct linkage with exploiting the fishery and an interest in conservation. During the IFM project support and discussions, the issue of dewatering kuas for harvesting and number of times they are fished out was raised. Kuas are 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. This was a voluntary good practice that they would not dewater or harvest more than once that was promoted in 2004 and 2005.

7.3 Compliance – Fishing Effort and Gear Use

Fisheries data was recorded by western months, but comparing the estimated effort as gear days for April through to July (four months) in each year shows that up to the start of the IFM project activities (in the field in July 2003), effort was gradually increasing in this period despite the BMC and community in theory having adopted a closed season. In 2004 and 2005 fishing effort dropped in this period indicting better compliance with the ban (and the effect noted above of the increase in aus paddy cultivation in 2005).



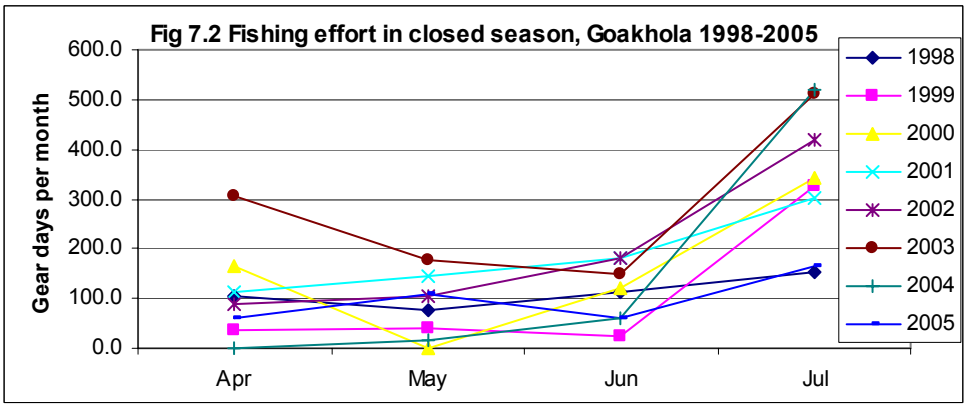
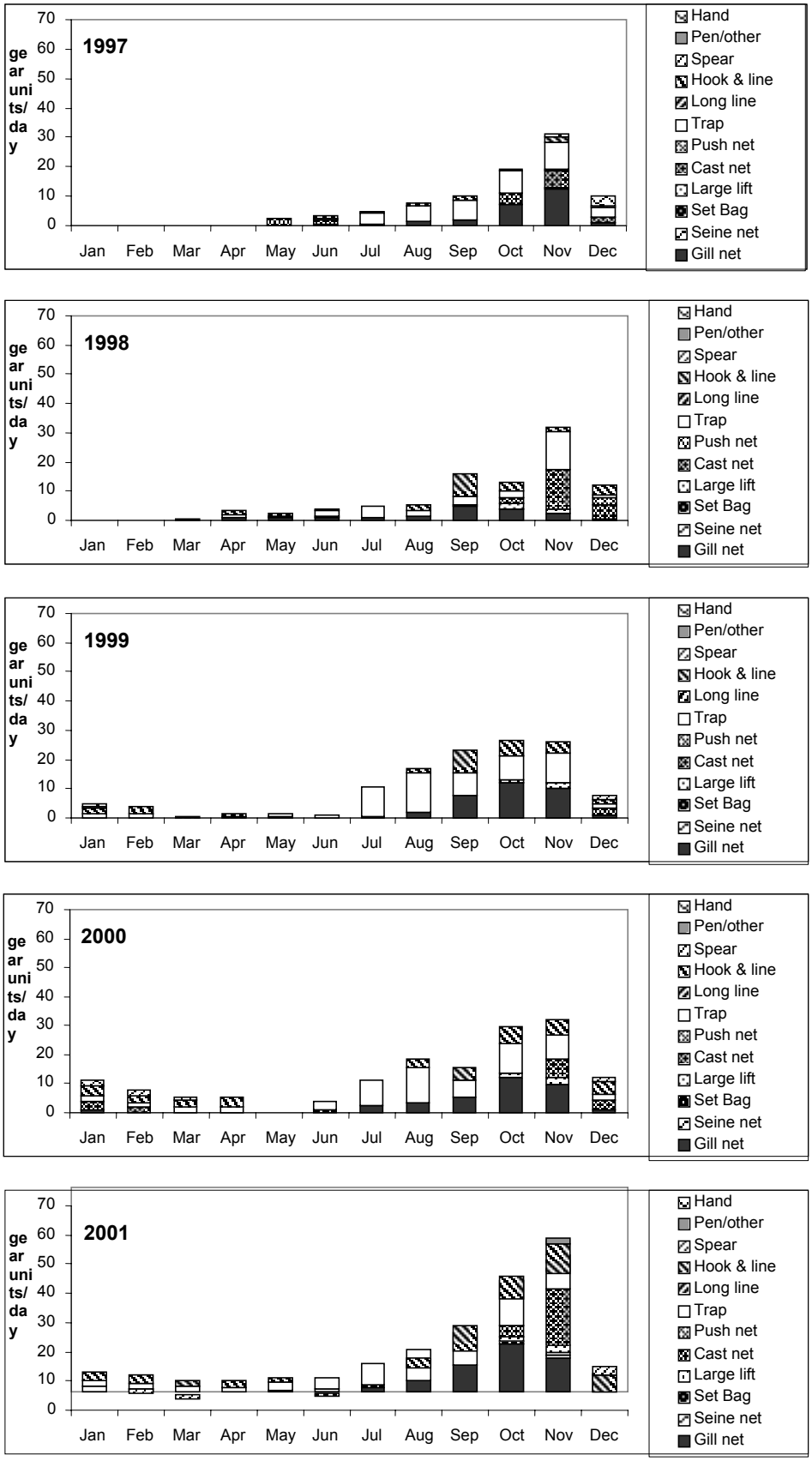


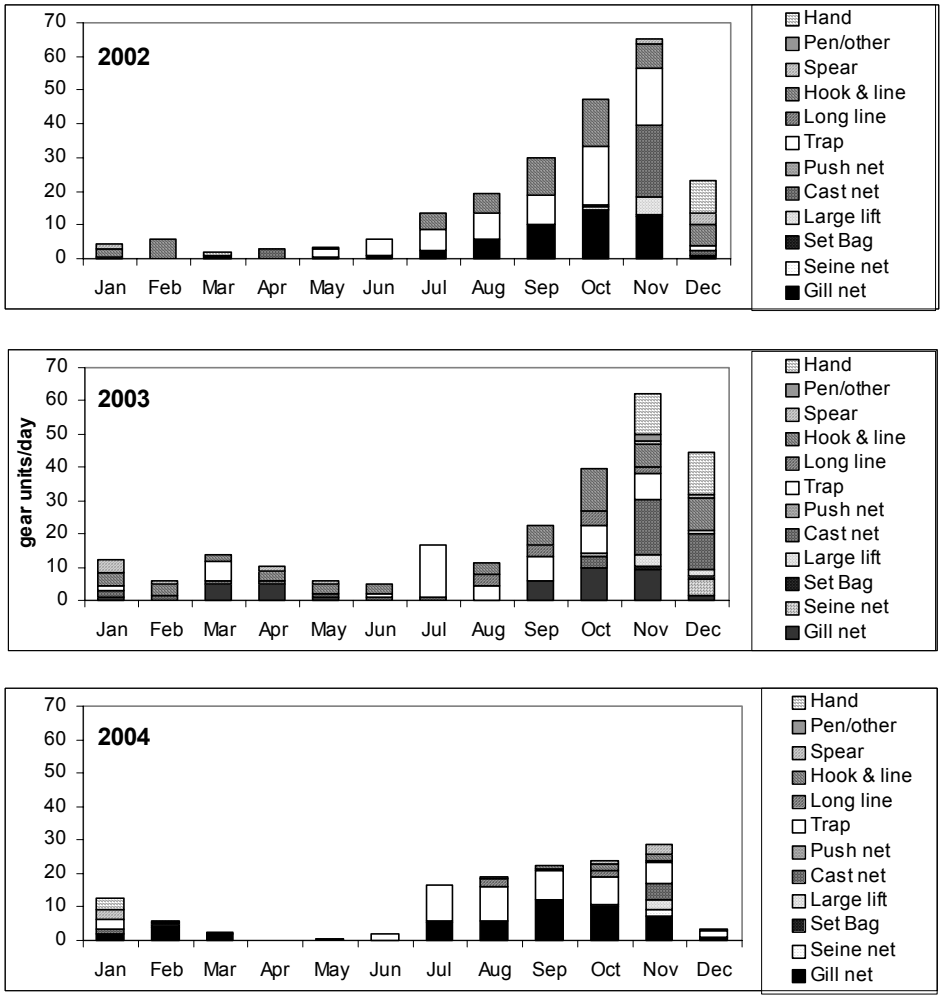
Fig 7.2 confirms that in the core two months of the ban period – May and June – fishing effort has generally been very low, but quickly rose during July in all but 1998 and 2005. Over the whole year traps and gill nets are the main gears used followed in some years by cast nets when there is more open water such as 2001 (Fig. 7.3).

Fig 7.3 Fishing effort in Goakhola-Hatiara Beel under CBFM 1997-2001.



As can be seen in Figs. 7.3 and 7.4 fishing effort reached very high levels in the post monsoon (October-November) in 2001 to 2003 driven by extensive use of cast nets and in 2003 fishing by hand as water drained out of the beel during these months. In 2004 fishing effort was much reduced in the monsoon and post-monsoon, returning to the level of the late 1990s.

Fig 7.4 Fishing effort in Goakhola-Hatiara Beel under CBFM and with IFM activities 2002-2004.



7.4 Total Fish Catches

From the catch monitoring surveys seven complete years of data are available. This indicates a total estimated fishing effort and fish catch in 2004 that was similar to that in 2000, but much lower than the unusually high catches reported in 2001 and 2001 when catch rates were high especially from lift nets in the Goakhola khal.

Table 7.1 Fish catch and effort (excluding kuas) from Goakhola-Hatiara Beel.

Year	Catch (kg)	Effort (gear days)	CPUE (kg/unit day)
1998	11,074	2,852	3.88
1999	9,102	3,743	2.43
2000	12,822	4,667	2.75
2001	36,969	6,395	5.78
2002	26,082	6,812	3.83
2003	19,493	7,723	2.52
2004	12,501	4,188	2.98

A major part of the fish catch, usually about a quarter of the total catch, comes from the many kuas in the floodplain of Goakhola (and also in Maliate) Beel. Before the introduction of IFM kua catches fluctuated around 50 kg per kua (water area of just over 7 decimals)(Table 7.2). Kua catches increased in 2002 in line with the increase in fish population and catches experienced from 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 7.3).

Table 7.2. Fish catch and returns from kuas in 1997-2002 in Goakhola-Hatiara Beel.

	1997	1998	2000	2001	2002
Number of kuas in the area	86	86	87	91	91
Mean area of kua (decimals)	7.9	7.9	7.3	7.6	7.6
Total area of kuas (ha)	2.75	2.75	2.57	2.80	2.80
Mean (per kua)					
Catch (kg)	51.4	40.8	59.0	45.5	71.0
Gross catch value (Tk)	2,091	1,936	2,310	1,992	2,730
Net income (Tk)	1,766	1,630	2,153	1,837	2,239
Totals					
Catch (kg)	4,418	3,506	5,016	3,597	5,820
Gross catch value (Tk)	179,860	166,458	198,700	167,288	232,015
Net income (Tk)	151,912	140,162	182,974	154,281	190,324

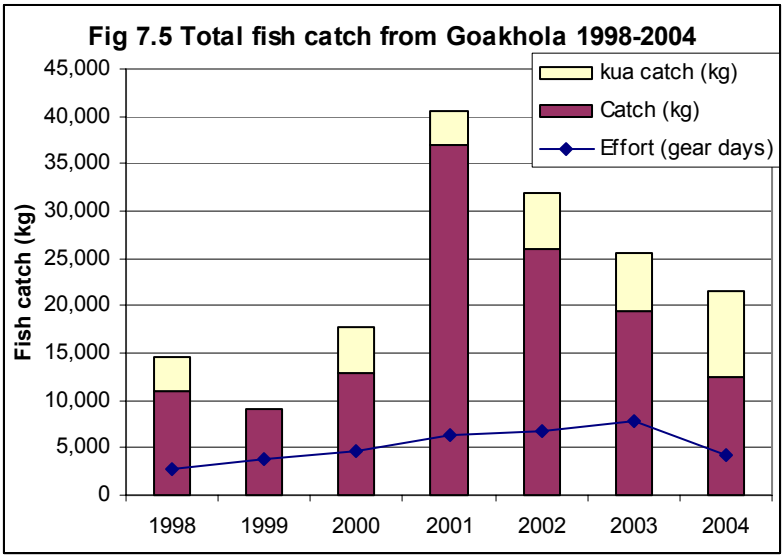
Source: kua census.

1999 data not collected

Table 7.3 Fish catch and returns from kuas in 2003-2005.

		Goakhola-Hatiara			Maliate	
		2003	2004	2005	2004	2005
Number of kuas in the area		91	91	91	42	42
Mean area of kua (decimals)		7.78	7.93	7.98	6.30	8.00
Total area of kuas (ha)		2.87	2.92	2.94	1.07	1.36
Number of times harvested	0	4	4	8	2	6
	1	70	63	72	29	35
	2	14	22	11	11	1
	3	3	2	0		0
Mean (per kua)						
Catch (kg)		67	100	73	74	64
Gross catch value (Tk)		3,190	3,669	3,143	3,440	3,088
Net income (Tk)		2,825	3,381	2,846	3,184	2,793
Totals						
Catch (kg)		6,097	9,100	6,643	3,108	2,688
Gross catch value (Tk)		290,290	333,879	286,013	144,480	129,696
Net income (Tk)		257,075	307,671	258,986	133,728	117,306

Consequently the total estimated fish catch from the beel remained above 20,000 kg in 2004 (Fig. 7.5), but the kua owners enjoyed a relatively greater share of the catch (42%). This trend may be set to continue 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 (aus and jute) 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. Comparing with Shuluar Beel (a similar seasonal beel in Narail Upazila and also under CBFM-2 project) suggests that the change in fishing in 2005 monsoon was due to local factors (only traps being used because of crops in the fields), but also indicated that in 2004 there was more intense fishing in both beels than in 2003, this trend continued with high catches in the 2005 monsoon in Shuluar where there was more open water. In theory this should be compensated in Goakhola later in 2005 when fish have grown to a larger size.



Note kua data missing for 1999

Table 7.4 Fishing effort, catch and CPUE in Goakhola and Solua Beels in July-August 2003-2005

Beel	Gear	2003			2004			2005		
		Effort (gear days)	Catch (kg)	CPUE (kg/ gear day)	Effort (gear days)	Catch (kg)	CPUE (kg/ gear day)	Effort (gear days)	Catch (kg)	CPUE (kg/ gear day)
Goakhola	Gill net	0	0		348	327	0.9	31	25	0.8
	Seine net	0	0		16	64	4.1	0	0	
	Large lift	0	0		0	0		0	0	
	Cast net	31	37	1.2	0	0		0	0	
	Trap	620	478	0.8	659	757	1.1	452	317	0.7
	Long line	98	88	0.9	70	75	1.1	31	16	0.5
	Hook & line	109	48	0.4	8	8	1.0	0	0	
	Total	**858**	**651**	**0.8**	**1100**	**1231**	**1.1**	**514**	**357**	**0.7**
	% of 2003				**128**	**189**		**60**	**55**	
Solua	Gill net	217	201	0.9	134	118	0.9	93	163	1.8
	Large lift	31	24	0.8	93	64	0.7	31	102	3.3
	Cast net	0	0		47	29	0.6	145	263	1.8
	Trap	202	136	0.7	362	291	0.8	217	421	1.9
	Hook & line	31	38	1.2	0	0		0	0	
	Spear	0	0		155	297	1.9	0	0	
	Total	**481**	**400**	**0.8**	**791**	**799**	**1.0**	**486**	**949**	**2.0**
	% of 2003				**164**	**200**		**100**	**237**	

7.5 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) used in this chapter so far, and from household monitoring of fish consumption done by the same local women monitors throughout the period. This does not chow any clear pattern for Goakhola Hatiara Beel – annual species diversity probably does not differ greatly, but the species recorded have varied between years. Although in 2004 a record number of species were recorded from catch monitoring, the trend for more species in that year was repeated in the other two beels (Table 7.5). 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 7.5 Fish species count by waterbody by year.

Waterbody	Year	Species recorded from catch monitoring	Species recorded from consumption monitoring	Local wild species from consumption monitoring	Wild species only recorded in this year
Goakhola-Hatiara*	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
Maliate Beel	2002***	na	38		
	2003	21	32		
	2004	36	32		
Shuluar Beel	2002****	23	44		
	2003	36	41		
	2004	47	43		

* *The size of the sample of households monitored for their fish consumption changed to xx households from 2002, in previous years it was 60 households*
** *data from consumption monitoring is from last 4 months of year only*
*** *data from consumption monitoring is from last 6 months of year only*
**** *data from consumption monitoring is from last 5 months of year only*

About 30% of the total catch is of one small fish – jatputi (Table 7.6), followed by a snakehead (taki) and climbing perch (koi). Many species have fluctuated as a proportion of catch, but two have been restored/returned to the area – meni and pabda although to some extent this happened before IFM was introduced, they are reported to be present in 2005.

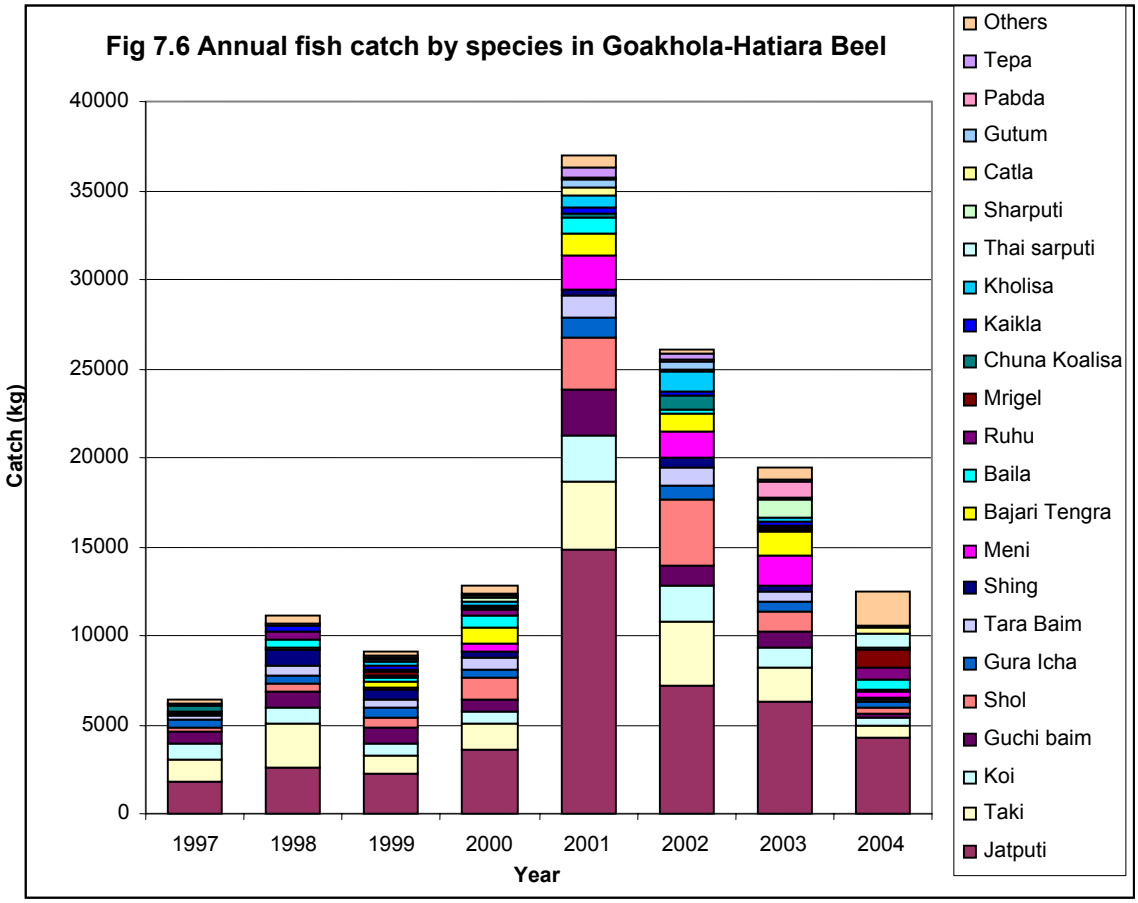
Table 7.6. Main fish species caught in Goakhola-Hatiara Beel 1997-2004.

Species	1997	1998	1999	2000	2001	2002	2003	2004	Overall	Total kg	Trend
Jatputi	28.0	23.8	24.8	28.2	40.2	27.5	32.2	34.1	30.0	646.0	Stable
Taki	19.0	21.7	11.6	11.2	10.4	14.0	10.2	5.5	12.8	275.6	Decrease
Koi	15.3	8.0	7.3	5.6	7.0	7.6	5.6	3.5	7.2	155.4	Dec-stab
Guchi baim	9.2	8.1	10.0	5.0	6.8	4.4	4.3	2.1	6.3	135.8	Decrease
Shol	3.6	4.3	5.3	9.2	8.0	14.0	5.7	2.5	5.7	122.1	Inc-dec
Gura icha	7.1	4.1	6.0	4.1	3.2	3.3	3.0	2.8	4.2	89.7	Decrease
Tara baim	3.6	5.3	5.7	4.9	3.2	3.9	2.9	1.0	3.7	80.5	Inc-dec
Shing	1.1	8.3	5.5	2.6	1.0	2.1	1.6	0.6	3.1	66.7	Inc-dec
Meni	0.0	0.0	2.0	3.9	5.0	5.4	8.9	2.3	3.1	65.7	Increase
Bajari tengra	0.1	1.0	3.8	6.8	3.5	4.2	6.7	0.9	3.0	65.5	Inc-dec
Baila	2.1	3.5	2.5	4.9	2.4	0.7	0.8	4.9	3.0	64.4	Fluctuate
Ruhu	0.6	4.2	1.2	3.3	0.0	0.0	0.2	5.7	2.3	50.0	Fluctuate
Mrigel	0.0	0.0	1.7	0.0	0.0	0.0	0.0	7.7	1.6	34.3	Fluctuate
Chuna koalisa	6.2	0.1	1.6	0.4	0.5	2.8	0.8	0.2	1.3	28.1	Dec-stab
Kaikla	0.3	2.7	2.2	0.9	1.1	1.2	0.9	0.4	1.3	27.2	Stable
Kholisa	0.0	0.3	2.3	1.9	1.6	4.2	1.2	0.1	1.1	24.1	Fluctuate
Thai sarputi	0.0	0.0	0.0	0.1	0.0	0.0	0.0	6.3	1.1	24.2	Fluctuate
Sharputi	0.0	0.1	0.6	1.5	0.1	0.0	5.2	0.0	0.9	19.1	Fluctuate
Catla	1.2	0.0	0.3	0.0	1.1	0.5	0.0	3.2	0.9	19.4	Stable
Gutum	0.3	0.6	1.8	0.8	1.4	1.5	0.9	0.0	0.8	17.9	Stable
Pabda	0.0	0.0	0.0	0.6	0.2	0.8	4.7	0.0	0.7	14.7	Increase
Tepa	0.0	0.4	1.3	0.2	1.5	1.0	0.5	0.5	0.7	14.1	Stable
Others	2.2	3.7	2.5	3.7	1.9	1.1	3.6	15.8	5.1	110.1	Fluctuate
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**		
Weight (kg)	**240.8**	**365.8**	**301.4**	**224.8**	**286.6**	**99.4**	**252.5**	**379.2**	**2150.6**	**2150.6**	

Source: CBFM-1 and CBFM-2 catch monitoring, data from weighing sample catches.
All species with over 0.5% of total sample catch shown.

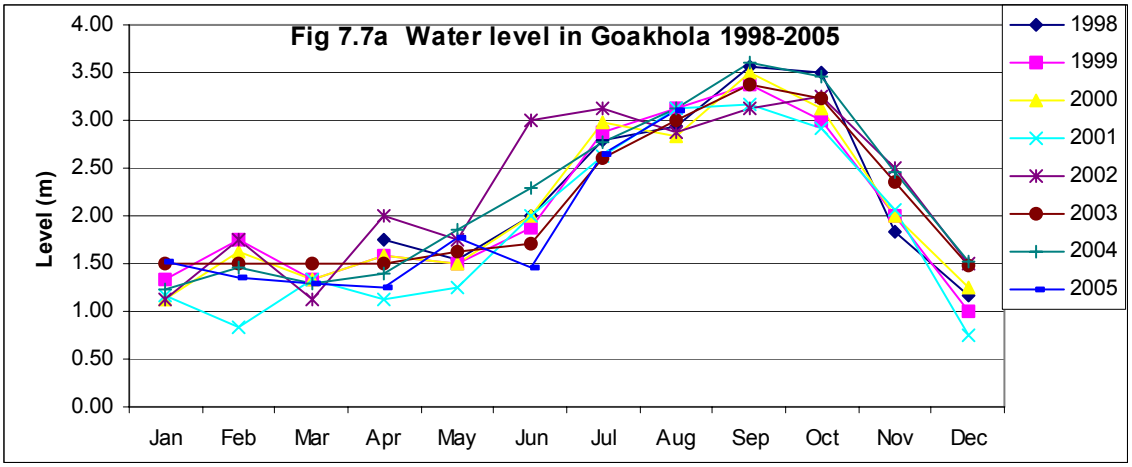
It is also notable that four species that probably do not occur naturally in the beel are among the more frequently caught fish – catla, mrigal, rui and Thai sharputi, but only in certain years – notably in 2004 when they presumably escaped from flooded ponds.

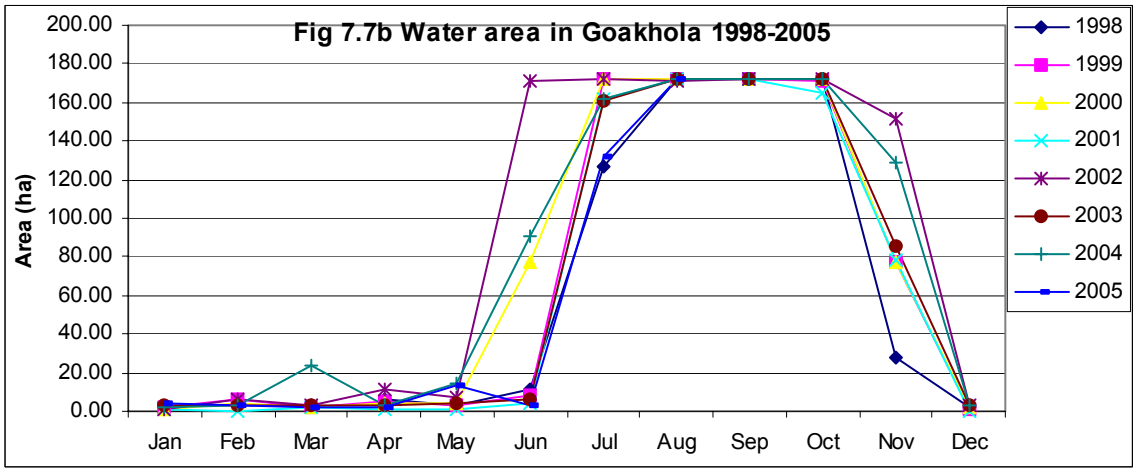
The estimated total quantities of different species caught have changed greatly between years (Fig. 7.6). For example large quantities of beel resident predatory snakeheads (taki and shol) were caught in the high catch years along with their small fish prey such as jatputi. From this it is difficult to discern yet any trend in species composition of catch that might be associated with either CBFM or IFM.

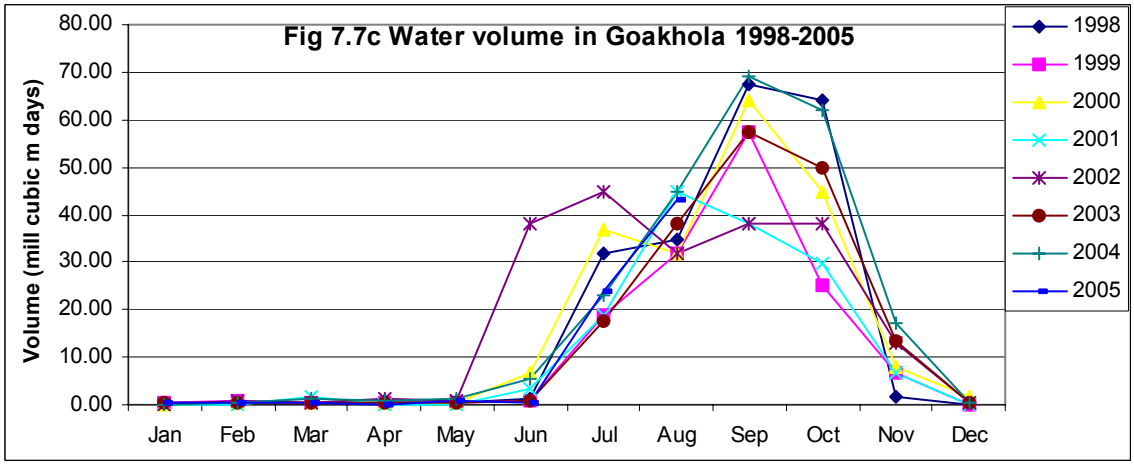


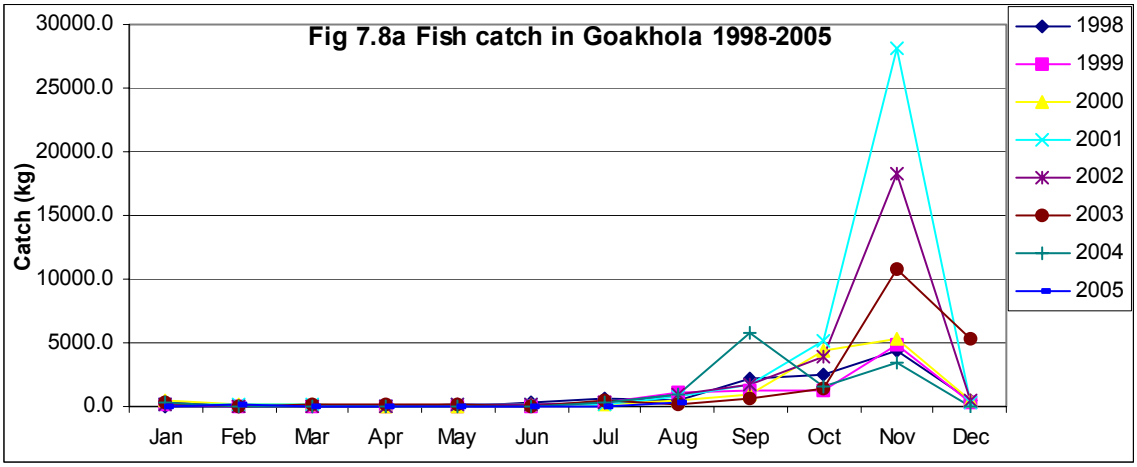
7.6 Relation Between Water Levels / Extent and Fish Catches

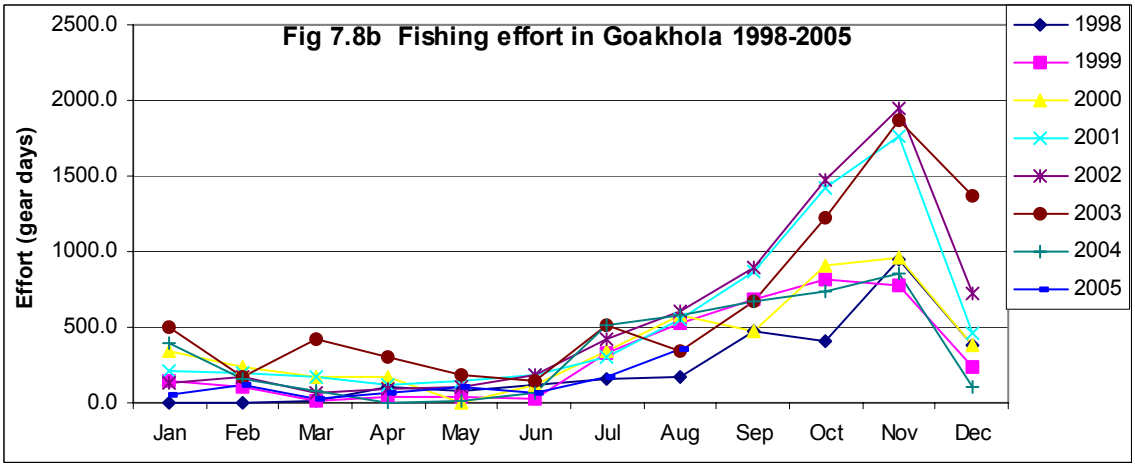
Figs. 7.7 and 7.8 respectively summarise indicators for water (level, area, volume) and fishing (effort, catch and CPUE) by month for eight years (data is only available up to the end of August 2005), and water data is only available from April 1998.

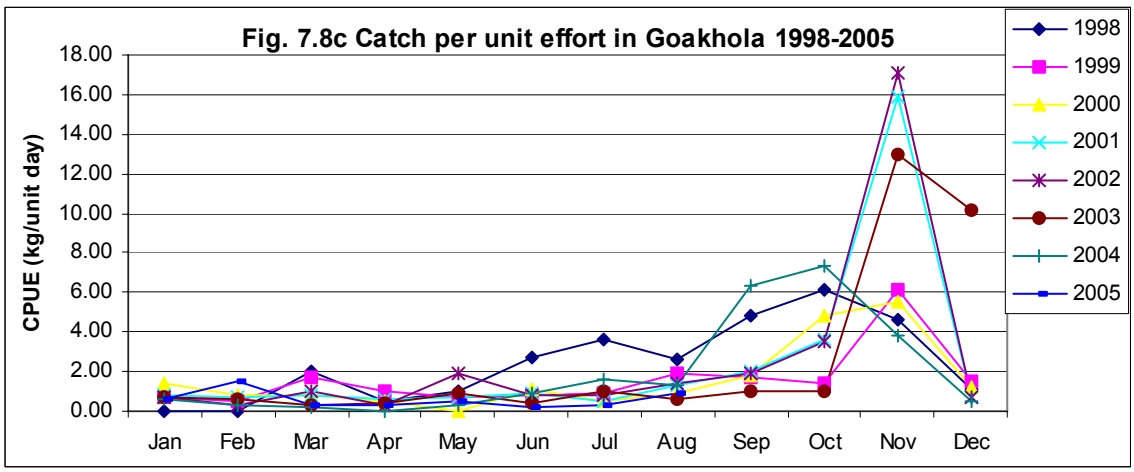












As can be seen there was considerable variation in fishing effort, fish catches and CPUE between years (highest in 2001 and 2002), and fishing was strongly seasonal as might be expected considering that for the first four or so months of the year there is very little water (and part of that is being protected as a sanctuary). 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.

Unfortunately complete data is only available for six years to attempt relating fish catches with water parameters (water level was not recorded in the first quarter of 1998 and data for September 2005 onwards of course cannot be collected yet. Annual catch is of course correlated with annual effort ($r=0.71$, $p<0.1$) and with CPUE ($r=0.81$, $p<0.05$), but there were also significant correlations with water level in the first quarter ($r=-0.75$, $p<0.1$) and third quarter ($r=-0.82$, $p<0.05$), unfortunately these indicated higher catches in years with less water, but the results are not reliable as there was no significant correlation with estimated water volume.

7.7 Value of Fishery

The value of fish produced from Goakhola-Hatiara Beel has been 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, as data was available for October in each year, prices for missing months were estimated based on the average ratio of the price in those months in the other years to the October price. Similarly an estimate of the kua catch in 1999 was estimated based on the catches in the previous and following years.

Overall there was an obvious jump in the value of the fish catch in 2001 when it more than doubled due to both a major increase in catch and an increase in price. Fish prices have increased further in 2004 and consequently the value of the fishery during the IFM period in 2004 has remained close to Tk 1.5 million a year (Table 7.7) which equates on an average to around Tk 4,300 per household for negligible individual investment beyond repair of gear and time, but is also the return to protecting 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. In theory there may yet be a substantial incremental gain from increasing the amount of (protected) dry season water through IFM supported initiatives in and beyond 2005.

Table 7.7 Estimated value of Goakhola-Hatiara fishery.

Indicator	1998	1999	2000	2001	2002	2003	2004	2005
Average fish price Jul-Dec (Tk/kg)*	30.47	30.03	33.92	41.01	37.33	47.22	67.85	
Fish catch except kuas (kg)	11,074	9,102	12,822	36,969	26,082	19,493	12,501	Na
Fish catch kuas (kg)	3,506	na	5,016	3,597	5,820	6,097	9,100	6,643
Total catch (kg)**	14,580	12,348	17,838	40,566	31,902	25,590	21,601	
Estimated value of total fish catch (Tk mill)	0.44	0.37	0.61	1.66	1.19	1.21	1.47	

* Most of year's catch is in these six months, data from CBFM-2 records, some months missing

** for 1999 no kua census was done, for total catch the average ratio of kua to non-kua catch of 1998 and 2000 was used.

CHAPTER 8: SLUICE MANAGEMENT

Goakhola Sluice from khal side, dry season 2003-04

8.1 Issues

Goakhola Khal connects Goakhola Beel with Afra River. The khal has now been set aside as a fish sanctuary during the dry season by the community. An embankment built in the early 1990s separates the beel from the river. A flap-type sluice gate controls the flow of water between the Khal and Afra River. There is a tidal range in this river, and the sluice gate is supposed to automatically close during rising water period to keep out saline water. Then if the water level inside the khal is higher than in the river the gate automatically opens during the low tide period (draw down) draining water from Goakhola and the connected surrounding beels.

Sluice operation is important because:

- it directly affects water levels and volumes in the khal and in the beel,
- it affects migration of fish from river to beel and from beel to river,
- it affects the catchability of fish within the khal
- it affects the volume of water available or replenished against pumping from the khal.

Fishing activity is most intense during the post monsoon when water is draining out of the beel through the sluice. The effectiveness of the khal as a fish sanctuary is questionable giving the reported intensity of fishing along its course. However, it is believed that it would be impossible to restrict fishing activity during the post monsoon, since this is the main fishing period and this is one of the prime fishing locations. In effect, the sanctuary acts as simply a closed season for the latter half of the dry season and rising water period. Little fishing activity occurs during rising water period because fish density is low and at this time there is a high demand for agricultural labour.

Surface abstraction of water from the khal occurs during dry season period by means of diesel pumps of varying capacity. Four pumps operate pumping water from Goakhola Khal within the project area - between the sluice gate and the road bridge. The largest of which is used to irrigate 40 ha of boro on a daily basis for 3 months between December and March. Apparently, this abstraction is replenished by occasionally opening of the sluice gate when water levels outside the gate exceed those inside.

Kuas are also leased on floodplain to provide further fish sanctuaries but represent less than 1% of the total dry season water area. However, high densities of fish including juveniles occur in them. "Blackfish" – beel resident species - dominate the catch in the beel, although some "whitefish" – species that migrate between rivers and floodplains as part of their annual life cycle - are caught when the sluice gate is opened. In some circumstances during the early monsoon period, the water level inside the beel and khal exceeds that outside and water drains out of the khal into the Afra River. During these events, whitefish are often caught attempting to migrate through the sluice gate into the khal.

Occasionally, the sluice gate flap is forced open and secured during the rising water period to allow water into the Khal for irrigation purposes from where it is pumped into the adjacent fields. However, sluice gate operations of this type are infrequent because inflowing water in the dry season is saline and can damage crops and degrade the soil.

The sluice management committee was intended to operate the sluice 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. While in June-July, when it is safe to open the gate, there are fewer fish moving nearby. Moreover the community believe that most of the fish entering the khal swim on into seasonal beels further upstream.

8.2 Decisions Made by Community and Their Implementation

Up to 2004 one large farmer had the responsibility for operating the sluice gate and this had been recognised by BWDB. He took decisions in the interests of crop needs after discussing with other larger farmers, sluice operation was in response to the varieties of crops that were customarily grown. In early 2004 discussion on operation of the sluice gate as part of IFM related activities started, eventually in May 2004 it was agreed that one person should not take the decisions. Instead the farmers agreed that they would discus with the IFM committee which has all stakeholders within it before operation of the sluice. Small farmers were interested through IFM to cultivate shorter duration paddy in some of their land, then water could enter earlier and both fish could enter and transplanted early monsoon (aus) paddy could grow with that water. So they agreed in 2005 to open the sluice earlier in May.

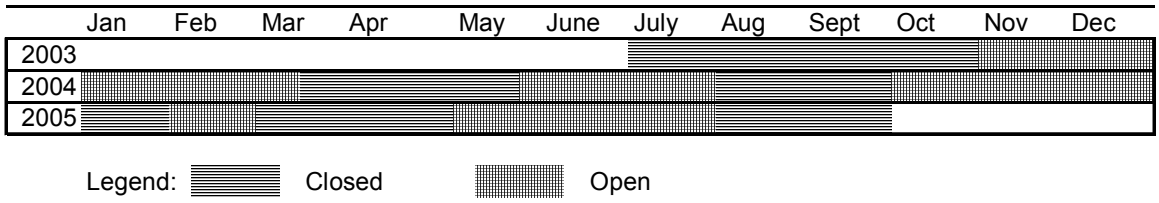
In addition the IFM committee applied in writing to BWDB for repair of the sluice gate and in participatory feedback meetings BWDB officers agreed in principle, although they inspected it no government repairs were made, so opening and closing is done by the community using temporary materials such as banana tree trunks to prop the gate open.

8.3 Sluice Operation Records

Since the start of the project in mid 2003, the status of the sluice gate was recorded each week. Fig 8.1 summarises the operation of the gate. As can be seen in 2004 it was opened earlier in the post monsoon to drain out water, but was then kept closed for longer in the dry season (first four months of 2005), which might help to retain water in the khal. Moreover it

was opened a month earlier in the critical month of May in 2005 than in 2004, and it is hoped that this will permit more migrant whitefish to enter in the beel.

Fig 8.1 Change in Sluice gate operation



8.4 Additional Sluice made by Community

The community of Goakhola-Hatiara including Mandiarchar village proposed a small canal leading to the river with a small pipe and flap gate to drain excess water in the dry season and early monsoon from 27 ha land, so that they could grow 2 crops and then afterwards retain water to conserve fish. They have resources but the work was not done due to lack of coordination, initiative and lack of trust. After forming the IFM committee, the community gave the responsibility to implement this to the committee. The committee collected about 25% of the cost and the rest was given by an outsider who wanted to help. The canal as well as the gate was built in the dry season of 2004 at Mandiarchar. They community also provided manual labour. Subsequently in that area in 2005 they cultivated Aus paddy and harvested about 225 mt of paddy (Photo). The new road served as a threshing as well as drying place for this extra production.

In the middle of Goakhola Beel some landowners also made a bund to keep out water, which now the community plans to withdraw and they will excavate another canal to keep water inside in that area.

8.5 Impact on Crops and Fish

Although the immediate impacts of the extra pipe sluice on crops are apparent, the overall impact of that structure and of changes in sluice operation in 2005 will not be apparent until fish catches from the last three months of 2005 are available.

CHAPTER 9: KNOWLEDGE SHARING

Participatory assessment of crop demonstrations.

9.1 Exchange Visits

In 2004 two exchange visits, one to Chalan Beel (CNRS supported site under this IFM project) comprising 20 farmers and 2 officials and 2 NGO worker, and another to Charan Beel (large floodplain in northwest Bangladesh) comprising 12 farmers, 1 official, 1 NGO staff, were arranged for sharing knowledge with the local farmers who are cultivating different types of crops in their field (Table 9.1). Both the areas are floodplain beels and have a similar environment to the project area. All the visit participants arranged a workshop on 21 March 2004 to exchange views and experiences from both sites. In 2005 they requested further visits. A third visit was arranged on request from some of the project area farmers to see a privately managed alternate rice and fish culture system in eastern Bangladesh. The local farmers there have a cooperative type arrangement and they share expenses and profit from rice and fish cultivation from the same fields and from other resource based incomes with everyone in the area who has joined. The fourth visit was arranged in Sonatala Small Scale Water Resources Development Project (SSWRDP) where the cooperative has different activities for water management and income generation. This visit was arranged in order to get ideas about the cooperative management system.

Table 9.1 Exchange visits by stakeholders from Goakhola-Hatiara and Maliate.

Date	Place	No. made visit	Topics
16-18 February 2004	Chalan Beel, Natore	20	Cultivation method for new crop varieties
22-24 February 2004	Charan Beel, Kalihati	20	Newly introduced crop varieties
24-26 August 2005	Uzanisher, Brahmanbaria	25	Rice fish cultivation and institutional arrangements
4 September 2005	Modhukhali, Faridpur	25	Cooperative management system in small scale water resources management project

The key points from the visits, as found by the participants, are summarized below.

9.1.1 Charan Beel, Kalihati, Tangail

The visit was done in the CNRS site where farmers have maize, garlic, potato and wheat demonstration plots. The visitors discussed potato cultivation as they have previous knowledge on this crop. Farmers in Goakhola-Hatiara were cultivating potato long ago and some adopted this crop again in 2005 after demonstrations under IFM in 2004. Local knowledge was that potato exposed to sun during growth period becomes green and it's taste and quality declines. The local farmers involved in demonstration of potato cultivation agreed with the visitors knowledge. According to the visitors, the local farmers also used high doses of urea in some maize fields. Garlic demonstration was not found to be very good but was still a practical knowledge sharing for the visitors.

The discussion meeting with all the exchange visit participants after their visit revealed that farmers can diversify their cropping pattern and can try these crops in 2005. They mentioned that they have already discussed with their neighbours and estimated how much crop can be cultivated in the next rabi season.

9.1.2 Natore, Lalpur, Gurudaspur and Singra, DAE (Charan Beel)

The main lessons learned from the visit were:

- Garlic – no tillage is needed and it can be planted soon after monsoon water recedes with mulching to restore soil moisture. The cost effective analysis by both garlic farmers and the visiting farmers came to the conclusion that garlic is more profitable than paddy and suitable for the project area. The participants were encouraged to cultivate garlic in their high and medium high lands. They would have to do some soil treatment with green manuring and then cultivate crops.
- Water melon may not be suitable for the kind the soil in the project area. But some farmers might still try.
- Along with the main crop other minor crops can be cultivated.

9.1.3 Rice-fish culture

The third visit was arranged for the project beneficiaries to see the rice-fish culture technique, the process of participation and benefit sharing. A group of 23 farmers and 2 local government officials participated in this visit. The host community (52 members) explained how they started the project in 103 acres of privately owned land and how they have been continuing for 7 years. This community received a small grant from an IFAD project and through that had training from Bangladesh Fisheries Research Institute 6 years ago. The 7-member executive committee makes arrangements for tree plantation, nursery pond maintenance and fingerling stocking. Others help them whenever needed. They keep a stock of natural fish for the next year, in the floodplain but they also stock carp fingerlings each year. The host community wanted to learn about golda prawn *Machrobrachium rosenbergii* (which is common in Narail area) cultivation from the visitor community and are willing to visit other areas to learn more.

Lessons learned:

- A project can be sustained if all the beneficiaries of an area participate.
- Diversification of the activities provides a higher income.
- Poor should be included in the benefit sharing system.
- Their experience should be communicated to other people through different media.

The visitor (Goakhola) community said they would take a decision on the possibility of implementing this method, as increasingly the farmers are not willing to grow Aman paddy which stays in the field for longer period. They thought that they would be able to harvest Aus paddy and then let the natural fish grow without feed.

9.1.4 Water management cooperative

The fourth visit was to a small scale water resources management project site supported in the past by LGED. This project has one executive committee (Water Management Cooperative Association) and four sub-committees for fishery, agriculture, micro-credit and tree plantation. They general body of 542 members includes all types of stakeholders. Women are included in each committee. The host community explained the process of cooperative formation. The visit was useful for the representatives from the IFM Narail sites as those community organisations if they want to be legal entities will have to register as cooperative because of a recent (2005) government decision whereby the Social Welfare Department is no longer registering organisations.

Lessons learned:

- Strong leadership is the key for sustainability.
- Transparency of the committee can keep up trust and respect.
- Diversified activities can build up funds quickly.

9.2 Reflective Learning on the IFM Project as a Whole

In mid 2005 nine stakeholder groups have separately evaluated their activities and the IFM project related activities on the basis of progress, participation, attitudinal change and benefits. The groups were:

1. Resource Management Committee
2. Farmers
3. Fishers
4. Integrated Pest Management group
5. Demonstration Plot owners
6. Kua owners
7. LLP owners
8. Sluice gate operators
9. Local government Institutions (Department of Agricultural Extension, Department of Fisheries, Local Government Engineering Department, Bangladesh Water Development Board, Jute Department) plus NGO (Banchte Sheka).

The outcomes of the sessions are consolidated in Table 9.2.

Table 9.2: Consolidated outcomes of the sessions – lessons reported by the participants.

Reviewed Activities		Who does this	When
Formation of IFM committee	There was no coordination or regular meeting between different committees active in the area. Their activities were also not so well organized. The ongoing project, project personnel, local government and NGO were each following their own agenda. Bringing fishery, agriculture and sluice operation activities under IFM has effectively improved management and coordination in the floodplain. Activities related to fishery, agriculture and sluice operation should progress through sub committees. Sub committees can independently take decision concerning specialized activities but should discuss with IFM committee before implementation.	Ad-hoc Committee	2003

Reviewed Activities	Learning	Who does this	When done
Jute retting issues, new techniques and training in these	Jute retting pollutes water, kills fishes, causes skin diseases and produces a foul smell. In both 2004 and 2005 jute seasons trainings were held in different spots with 210 jute farmers from different beels linked with the Chitra River and with the project beels. Jute farmers from other jute growing areas from Tangail, Magura, Kalia also attended the training session. The trainings were facilitated by local Agriculture and Jute extension officers. Demonstrations were done in 2004 during the training sessions. The project has provided 6 very low cost jute debarking machines designed by Jute Department to the jute farmers. Some of the farmers also experimented with jute retting in different environments, such as closed water, in huge earthen pots, and open water, in order to see which gave the best result. The new method of jute retting (ribbon retting) controls water pollution, produces jute fibre of a high quality and price, and produces strong and durable jute sticks which are also higher priced and are in demand for the betel leaf vine growers. However, farmers are still not in favour of using the method extensively as they have no place for retting jute and it is initially more labour expensive. Those who have done it and saw the result are willing to adopt it on a larger scale next year because they think the costs will be lower when they are experienced with the de-fibreing process. They compared this process with the paddy post harvest techniques they are adopting now which were also expensive at the beginning. They opined that this is a new initiative and will take one or two seasons for the farmers to adopt. Overall there is little jute retting in the beel but it is affected by an inflow of water form the nearest river where farmers ret jute.	Project personnel +DAE and Jute Department	Annually
Excavation of canal and flap gate pipe sluice	A small canal was excavated at the end of the 2004 dry season with a flap gate installed to regulate excess water to permit fish and water to enter the beel. This canal also restores water in the outside link canal and supplies water inside whenever necessary. An estimated 100 acres (40 ha) of land were reclaimed from regular fallow status in the early monsoon. An extra 225 tons of Aus paddy harvest is possible (based on 2005 experience). The cultivation of Aus rice prevented subsistence and part time fishers from catching small sized fish in the beel while the crop was growing, but in return they hope to get bigger sized and better priced fish in by the end of the 2005 monsoon. Working together can bring confidence and cohesion back, but it needs external facilitation.	IFM committee and other farmers/fishers	February-March 2004
Fish sanctuaries	The Beel Management Committee under CBFM-2 Project has excavated 3 permanent fish sanctuaries. These sanctuaries are new but are expected to save fish in the next (2005-06) dry season. However during 2003-2005 they have maintained the canal as a dry season sanctuary. Fish took shelter in that canal. In addition according to the farmers a huge amount of fishes entered the beel through the new canal in 2005 monsoon. They saw a rarely recorded fish species - Sarputi (*Puntius sarana*) in the beel this year (none recorded in catch monitoring in 2004).	BMC, IFM committee and other farmers/fishers	February-March 2004
Low use of irrigation water /Alternate crops	Low production costs and high returns were reported from alternate crop cultivation in the high water demand areas. Rabi crops provide 1.5 times more profit than paddy. Rabi crops such as Khesari (*Lathyrus sativus*), Potato, Sesame, and Chick pea are best suited species for the area as most of the soils are clay-loamy. During the monsoon Aman paddy was the main crop. Now they can cultivate transplanted Aus paddy at low cost and get more return.	Farmers	Annually

Reviewed Activities	Learning	Who does this	When done
Closed season	Three months closed season from Baishak (Mid April) to Ashar (Mid July) facilitates fish breeding and avoids catching small sized fish.	BMC, Fishers and community	Annually
IPM, Farmers Field School	DAE had a Farmer Field School which after finishing a 3 month session just at the start of the IFM project formed a basis for establishing the local IFM institution. This field school is operating very well and pesticide use is very limited in the area. This also showed good result on fisheries. There is no pesticide pollution in the area.	Farmers	Annually
Rehabilitation of locally extinct fishes	IFM members have introduced Sharputi (*Puntius sarana*) and Pabda (*Ompak pabda*) in the kuas (ditches) and they can see some fish now in the water as they have not yet started fishing.	BMC, Fishers and community	Annually
Communication and linkages with other institutions	All the institutions in the area are now better coordinated. IFM committee includes members from BMC, Sluice gate committee, IPM group, school committee and local theatre group, these are now operating like sub-committees. Departments of Fisheries, Agriculture and Jute, LGED and BWDB are in constant coordination with the people and IFM committee.	IFM committee, BMC, IPM group, school committee, local theatre group. Departments of Fisheries, Agriculture and Jute, LGED and BWDB	Through-out the year
Sluice gate operation	Sluice gate operation was extremely successful in last (early 2005) dry season. The community was enthusiastic and IFM committee was successful in persuading people to repair the sluice gate, change cropping pattern and grow short duration crop in the dry season in order to open the gate earlier for fish to enter during the first rains. They also prevented anyone from fishing at the mouth of the gate during the first rains when they believe fish migrate into the beel. The newly built sluice also facilitated fish migration into the beel.	Sluice gate sub committee/farmers/fishers	Through-out the year
Knowledge sharing	4 exchange visits have facilitated 90 farmers to visit other areas. They shared their experiences, gained new knowledge about agriculture and fishery and decided to try growing some new crops such as wheat, garlic and maize in smaller plots.	Project personnel, NGO staff, staff of Departments of Fisheries, Agriculture and Jute, local community and committees	Annually
Awareness raising	Local theatre groups have given two open air performances in the area of dramas that contained IFM messages, which attracted huge audiences and have helped raise awareness on IFM.	Local theatre group, project personnel, IFM committee	Annually

The participants in the lesson learning sessions were asked to score the achievement of IFM project activities against eight basic learning principles. The different stakeholders in the committee were asked to give a score between 1 and 10 against each of those learning principles for the status of their newly gained experiences. The criteria were those they think are necessary for assessing their strengths and weaknesses in the learning process. The average scores from the different groups are shown in Fig 9.1. Strengthen and weaknesses were determined from their scores.

Strengths of IFM piloting

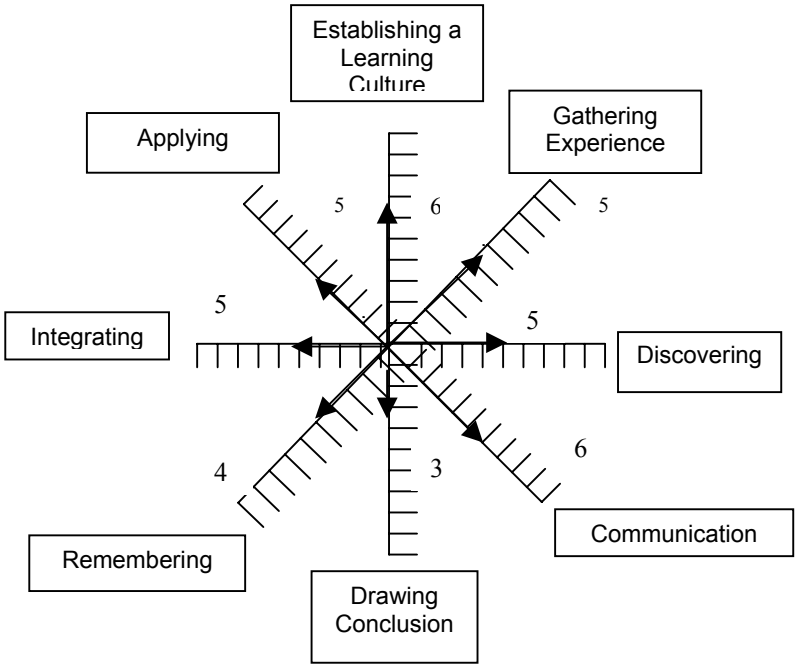
- Communication and information sharing is good within wider community in project area but not widespread outside the area.
- For the first time, all government departments concerned sit with the community in the rural areas so there is better coordination.
- Community received training and demonstration: capacity building.
- Power relations are not influencing reflective learning.
- Team work (farmers, fishers, poor, etc.) is excellent but needs external facilitation.
- Capacity to utilize government facilities strengthened.

Weaknesses of IFM piloting

- Government recognition of the organization.
- Integration.
- Floodplain Management Committee works in isolation and no flow of information.
- Weak group dynamics.
- Experience gathering only through feedback sessions but not with wider community.
- Databases not properly/systematically stored.

Overall the learning processes of the project and the IFM participants were rated by the participants as average – establishing a learning culture and communications were rated better than the other dimensions, while their capacity to draw conclusions has not developed so much yet.

Fig. 9.1 Organisational assessment of learning (average scores)



CHAPTER 10: STAKEHOLDER ASSESSMENTS AND LEARNING

Participatory learning August 2005

10.1 Adjustment of IFM Plan by IFM Committee

On 3 October 2004 the various stakeholders assessed their previous year's activities and added some activities for the next (2005) year. The adjusted plan for 2005 comprised:

1. Fund raising for IFM
2. Open bank account for IFM committee
3. Preparation of a draft constitution
4. Workshop for awareness raising
5. Poster and leaflet distribution
6. Continue awareness campaign (open air theatre, miking, video show)
7. Demonstration plot for alternative rabi and monsoon crops
8. Each committee member should influence 5 farmers to cultivate alternate crops instead of irrigated boro and give a lecture to the school children in their local school.
9. Grow Aus instead of Aus/Aman crop which takes longer time and delays sowing of the alternative rabi crops.
10. Grow short duration paddy on those plots that continue to grow boro paddy in order to open sluice gate to facilitate entry of fish in the beel
11. Exchange visit
12. Make cost-benefit analysis by the farmers for different crops.
13. Merge sluice gate committee with IFM committee.
14. Obtain training on rabi crop cultivation, jute retting, sanitation, and handicrafts from competent local specialists (government, etc).

In August 2005 The IFM committee set its ideal targets for the 2005-2006 rabi season, they hope for the following areas of non-paddy crops (note that this is unlikely to be practical as it implies no boro paddy cultivation):

- On high land: 150 acres of khesari (blackgram)
- On other lands: 75 acres of wheat
  25 acres of potato
  5 acres of maize
  35 acres of garlic.

10.2 Participatory Assessment of Crop Demonstrations in 2004

A number of locally grown crops which were cultivated in the area in past times but had not been grown for several years were tried through different farmers who were willing and wanted to try these crops. The project provided advice and supervised the activities. A workshop was arranged with invited farmers to create awareness and enthusiasm for cultivating those alternate crops. The other farmers inspected the fields for themselves and the demonstration plot owners gave them detailed income-expenditure figures. The details of the demonstrations are given in Table 10.1.

Table 10.1 Summary of demonstration plots in 2003-2004 dry season

Crop	Replications	Area (dec)	Date of Sowing	Date of harvest
Sesame	1	33	19.12.03	15.3.04
	2	33	17.12.03	15.3.04
	3	33	15.12.03	14.3.04
Potato	1	12	8.12.03	6.3.04
	2	20	20.12.03	18.3.04
	3	15	15.12.03	15.3.04
Khesari	1	48	19.12.03	15.3.04
	2	25	24.12.03	17.3.04
	3	26	27.12.03	19.3.04
Motor	1	10	8.11.03	17.3.04
	2	20	15.11.03	25.3.04
	3	15	10.11.03	15.3.04
Paddy	Lowland	122	11.12.03	15.5.04
	Highland	24	9.12.03	11.5.04

Note: 100 decimals = 1 acre or 0.4 ha; 1 decimal = 40 m^2

In March 2004 a workshop with the crop demonstrators other farmers and Government officials was held, the demonstrators summarized their experience by making the comparative assessment of costs and benefits shown in Table 10.2. As can be seen the demonstrator's, when they compared their experience, concluded that potato followed by HYV boro paddy had the highest costs, yet the net cash return from potatoes was over 3 times more than for boro. Khesari (black gram) gave a higher net return than boro for only 20% of the costs. The good returns from jute also explain why its area cultivated has increased during the project period. Of course the farmers can eat rice that they produce, whereas they have to sell the other crops to then buy rice and other necessities. Even so higher cost crops are risky if the harvest fails, so the low input cost alternatives are attractive. Lastly kuas give a very good return compared with costs, suggesting that if fish populations and catches increase some farmers may invest in digging kuas, although the costs of doing this were not considered here. Also these figures assume complete dewatering of the kuas, when the owners adopt the practices promoted now for IFM of not dewatering then the return from the kuas is lower.

Table 10.2 Comparative assessment of crop income and expenditure made by demonstration farmers using local units (all for a typical 48 decimal ((0.19 ha) plot of land).

Activity	HYV Boro	Khesari	Chick pea	Sesame	Potato	Jute	Kua**
Costs							
Land preparation*	200	0		600	500	300	370
Fertilizer	900	0		260	620	260	
Seedlings	300	350	700	60	2,400	120	
Transplanting	250	0		0	500		
Irrigation/pumping	1,200	0		0	300		550
Weeding	200	0		200	200		
Herbicide	50	0		0	0		
Harvesting + threshing	400	300	300	300	250	300	920
Cleaning						100	
Total	3,500	650	1,000	1,420	4,770	1,080	1,840
Returns							
Production (maunds)	25	8	5	5	80	15	
Price (Tk/maund)	250	500	700	700	200	300	
By-product value (Tk)			0	0	0	1,000	
Gross income (Tk)	6,250	4,000	3,500	3,500	16,000	5,500	11,800
Net income (Tk)	**2,750**	**3,350**	**2,500**	**2,080**	**11,230**	**4,420**	**9,960**

* annual cost of brushpile for kua, does not include cost of digging the ditch

** kua figures were estimated by community for an average area of 13 decimals that would contain about 8 decimals of actual ditch and converted here for same size 48 decimals

The implications for farm labour are also important: potatoes require more hired labour according to the farmers' analysis, but adoption of black gram and chickpeas instead of boro will significantly reduce opportunities for farm labouring work.

10.3 Social Analysis of IFM and Changes in Local Community

In May 2005 a participatory assessment of the social, poverty and overall impacts of the IFM activities was made with seven stakeholder categories (Table 10.3). Notably all stakeholders reported substantial improvements in the environment and their linkages and coordination with other institutions and stakeholders.

From this it is clear that all stakeholders found IFM very relevant and largely attributes benefits and changes in the last two years to the project. All local community participants felt they had been strongly involved in decision making but to some extent government officials felt left out of this. The IFM experience was also seen as empowering by all stakeholder groups, although trust and harmony were not seen as having improved so much.

Interestingly opinions on who had benefited most from IFM differ by the stakeholder making the judgement: landless men and women believe everyone has benefited and to the maximum extent they could imagine. Farmers believe the sluice managers (who are large farmers) have benefited to the maximum. The BMC members are generally perceived as having benefited, in part in terms of status, relatively more than some other stakeholders. Local officials, BMC and sluice operators all believe that the participant farmers and other farmers did not benefit as much as other stakeholders.

Table 10.3 Social Analysis of IFM (score 1-10 scale)

		Participants						
		Participant farmers	**Other farmers**	**Landless men**	**Landless women**	**Local Admin.**	**Sluice gate managers**	**BMC**
Attribution	Benefits due to project	7	7	8	8	8	7	8
Relevance	Importance of the project	10	10	10	10	10	10	10
Participation	Involvement in decision making	10	10	8	9	6	10	10
Poverty alleviation / Impact (opinion on who benefited most)	Particip. farmers	7	7	10	10	6	6	6
	Other farmers	8	8	10	10	5	5	5
	Landless men	7	9	10	10	7	6	8
	Landless women	7	7	10	10	8	8	9
	Local Admin.	8	8	10	10	8	8	9
	Sluice managers	10	10	10	10	7	7	8
	BMC	9	9	10	10	8	7	9
Changes in livelihood capitals	Physical	8	8	7	8	6	9	9
	Social	7	10	10	10	9	10	10
	Financial	8	8	10	10	7	8	7
	Human	9	8	10	10	7	8	9
	Natural	10	10	10	10	8	8	9
Changes in environment	Pollution, land reclamation, new varieties, IPM, low water abstraction	8	8	9	9	8	8	9
Linkages	Coordination with GO/ NGO, formal/informal agencies	8	8	8	9	9	8	9
Social capital	Cooperation	8	8	9	9	8	8	9
	Empathy	7	7	8	8	7	8	8
	Unity	8	9	8	8	8	8	8
	Conflict resolution	7	7	8	8	6	8	7
	Trust	6	6	5	5	6	6	7
	Harmony	6	6	6	5	5	6	5
	Empowerment	8	8	10	10	10	9	9
Awareness	Understanding , learning environment	8	8	9	8	7	8	8
Communication		7	7	6	6	6	7	7
Adaptability	Rate of adaptation, who adapted	9	8	6	6	6	5	9
Capacity building	Training, Exposure visit	7	7	8	7	7	6	7
Equity		9	9	8	8	7	6	5
Sustainability	Likelihood of continuation of benefits	7	7	8	8	8	7	7
Innovation	New technology/ variety	8	8	7	7	8	7	8
Replication (likely looking at future)	Likelihood of adaptability by others	9	9	10	10	9	9	10
Overall impact		8	8	10	10	9	9	10

Scale: 1 = worst situation/no improvement, 10 = best condition respondents could imagine**.**

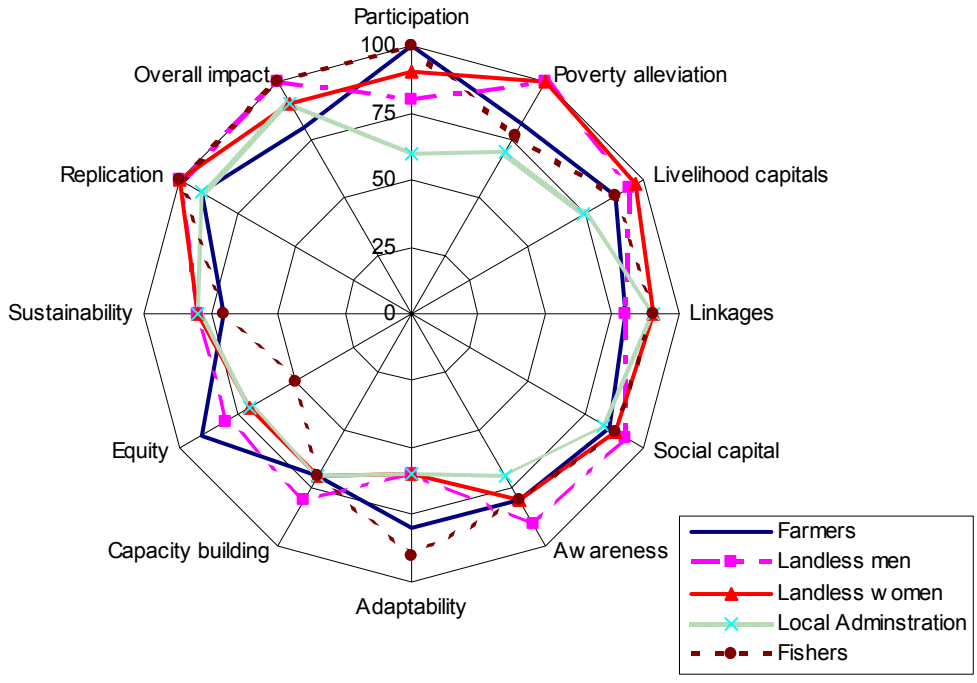
Some key findings raised by the participants were:

- 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 have increased a lot.
- People now have a better sense of timekeeping.

Overall the IFM approach was 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 (Fig 10.1).

Fig. 10.1 Assessment of IFM indicators by different stakeholders (scores converted to percentages).



10.4 Individual Assessments of Change in Livelihoods

Based on a sample survey of 30 households in August-September 2005, capital assets have changed over the last 3-4 years (including during the IFM period). House size (floor area) and number of dwellings increased since 2001. House condition has improved too. More people are now using tin walls. Even some people have brick walls now (Table 10.4).

Table 10.4 Housing in Goakhola Hatiara Beel area.

		1996	2001	2005
Number of households		30	30	30
Number of houses/household		2.7	1.3	1.9
Average house area (sq m)		30	40	71
Wall %	straw/grass/jute/bamboo	83	87	60
	tin	2	3	18
	earth	10	7	4
	brick/concrete	5	3	18
Roof %	straw/grass/jute/bamboo	37	7	7
	tin	62	93	93
	tiles	2	0	0
	concrete		0	0

Source: 1996 CBFM-1 baseline, 2001 CBFM-1 impact, 2005 IFM impact survey

Now the area of ponds per household has doubled compared to 2001 - almost every household has its own pond and they are cultivating fish. Freshwater prawn cultivation has become profitable and three prawn/fish ghers (large ponds constructed on floodplain land) were newly built in the area. These ghers are used for dry season crop cultivation (6 months) as well as for fish and prawn culture (6 months). Landholdings have increased largely through the addition of ponds and more land being rented and sharecropped out (Table 10.5). Households have also continued to increase their ownership of other assets (except for boats)(Table 10.6).

Table 10.5 Changes in landholding (land in decimals).

	1996	2001	2005
Homestead land	14.7	11.2	11.6
Own pond	0.4	11.8	23.9
Own cultivated land	146.3	132.8	132.8
Other's land used	54.7	77.7	18.3
Own land rented/mortgaged/sharecropped out	0.2	11.1	32.9
Total own land	161.5	166.9	201.2

Source: 1996 CBFM-1 baseline, 2001 CBFM-1 impact, 2005 IFM impact survey

Table 10.6 Change in household/personal asset ownership (% of households owning asset).

Asset	Number	1996	2001	2005
Bed	0	17	3	0
	1	37	17	11
	2+	47	80	89
Watch	0	55	33	30
	1	35	33	35
	2+	10	33	35
Radio	No	68	40	33
	Yes	32	60	67
Bicycle	No	52	50	32
	Yes	48	50	68
Boat	No	87	57	76
	Yes	14	43	24

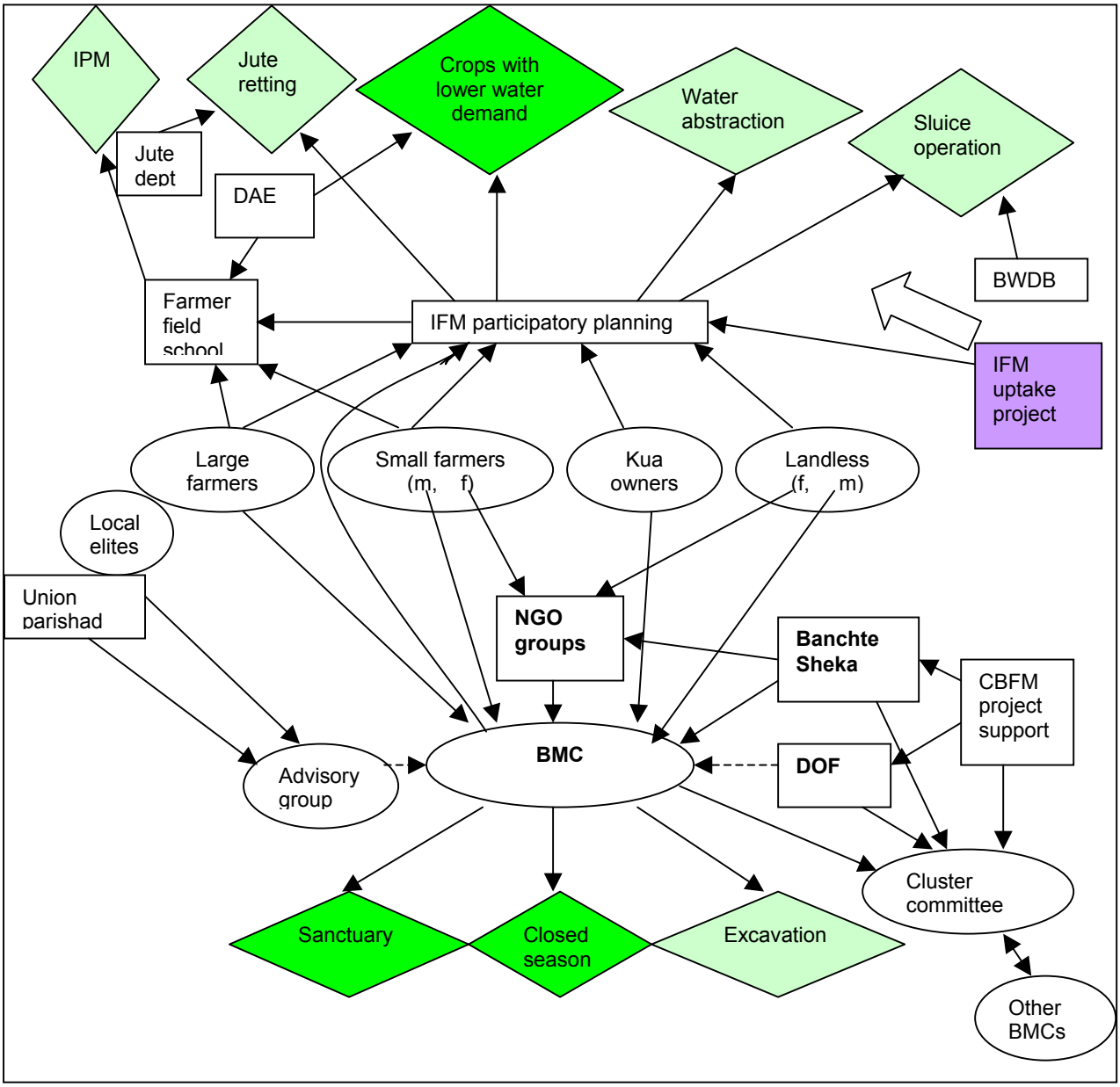
None of the respondents reported facing any food shortage for a prolonged time, over 80% now report being surplus in respect of food consumption, an improvement on 2001 (Table 10.7). They have more work now. In 2005 in the monsoon farmers cropped about 27 ha land that earlier could not be cultivated in that season, and grew Aus paddy. They said that those fields were fallow in that season for the last 25 years as they are low lying. Due to a new small canal and small pipe with flap gate in the embankment they were successful in growing more rice.

Table 10.7 Changes in reported food security in Goakhola Hatiara.

		1996	2001	2005
Food consumption (% households)	Usually deficit	15	3	0
	Occasional deficit	42	13	3
	Break even	30	20	10
	Surplus	13	63	87
Change in status between years (% households)	Worse	25	7	0
	No change	35	21	48
	Improve	40	72	52

Due to the integration of all the committees related to water management, social cohesion increased, people now discuss with each other and take decision together. The poor gained bargaining power and they can now claim their rights on different issues. Participation of all stakeholders in different events and decision making reportedly increased. Women are allowed to go outside the village for income or to attend meetings, exposure visits or training. In the IFM committee as well as in all the subcommittees women are involved.

CHAPTER 11: LINKAGES AND INTEGRATED FLOODPLAIN MANAGEMENT SYSTEM



Linkages between stakeholders, institutions, and IFM options in Goakhola-Hatiara

11.1 Concept of IFM and Linkages Between System Components

The IFM approach recognizes the floodplain as a system where the amounts and uses of surface water in the dry season and monsoon critically affect the two main components of products used by people – crops and fish, and where interactions between these uses and activities are important. This involves both private and common pool resources within the same area. Specifically, fish populations in the seasonal floodplain depend on the amount of surface water in the dry season and that this is protected from fishing, and on the timing and duration of flow from the river system. Agriculture and decisions by farmers on which crops to grow affect this. Irrigated rice lowers the water table and pumps water from the khal in the

dry season, while keeping the sluice gate closed to prevent crop damage in the early monsoon affects the movement of fish at the main breeding time. Since the community members depend both on agriculture and on fishing, a common interest in increasing the overall returns from the floodplain system was found. Alternative dry season crops can reduce water demand while maintaining farmer income, in this way more fish can survive to breed in the next monsoon, and this is further enhanced if the dry season crops are of shorter duration and therefore not at risk from early floods enabling the sluice to be opened earlier.

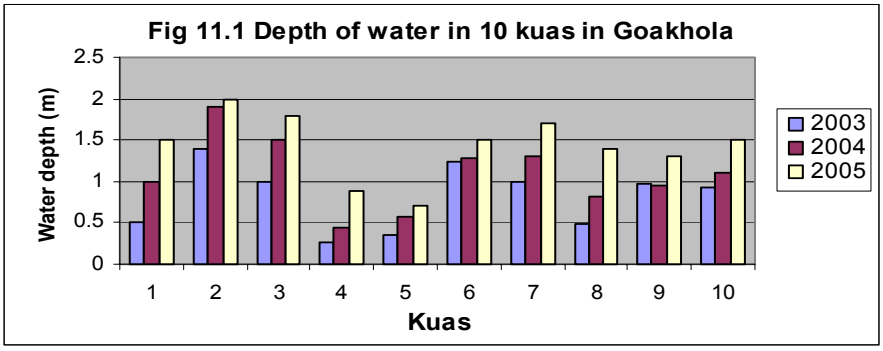
During the project the inter-linkages were found not to be limited to these, changing to alternative rabi crops combined with farmers interest in growing rice for household food security plus the community building of a small sluice meant that more early monsoon rice (aus) was grown, fish can grow undisturbed by fishing among this crop. This further potential benefit was, however, counteracted by the same conditions plus favourable market prices encouraging also the growing of jute in the same early monsoon season. The disadvantage of this is that retting of jute in the floodplain results in water that has insufficient oxygen for fish to live in. Recognising that this trend could not be prevented by stopping farmers from growing the crop, the project team made links with the local Jute Department officers who helped train the community in retting methods that are expected to reduce the loss of water quality. It is too early to tell if this last activity has been successful. One further linkage deserves mention – that pesticides and agro-chemicals can have adverse effects on fisheries especially when fish and surface water are concentrated in the dry season. This issue did not need to be addressed through additional IFM activities because integrated pest management (IPM) was so successfully adopted in the area through the farmer field school and through the IFM project continuing the activities of the field school beyond its three months of DAE support. Agricultural surveys undertaken for IFM confirmed negligible use of pesticides in the area.

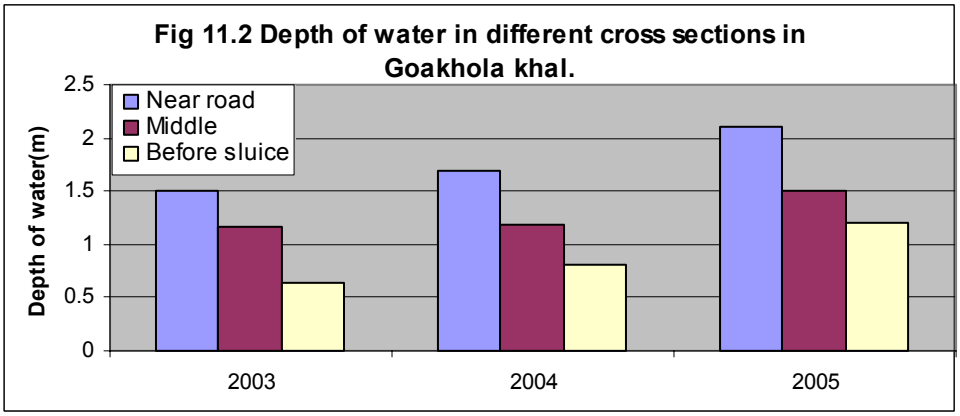
Secondly linkages between stakeholders and institutions are emphasized in the diagram and the approach discussed in this report. One of the main achievements of the IFM project, as recognized by the stakeholders, has been to introduce system thinking to them, and to facilitate discussions and linkages between community members and with government agencies and officials. Thus the piloting of alternative jute retting is in large part due to initiative by local extension officers once they were sensitized to the problem and met with the farmers. This has brought increased confidence in the community that they can raise problems and expect a service, advice and help from officials. For example, the farmers raised the problem of poor quality seeds in their meetings with officials, and DAE has agreed for the 2005-06 dry season to help arrange access to better quality seed – this is the first time the community has experienced DAE volunteering to respond to its problems. The farmers also requested that DAE test their soil quality to advice and help them adjust their fertilizer use, but DAE locally has no equipment.

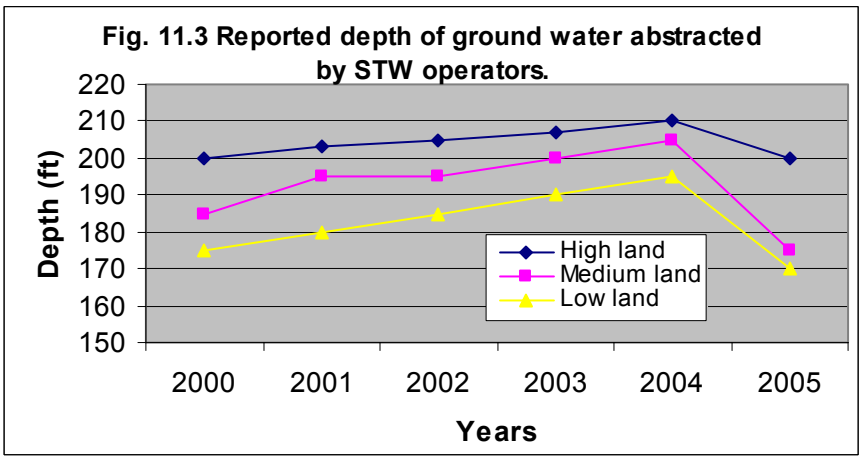
11.2 IFM Performance

The IFM approach was intended to optimise or improve the overall productivity of the floodplain system. Although the value of fish caught from Goakhola-Hatiara Beel in recent years has been around Tk 1.5 million a year which is considerably less than the value of crops harvested, the agricultural changes that have been taken up through the IFM approach have maintained the value of production and reduced irrigation costs. In 2005 in particular they have also apparently improved dry season water availability for fish. Figs 11.1 and 11.2 indicate a consistent increase in depth of water recorded in kuas and Goakhola khal in the dry season from 2003 to 2004 and then to 2005. This may bring additional benefits, according to the operators of STWs the ground water being pumped was not as deep in 2005 as in the previous years (Fig. 11.3). However, this last reported change has not

been physically measured by the research team and may also be affected by rainfall and ground water movements beyond Goakhola, as well as by STW abstraction.







Based on the field measurements of dry season water in kuas and the khal and their areas, the standing water volume in at least part of the dry season appears to have increased substantially – 66% more in 2005 compared with 2003. These volumes are more than predicted by the digital elevation model, but that because of its grid size missed part of the khal and is unable to represent small (but significant for fish) depressions. The increased fish habitat is roughly consistent with the reduction in surface water abstraction when the occasional opening of the sluice to let in high tide water is taken into account. In addition fewer kuas have been drained out for fishing, and the khal has been protected as a fish sanctuary.

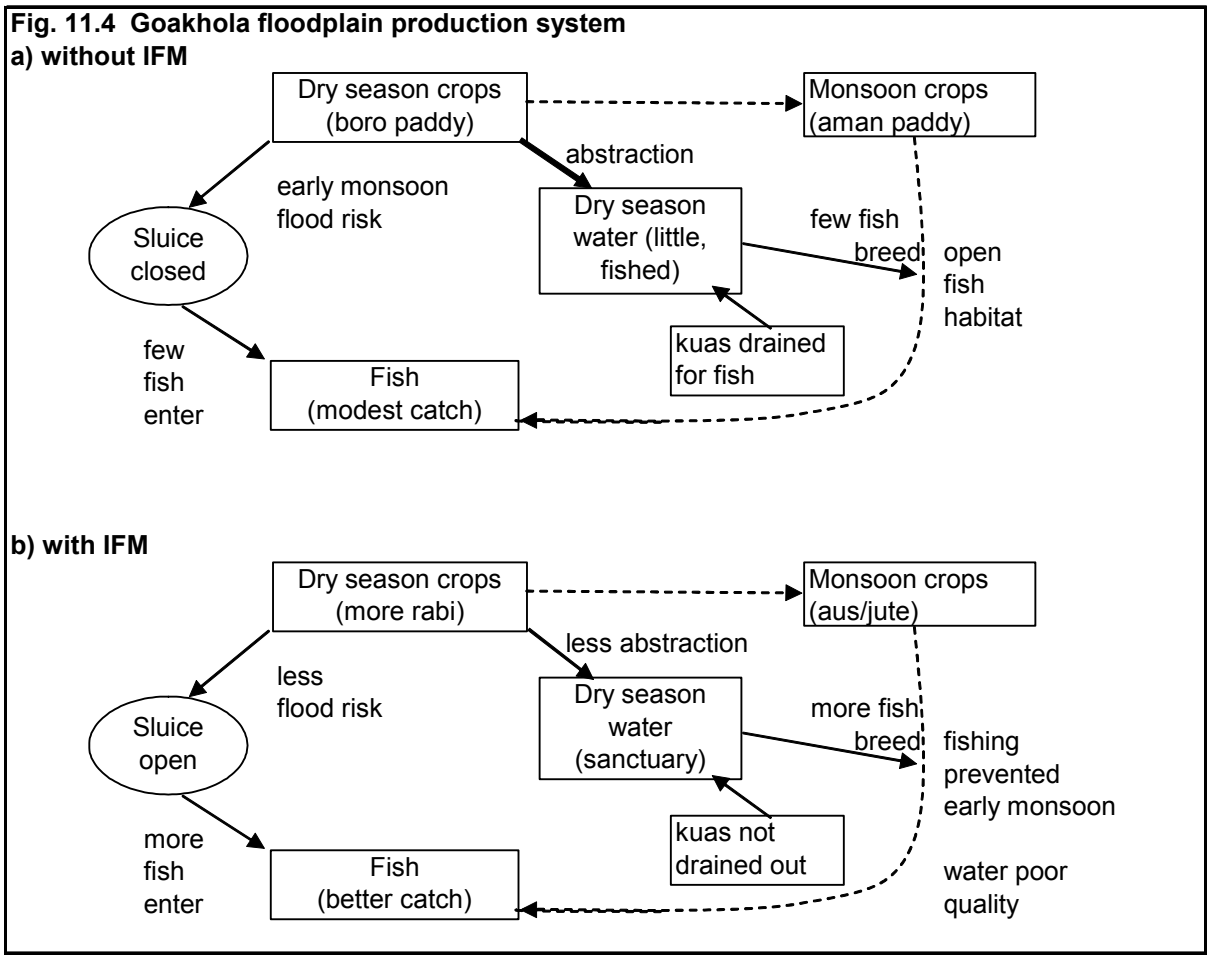
Table 11.1 Changes in surface water abstraction and dry season fish habitat attributable to cropping pattern changes linked to IFM approach in Goakhola-Hatiara Beel.

	2003	2004	2005
Volume of water in 2.9 ha of kuas (m^3)	23,693	31,552	41,441
Volume of water in 1 ha of khal (m^3)	11,000	12,300	16,000
Total fish habitat in dry season (m^3)	34,693	43,852	57,441
As % of 2003	na	126	166
Estimated water abstracted from surface for irrigation (m^3)	117,611	86,948	33,105
As % of 2003	na	74	28

Volumes of surface water based on measurements in sample spots and kuas as shown in Figs 11.1 and 11.2.

Considering the previous interactions in the floodplain system, and the changes brought about through the different options for IFM introduced in Goakhola-Hatiara Beel, Fig 11.4 summarises the changes and how in theory they link together.

Fig. 11.4 Goakhola floodplain production system



One important impact has been the acceptance and wide understanding of practices and linkages promoted through the IFM approach. This has been achieved through demonstration and participation processes in the pilot sites, and inviting people from neighbouring beels and local officials and extension workers to observe and attend meetings. Interest from local officials and media has developed, for example local extension workers have promoted the approach and their activities in newspaper articles. As a consequence of media coverage IFM was discussed in the District Coordination Committee and the involved government agencies (DOF and DAE) are now advocating the approach as part of their work.

11.3 Between Year Variability of Floodplains

An integrated approach to floodplain resource management that takes account of individual returns from agriculture and fishing/aquatic resources, and which makes inter-linkages and externalities clear and addresses them through collective action, should not only achieve a higher level of production, but should also be more resilient. The floodplain has a very variable environment in terms of the surface water that drives the system in both the dry season and monsoon, with each year different in the timing of rising and falling of monsoon water levels, flood depths, dry season water levels, rainfall in dry or wet season, etc.

Table 11.2 indicates how in theory some of the main changes introduced with the IFM approach are expected to respond in unusual conditions in the dry (columns) and wet (rows) seasons. This indicates that the existing/previous combination of practices and uses might give a high total return when a wetter than average dry season is followed by a normal monsoon, but returns are likely to be low if there is a drought. Whereas with changes involved in the IFM approach, particularly alternative rabi crops and fish conservation in the dry season there should be a win-win situation, with total returns higher than in the previous system in each combination of conditions.

Table 11.2 Resilience characteristics of floodplain production system in Narail.

a) without/before IFM

	Drought	Wetter dry season
Normal/drier monsoon	-- Less return from boro paddy (lower yield/higher irrigation cost) -- Low fish catch (low dry season survival, poor growth/reproduction) + Good aman paddy return	++ Better return from boro paddy (lower costs) = Moderate fish catch (better dry season survival, poor growth/reproduction + Good aman paddy return
Flood	-- Less return from boro paddy(lower yield/higher irrigation cost) = Moderate fish catch (low dry season survival, better growth/reproduction) -- Poor aman paddy return (flooded)	++ Better return from boro paddy (lower costs) + Moderate-good fish catch (better dry season survival, better growth/ reproduction -- Poor aman paddy return

b) with IFM

	Drought	Wetter dry season
Normal/drier monsoon	= Reasonable return from rabi crops (lower yield) - Moderate/poor fish catch (ok dry season survival, poor growth/ reproduction) + Good aus/aman paddy return	++ Good return from rabi crops (higher yield) + Good fish catch (better dry season survival) + Good aus/aman paddy return
Flood	= Reasonable return from rabi crops (lower yield) + Good fish catch (low dry season survival, better growth/reproduction) = Moderate aus/aman paddy return (aus ok unless early flood)	++ Good return from rabi crops (higher yield) ++ V good fish catch (better dry season survival) = Moderate aus/aman paddy return (aus ok unless early flood)

11.4 Remaining Issues

There are further floodplain resource linkages that can be addressed and may already be coming into the thinking of the community taking the IFM system approach.

For example, as noted earlier snail populations have declined and with them the incomes of women collecting snails, with also possibly negative impacts on water quality in the beel.

The increasing cultivation of aus paddy may help to reduce collection of snails (as farmers do not allow access to flooded fields of aus paddy), but an issue for the community is what level of snail collection is best. Other aquatic resources such as water lilies are also scarce, but may not have sufficient value for the community to change their practices or reintroduce them.

The IFM activities did not address grazing as a common seasonal resource in fallow fields, but now there is virtually no common grazing within the beel so cattle are stall fed, instead farm power is now almost all mechanised for land preparation. Although this is a Hindu community they appear to have replaced the need for cattle with fish as part of their local culture.

There remains scope to test and demonstrate other rabi crops in the area, and to work on adjustments in sluice operation as cropping changes to permit more fish to enter in the early monsoon. Hopefully the IFM committee will be able to encourage testing of options and comparison of the results, and can continue the initial successes it has had in coordinating and encouraging cooperation among the beel community and with government service providers.