

Livelihood Impacts of Community Based Management: Experience from Floodplain Fisheries in Bangladesh

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Abstract:

This paper presents the impact of Community Based Fisheries Management Organizations (CBO) on fishing households' welfare and their livelihood in Bangladesh. During 1995 to 2006 the CBFM project established local fishery CBOs by providing credit facilities, training and promoting social awareness with an aim to enhance poor fishers' capability of greater access to their livelihoods. This paper describes the results from a survey of 2,826 households in 40 water bodies.

The study found that fisher's income from fishing did not raise significantly in project *open beel* sites and fell in *closed beel* sites. In contrast a clear improvement was demonstrated in fisher's income from fishing in *river* and *floodplain* sites. This indicates that it is difficult to determine the outcome of CBFM due to the variability between the resource systems and the communities. The study shows that the households in the project areas were found to be more cooperative, more aware of fisheries rules and regulations and were able to resolve conflicts due to project interventions. The results suggest that the success of community based interventions mainly depends on the particular context. It conclude that future community based interventions need to give priority to flexible management approach and follow the context specific guidelines rather than applying a fixed approach. The roles of partner NGOs and government should be well defined for future sustainability of community based institutions in inland fisheries of Bangladesh.

Keywords: *Community-Based Management; Institutions; Inland fisheries; Livelihood; Sustainable management*

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1. Introduction

The open-water fisheries resources of Bangladesh are crucial for the livelihood of the poorest and vulnerable sectors of the country in providing employment, fish for consumption and income. While harvests from fish culture are rising, catches from open-water fisheries appear to be declining. In common with many other small-scale fisheries, the reasons for the decline are more to do with difficulties in controlling access to and exploitation of a common property resource than any particular technical issues.

The current leasing system is based on competitive bidding where fishermen cooperatives were given priority in leasing the government owned water bodies⁴. This has developed into an exploitative system where cooperatives often act as fronts for influential individuals who take the three year lease and then employ fishermen or sub-lease it to small fishermen. The short leasing period means that there is no incentive to protect and conserve fish stocks. Lease fees are pushed up each year but many remain unpaid as legal disputes between the leaseholders and the government are common and take many years to resolve.

This paper presents the impact of Community Based Fisheries Management Organizations (CBO) on fishing households' welfare and their livelihood in Bangladesh. The prime objective of CBFM which has been piloted in various fisheries resources over 10 years is poverty reduction through improved management. With variability in the resource systems and the communities, it was found that CBFM has significantly contributed to the income of fishers in the rivers and floodplain beels compared to closed beels and open beels. There was a clear trend of fishers taking up other income generating activities, particularly agriculture, by increasing their land holdings, as the project intended to achieve. Clear impacts were also found on households social assets, in project sites, people were more cooperative, were more aware of fisheries rules and were able to resolve conflicts in project sites compared to the control sites.

The results conclude that attribution of livelihood improvement through CBFM is not easy and depends on the specific circumstances; these suggest that only access to small and profitable fisheries is not enough to attribute income from fishing due to conflicts and high leasing costs. This does not support the premise that small and well defined fisheries are potential to benefit poor fishing community. Future policy should take into consideration flexible and suitable management approach to improve fisheries and sustainable livelihoods.

The paper is organized as follows. Section 2 provides an overview of fisheries management and CBFM project in Bangladesh; while the data source and

⁴ Bangladesh has an estimated 4 million hectares of lakes, rivers and floodplains as well as a further 0.5 million hectares of ponds and culture based fisheries. The Government of Bangladesh (Ministry of Land) owns 12,000 waterbodies (beels and river sections) in which access is controlled by leasing. Besides, the government owned waterbodies (jalmahals), Bangladesh has 2.8 million hectares of floodplains (21% of total area), in these areas, and in rivers where leasing was abolished in 1995, there is even less control over exploitation of the fisheries.

measurements of livelihood asset indices are described in Section 3; Section 4 describes the characteristics of households and impact of livelihood assets; Section 5 presents the results of the impact on livelihood assets in the CBFM project and non-CBFM sites. Section 6 discusses the regression results. The final section presents the conclusions and policy recommendations.

2. Overview of fisheries management and CBFM

A number of projects were implemented by the Government of Bangladesh based on the concepts of community management and co-management of fisheries in an effort to address concerns over the damage caused to the fisheries resource and to ensure that access to fisheries is given to genuine fishermen.

The CBFM project, funded by the Ford Foundation and the UK Department for International Development (DFID), aimed to promote the sustainable use of, and equitable distribution of benefits from, inland fisheries resources by empowering communities to manage their own resources. The project was implemented in two phases: 1994-1999 (CBFM-1) and 2002-2005 (CBFM-2) by the WorldFish Center and the Government of Bangladesh's Department of Fisheries (DoF) with the support of 11 Non Government organizations (NGOs). By 2005 the project has facilitated the establishment of 130 Community Based Organisations (CBOs) in 116 different waterbodies⁵ located in regions throughout Bangladesh which served more than 23,000 poor fishing households.

The CBFM waterbodies, comprising mostly of rivers, closed beels, and open beels, but also significant areas of floodplains. There are also major differences in the way they are managed. Closed beels and open beels are government owned water bodies that have been leased out to individuals or groups as *jalmahals*. The cost of the lease varies according to what has been paid in the past for that water body and tends to be higher for more productive and more easily controlled water bodies, particularly closed beels, this is generally not a practical strategy in most open *beels*. Floodplains are seasonally flooded areas in which the land is privately owned when it is dry but the fisheries are traditionally open-access when the land is flooded. Most of the CBFM river-sections are former *jalmahals* where lease were applied. However since the lease system was withdrawn 10 years ago they have also been open-access.

In closed and open *beels*, CBOs had to take over a commitment to pay the lease fees in return to secure control over management of the water body. This involved a clear change in tenure and access as in most cases. Fishers in the newly established CBFM community groups (CBOs) had hitherto no access to fishing in those water bodies because the lease was held by a single person or a 'fisherman's co-operative' controlled by a few rich and influential individuals. Where CBO members had opportunities to fish, it was as wage labourers or after they had paid a fee to the leaseholder. Closed beels are usually managed as stocked fisheries which results in high production levels. However, this is generally not a practical strategy in most open beels.

⁵ There are more than one CBOs organized in some larger floodplain beels under the CBFM project.

In floodplains, the land was privately owned before the project and there was no effective change in access or tenure because no lease was required. The community groups operating in these areas were encouraged to implement measures to improve the state of the fish stocks, in particular, by excavating dry season refuges for fish. The situation in rivers was similar because leasing was abolished in 1995. This led to a free-for-all which tended to favour the most powerful who could afford to install and maintain fish aggregating areas known as *kathas*. Under the CBFM-2 project, CBOs were able to establish control over river sections, significantly reducing the number of *kathas* and establishing no-fish zones or sanctuaries.

3. Methodology

The main tool for assessing livelihood impacts was a pair of questionnaire-based field surveys - a baseline study carried out in 2002 shortly after the start of CBFM and an impact study carried out in mid-2006, just before the end of the planned project period. Both surveys included project water bodies where community based fisheries management was promoted, and control (non-project) water bodies. Household selection was based on random sampling of a comprehensive census in project and control areas. Therefore the results provide a snap-shot of the situation in the community as a whole rather than just household that became directly involved with the project as fishers, CBO group members or recipients of micro-credit.

We adopt the “rural livelihood approach” to assess changes in the well-being of different categories of households. Assets, as defined in terms of the rural livelihoods framework (Ellis, 2000) include social, physical, human, financial and natural assets are measured by a set of defined variables (Table 1). A set of ten variables were used to construct social capital index. Other variables are included in the study as independent variables.

3.1 Measurement of Social Capital and Other Variables

Social capital can be measured through the involvement of resource users in community based management schemes. Improving fisheries management is responsive to the local situation, resource users, empowerment of fishers, capacity building and access to information. We construct a quantitative social capital measure which focuses on social capital in community based organisations. Krishna & Uphoff (1999) and Grootaert & Narayan (2004) used several variables to construct a social capital index. A common method for measuring social capital is the Principal Component Analysis (PCA). The main purpose of this analysis is to reduce a number of explanatory variables into one or a few variables.

PCA is based on the multiple correlation principle and can explain the variance of the dependent variables. The principal component selects factors considered significant if their eigenvalues are greater than one. Social capital indices can be constructed using the following formula:

$I = \sum_{i=1}^n W_i X_i$ where, I = sum of the weighted index; W = weight of the combination of factors and X = the value given by the respondents for each variable.

A set of capital scores is obtained by the weighted sum of various variables. The combination of the important variables with high factor loading is used for constructing an index. The overall value of the index is calculated by percentage contribution of each selected highly loaded variable. This percentage contribution is used as weight for constructing an index of capital assets.

Table 1: Definition of variables

<p>Social Capital Participation = participation in decision making (10-fully participate; 1-no participation) Community Influence = influence in the community (10=fully able to influence; 1= not able to influence) Fisheries Compliance = compliance on fisheries rules (10= fully comply with rules; 1=no compliance) Better Management = fisheries management improved (10= very high improvement;1=not improved) Resolve Conflicts = conflicts over fisheries resolved (10 = conflicts resolved fully; 1 = serious conflicts) Information Exchange = information flow improved (10 = quick flow of information; 1= lack flow) Fishery knowledge = improved knowledge in fisheries (10= fully improved; 1= not improved at all) Cooperation = cooperation in the community improved (10- highly improved; 1-not improved) Group activities = activities towards community benefits (10- increased activities in group; 1-not at all) Support/help others= attitude towards help each other (10-all have this attitude; 1-none have this)</p> <p>Other asset variables Housing = value of house structure (Taka) Homestead land = area of homestead land (ha) Fishing equipment = value of fishing gears (Taka) Education = education of household head (years) Age = age of household head (years) Credit = amount of credit received by household (Taka) Institutional Credit = amount of credit received from banks and NGOs (Taka) Cultivable land = cultivable land owned by household (ha) Other capital assets= durable assets such as rickshaw/van, radio, bi-cycle, cattle heads owned (number) Household size = number of household members Number of fishers = family members participated to fish (number)</p>
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3.2 Regression Model

Multiple regression analysis is used to examine the link between income of various category of households and livelihood asset variables. The equation is specified and estimated separately for the CBFM project and non-CBFM control sites by the Ordinary Least squares technique. Only the important factors that contribute to household income are analyzed using a regression model. As shown in equation (1) the explanatory variables included in the model consist of those measuring various asset endowments and demographic characteristics of the households. The dependent variable is the welfare of the household measured by proxy in terms of annual household gross income from different sources.

$$Y = \alpha + \beta_1 FI + \beta_2 OL + \beta_3 CULT + \beta_4 NLA + \beta_5 CRT + \beta_6 FCRT + \beta_7 NICRT + \beta_8 ICRT + \beta_9 VFG + \beta_{10} HS + \text{Error}, \quad (1)$$

Where, **Y** = household annual income (taka)
 α = constant

β_1 to β_{10} = coefficient of variables for household asset endowments and household characteristics

FI = household fishing income (Taka)

OL = household own land (decimal)

CULT = area of household cultivable land (decimal)

NLA = non-land assets own (taka)

CRT = total credit received by households (taka)

FCRT = credit received from formal institutions i.e. bank, NGOs (taka)

NICRT = credit received from other local credit institutions (taka)

ICRT = credit received from informal sources i.e. friends, relatives (taka)

VFG = Value of fishing gears (taka)

HS = household size (number)

Error

3.3 Data Sources

The baseline survey was designed to represent all CBFM waterbody types including 28 individual sites, 5 cluster sites and 11 control sites and more than six thousand sample households. The sample for the impact survey includes half the sites covered in the baseline study comprises 1994 households (including both project beneficiaries and others) at 34 project water bodies and 832 households in 6 control water bodies. The questionnaire used in the impact survey was based on the baseline survey format which separated households into 5 categories based on their poverty and fishing profiles as shown in Table 2.

The baseline and impact questionnaires covered a wide range of socio-economic and livelihood parameters, details of aquatic resource use, fishing involvement, access, compliance, existing NGO support and scales to measure more subjective indicators including social capital.

Survey results were analysed according to water body type (closed *beels*, open *beels*, floodplains, rivers), and household type (Poor fisher; Poor – Non-fisher; Moderately poor fisher; moderately poor – Non-fisher; and Better off). In most cases, comparisons were also made against households from control waterbodies. The data from the impact survey were analysed using descriptive statistics and multivariate linear regression model used to examine the shifts in livelihood profiles.

Table 2 - Household categories

Category	Household type	Characteristics
I	Poor fisher	Fishes for income or for both income and food, usually does labouring work, and possesses no agricultural land.
II	Poor – Non-fisher	Does not fish for income, has no agricultural land, usually does labouring work, but not service or professional jobs.
III	Moderately poor fisher	Fishes for income, has some agricultural land but less than 100 decimals (0.4 ha), or if occupation includes service or professional job and has thatched house.
IV	Moderately poor – Non-fisher	Does not fish for income, has some agricultural land but less than 100 decimals (0.4 ha), or if occupation includes service or professional job and has thatched house.
V	Better off	May or may not fish for income, has land more than 100 decimals (0.4 ha) and/or has someone with a service or professional job and has a tin house, or a pucca (concrete) house.

4. Household Characteristics

The poor fishers of Bangladesh are in a disadvantaged position in respect to access and control of various assets. The assets include poor health and lack of formal education, little cultivable land, limited access to common property resources, limited entry to formal credit markets, and possess few physical assets. They have limited “social assets” (having poor linkage with the community and neighbor). This section presents the evidence covering all the dimensions of livelihoods of various economic groups between 2002 and 2006.

Table 3 compares the changes in assets for the five economic categories of households in the CBFM area over the project 2002-2006. It was observed that the quantity of assets owned by different category of households differs by waterbody types. The category of poor and moderately poor fisher households has the lowest mean value of assets such as land, other non-land physical assets followed by the poor and moderately poor non-fisher household in all types of water bodies except in the floodplain beels. The lowest asset position of the poor fishers indicates that they had poor assets at the initial stage before the project started.

In the floodplain beels, however, the poor and moderately poor fisher category has relatively higher mean value of assets compared with similar poor non-fisher category. This indicates that fishers in the vast floodplain beel areas have already had better access to the important assets before the CBFM project. The well-off category of households has the highest mean value of assets in all types of waterbodies.

The study show that the poor fisher households have had greater access to institutional credit compared to the poor non-fishers in closed, open and floodplain beel sites, while in the river sections the amount of credit received by the poor fisher households were

relatively low. This evidence confirms that poor fishers are not overlooked by the NGOs, and other informal local credit institutions.

Average family size was recorded to be largest (5.9 persons) in the poor fisher households in floodplain beels and the lowest (4.2 persons) was found in closed beels. These households often find difficulty to meeting their daily needs due to large family size and they have less possibility to escape from the vicious circle of poverty.

The study found that project households of various economic categories have been involved in fishing. However, average number of fishers and their extent of involvement differ between the waterbody types. It shows that the number of persons fishing did not change significantly during the project 2002 – 2006. This confirms that majority of the rural households, irrespective of their economic category and locations have been fishing in the vast floodplains for meeting part of their basic livelihood demand. Average number of fishers per household was 1.2 to 1.7, however, on average 2 persons participated in floodplain fishing in 2002 and 2006. It appears that fishing in the floodplains is relatively easier as it does not require leasing and people can fish at low costs using multiple small scale traditional gears.

Table 3: Asset base of fisher households by waterbody types in CBFM project sites, closed beel, open beel, rivers and floodplains, 2002-2006.

Project	(a) CLOSED BEEL									
	Poor fisher		Moderately poor fisher		Poor non fisher		Moderately poor – Non-fisher		Better off	
	2002	2006	2002	2006	2002	2006	2002	2006	2002	2006
Labor force										
Family size (No)	4.2	4.6	4.7	5.0	3.8	4.0	4.2	4.5	5.4	5.4
Number of fishers	1.3	1.4	1.4	1.3	1.2	1.1	1.3	1.1	1.6	1.3
Natural assets										
Owned land (ha)	0.01	0.03	0.14	0.21	0.01	0.02	0.25	0.25	1.41	1.28
Cultivated land (ha)	0.06	0.17	0.20	0.27	0.12	0.13	0.24	0.29	0.99	0.91
Human assets										
Year of schooling of all members (no)	8.6	9.5	8.9	10.1	7.6	8.9	7.6	8.3	9.1	9.4
Financial assets										
Institutional loan taken (\$)	20	52	20	64	12	30	12	46	42	55
Non-institutional loan taken(\$)	6	24	14	26	11	23	12	17	8	24
Loans taken form relatives (\$)	7	9	8	8	6	7	5	8	22	34
Total loans (\$)	33	85	42	98	29	60	29	71	71	113
Physical assets										
Non-land assets(no)	1.2	2.6	2.1	3.2	1.4	2.2	2.5	3.6	4.8	5.8
Value of fishing gears (\$)	19	144	30	158	4	74	4	44	11	82

Table 3: continued

(b) OPEN BEEL

Project	Poor fisher		Moderately poor fisher		Poor non fisher		Moderately poor – Non-fisher		Better off	
	2002	2006	2002	2006	2002	2006	2002	2006	2002	2006
Labor force										
Family size (No)	4.6	4.9	5.0	5.3	4.3	4.5	4.6	4.9	5.7	6.0
Number of fishers	1.4	1.3	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.3
Natural assets										
Owned land (ha)	0.02	0.02	0.09	0.17	0.07	0.09	0.26	0.31	1.37	1.27
Cultivated land (ha)	0.09	0.15	0.28	0.29	0.17	0.22	0.34	0.35	1.10	0.94
Human assets										
Year of schooling of all members (no)	9.2	10.5	8.8	9.7	8.0	10.5	8.3	10.2	8.1	9.3
Financial assets										
Institutional loan taken (\$)	34	75	31	69	30	69	20	65	33	75
Non-institutional loan taken(\$)	16	26	15	40	12	26	21	14	20	37
Loans taken form relatives (\$)	12	22	13	24	14	20	27	45	52	56
Total loans (\$)	63	124	59	134	55	116	68	124	105	168
Physical assets										
Non-land assets(no)	1.1	1.5	1.9	2.3	1.5	2.0	2.4	2.8	3.9	4.4
Value of fishing gears (\$)	35	32	32	35	8	17	13	35	16	17

(c) RIVER

Project	Poor fisher		Moderately poor fisher		Poor non fisher		Moderately poor – Non-fisher		Better off	
	2002	2006	2002	2006	2002	2006	2002	2006	2002	2006
Labor force										
Family size (No)	4.7	5.3	4.8	5.2	5.3	5.3	5.5	6.3	6.0	5.9
Number of fishers	1.6	1.5	1.6	1.3	1.2	1.2	1.5	1.7	1.8	1.4
Natural assets										
Owned land (ha)	0.05	0.11	0.30	0.39	0.06	0.06	0.44	0.50	1.24	1.36
Cultivated land (ha)	0.13	0.19	0.41	0.41	0.22	0.22	0.58	0.68	1.17	1.12
Human assets										
Year of schooling of all members (no)	9.1	9.2	9.4	9.7	9.3	10.5	8.0	8.2	8.6	8.8
Financial assets										
Institutional loan taken (\$)	36	58	53	82	63	87	32	95	61	100
Non-institutional loan taken(\$)	32	45	32	52	41	41	28	112	35	32
Loans taken form relatives (\$)	11	22	15	54	12	27	42	22	23	16
Total loans (\$)	78	125	100	188	116	155	103	229	119	147
Physical assets										
Non-land assets(no)	1.5	1.7	1.9	2.7	1.8	2.0	2.7	3.1	4.2	4.3
Value of fishing gears (\$)	25	58	30	44	18	14	24	23	19	20

Table 3: continued

(d) FLOODPLAIN BEEL

Project	Poor fisher		Moderately poor fisher		Poor non fisher		Moderately poor – Non-fisher		Better off	
	2002	2006	2002	2006	2002	2006	2002	2006	2002	2006
Labor force										
Family size (No)	5.9	5.9	5.7	5.8	4.3	4.5	4.7	4.9	5.5	5.4
Number of fishers	1.9	2.0	2.0	1.9	1.5	1.2	1.5	1.3	1.7	1.5
Natural assets										
Owned land (ha)	0.28	0.17	0.32	0.35	0.10	0.08	0.38	0.49	1.04	1.15
Cultivated land (ha)	0.40	0.47	0.46	0.41	0.24	0.18	0.43	0.56	0.77	0.87
Human assets										
Year of schooling of all members (no)	7.5	9.6	9.2	10.5	9.3	10.0	9.3	9.7	8.6	9.2
Financial assets										
Institutional loan taken (\$)	67	121	58	67	49	74	45	130	50	41
Non-institutional loan taken(\$)	32	64	12	30	25	21	39	38	8	24
Loans taken from relatives (\$)	7	17	9	13	4	60	37	100	82	24
Total loans (\$)	106	202	79	110	78	154	121	268	140	89
Physical assets										
Non-land assets(no)	3.2	2.9	3.4	4.2	2.0	1.9	2.5	3.7	4.2	4.3
Value of fishing gears (\$)	29	29	31	30	8	9	8	10	8	10

Note: T-test for paired sample shows that for the poor fisher households in closed beel, the difference between two periods is significant at 1% level for cultivable land, institutional and non-institutional loans, and non-land assets. For the moderately poor fishers, the difference is significant at 1% level for institutional loans, value of fishing gears. For the poor non-fisher and moderately poor non-fisher households, the difference is significant at 1% level for institutional loans. In open beels, the difference is significant at 1% for the poor fishers for cultivable land, while the difference is significant at 1% level for institutional credit for all 5 categories of households.

In the rivers, the difference between two periods is significant at 1% level for institutional loans for the moderately poor non-fishers, loans taken from relatives at 5% level. The difference is significant at 5% level for the value of fishing gears for moderately poor fishers. In the floodplain beels, the difference is significant at 1% level for total loans received variable for the poor fishers.

5. Livelihood Impact on Fishing Communities

The results presented in Table 3 confirms that access to various assets endowments are important for improving livelihood, although some assets are clearly more important than others in the actual improvement in their livelihood. The majority of poor fisher households in the CBFM project areas have improved their physical, financial and natural assets.

Fisher's main income comes from fishing; it was possible to demonstrate clear improvements in fishers' income from fishing that could be ascribed to the project, as they were not observed in control sites. The fishers were found taking up other income generating activities such as cultivating high yielding varieties in their increased farm size. Project households also tended to be more reliant on the institutional credit from NGOs than their counterparts at the end of the project. The CBFM fishers were found to

be involved in other non-agricultural activities such as fish trade, services and non-agricultural labour (rickshaw/van pulling, construction, carpentry).

Change in natural assets

Land is regarded as one of the most important asset for poor people. The baseline and impact surveys recorded land ownership and rented or sharecropped land holdings. The results show that fishers in both project and control sites have increased their land holdings – mainly by renting or sharecropping but also by purchasing land. Poor fishers increased their cultivable land significantly in all types of project waterbodies, large improvement was recorded in closed beels (183%) and in the open beels (67%), while cultivated land size was moderately increased in rivers (46%) and in floodplain beels (18%) over the project period (Table 3). The increasing land holdings of fishers correlates well with the finding that agriculture has become more important for many fisher households. Increased access to land and HYV paddy cultivation at their farm, enabled them to increase income as well as to resist frequent migration to other areas during employment crisis in the rural areas.

Change in financial assets

Access to financial credit is important in financing working capital particularly for the poor community in rural area. A number of NGOs have micro credit programmes throughout the country to generate employment opportunities for millions of poor people of Bangladesh. The CBFM project had also a small micro-credit component to support fisher group members during closed seasons⁶ and to increase employment opportunities in sectors other than fishing. Poor fisher households have had higher institutional credit (NGO's micro-credit) access in floodplain, closed and open beels before the CBFM project. However, initial amount of institutional and non-institutional credit was lower for the poor fisher households compared to poor non-fishers in the project river sites (Table 3). Substantially higher amount of credit taken by the poor fishers from both institutional and non-institutional (local societies, informal groups) sources in all types of project water bodies indicate that increasing income through alternative employment of fishing communities has clear attribution to the CBFM project interventions. Poor fisher households in project sites have become less reliant than other households on money lenders (*mohajans*) which is the most exploitative type of lending as they charge very high interest rates. The results show that households in the control sites have become much more reliant on moneylenders, while project households have slightly increased their borrowing from *mohajans* over the project period (Islam and Dickson 2006). This indicates that CBO members have become more trusted in lending and borrowing at the village level.

Change in human assets

Human capital is important because it contributes household's economic and social well-being. Human assets are measured by the average number of earning members and their years of schooling. Average family size of poor fisher households is larger

⁶ The CBOs established fish sanctuaries in the project waterbodies and introduced closed seasons for 2-3 months during fish breeding time when fishing is restricted. These results in reducing fishing pressure as well as enhance natural stock in the floodplains.

than other household category. Although, fishing in the vast floodplains is the easiest employment opportunity, it was observed that young members of fishing households shift to other sectors for employment. Most of the household heads in poor fisher households are illiterate, however, average years of schooling of all members of fisher households (poor and moderately poor fisher households) was below Secondary School Certificate (SSC level; 10 years of schooling). Although, average years of schooling was relatively lower for the poor fisher households compared to the poor non-fisher households, it indicates that the young members of poor fishing community have had access to schooling, which may contribute to improve their human capital and livelihood in future. The project had training and awareness programmes including adult education in the rural areas provided by partner NGOs of CBFM mainly to improve knowledge in fisheries and public health awareness. The Government and NGOs have nationwide massive education programmes, which contributed to improve the level of education for mass community.

Change in physical assets

Physical asset endowments are good indicator of income, welfare and livelihood. Many fishers in Bangladesh possess poor capital assets and poor house materials. Impact study results show that CBOs have improved their house construction materials and fitted with flush sanitary latrines. Majority of the poor fisher households said that they have improved their houses with wooden, tin or brick walls during the project period. Improvements were found in the other non-land fixed assets such as fishing gears, poultry and livestock, rickshaw/van, bi-cycle and pump machines.

Average value of fishing gears held by poor fisher category in closed beels project sites increased by six times while moderately poor fisher increased by four times over the project period. Similarly, value of fishing gear increased by 132% and 46% for poor fishers and moderately poor fishers respectively (Table 3). Average value of fishing gears for poor fisher households in open beels and floodplain beels remained the same over the project period. These results confirm that micro-credit was mostly utilized for non-fishing income generating activities in open beels and floodplains such as farming and petty trade.

Change in social assets

As part of the impact study, heads of households were asked about their attitudes to social issues. Comparisons were made between project and control households in 2002 and 2006. Paired t-tests were used to compare their ratings on 1-10 point scale on the different questions. The responses to the questions indicate that there has been a very marked change in relationships and attitudes in project areas over the period 2002 to 2006. The results show that the mean differences in responses between project and control sites were significantly different in 2006 compared to 2002. The households in all four types of project sites have greater compliance and improved fisheries management skills over the project. Fishers increased their participation in community affairs, can influence fisheries management in open beels, floodplains and river sites, while in the closed beels fishers participation in community affairs and influence in fisheries management declined during the project (Table 4). Increased cooperation and

supportive mind to each other in the closed and open beels shows that fishers are more united to work together for common gains and were able to escape from exploitation by ex-leaseholders in these waterbodies. It is generally observed (in all waterbody type) that people come forward to help each other for common interest during the crisis like flood, cyclone, water logging, and road maintenance works. In floodplain beels and rivers, the fishers show less interest to participate in the common property management for better livelihood. Conflicts over fisheries resolved in open beels and floodplain sites, but still exist in closed beels and rivers showing that influence of rich people is very strong in these types of waterbody areas where project can take effective strategies in future.

Table 4: Change in household perceptions and attitudes in various waterbody types, 2002-2006

Social capital and attitudinal variables	Closed Beel		Open Beel		Floodplains		River	
	Mean Difference (Project-Control)		Mean Difference (Project-Control)		Mean Difference (Project-Control)		Mean Difference (Project-Control)	
	2002	2006	2002	2006	2002	2006	2002	2006
<i>Social Capital Indicators</i>								
Participation	0.91	-0.27	-0.24	0.23	0.18	0.04	0.24	0.19
Community Influence	0.64	-0.17	-0.10	0.21	0.33	0.00	0.27	0.07
Compliance Fishery	-3.01	5.24	0.07	0.52	0.61	1.55	0.50	0.60
Better Management	-3.50	5.78	0.26	0.84	0.46	1.76	-0.21	0.53
Conflicts resolved	-1.09	-0.06	-0.26	0.04	-0.21	0.07	0.10	-0.21
Information Exchange	-2.08	-0.13	0.03	-0.06	0.69	0.07	0.38	-0.06
Fishery Knowledge	-1.52	0.23	-0.08	-0.12	-0.07	0.35	0.29	-0.06
<i>Attitudinal Indicators</i>								
Cooperation	-0.36	0.13	-0.38	0.05	0.14	-0.26	0.54	-0.14
Group Action	0.46	0.10	-0.28	-0.27	0.59	-0.32	-0.47	-0.28
Support/Help other	-0.33	0.16	-0.37	0.13	0.90	0.53	0.11	0.27

Note: Mean difference of response between project and control households in 2002 and 2006 is undertaken to see the changes in their perceptions over the project period. The negative value indicates that project households put their ratings lower than the households in control sites.

In order to measure changes in social capital, an index was constructed using Principal Component Analysis. Two component of social capital were found: empowerment and trust. Six variables with high loadings were aggregated to form the empowerment index (Table 5). The most dominating variables of empowerment index were: Effective fisheries management (0.874) followed by compliance with local fisheries rules (0.864) and enforceable ability of fisheries rules (0.787). The CBOs actively participated in making decisions on fisheries management rules. These rules are: fishing restriction in fish sanctuary, restriction on the use of destructive gears and three months closed season introduced by the management committee. The fishers strictly obeyed the rules in their fisheries. The people in the project sites have been able to resolve social conflicts more quickly than those in control sites. They also said that their level of fisheries knowledge has increased significantly with an increasing flow of information among the people in the community which has high loadings (0.748 and 0.688).

Table 5: Empowerment Index: Factor Pattern

Performance Indicator	Factor Loading	Score
Effective fisheries management	0.874	0.185
Compliance with fishery rules	0.864	0.183
Ability to enforce fisheries rules	0.787	0.167
Speed of resolving conflicts	0.758	0.161
Information exchange	0.748	0.158
Knowledge in fisheries management	0.688	0.146
Total	4.719	1.000

Extraction Method: Principal Component Analysis

Table 6 shows three dominating variables in the Trust index: unity, trust and cooperation. Unity variable has the highest score (0.778) followed by trust (0.745) and cooperation (0.605). It shows that the CBOs are now represented more equitably in decision making, as the management committees are elected by all participants. The quality of institutions (CBOs) improved in the project sites, the CBOs are capable to protect resources from outsiders. The capable leaders in the community can establish trust in the society may build social capital easier. In the project areas, it appears that, the villagers trust each other in lending and borrowing, it was poor in control sites.

Table 6: Trust Index: Factor Pattern

Performance Indicator	Factor Loading	Score
Unity	.778	0.366
Trust	.745	0.350
Cooperation	.605	0.284
Total	2.128	1.000

Extraction Method: Principal Component Analysis

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0.853

Bartlett's Test of Sphericity: Approx. Chi-Square 10849 df 55 and significance at 1% level

Change in Household Incomes

The study found that the project has had clear positive impacts on household incomes. Average household incomes⁷ in project areas rose by 31%, and increased significantly in all types of waterbodies – by 21% in closed beels, 24% in open beels, 37% in floodplain beels and 57% in rivers from 2002 to 2006. However these rises were matched by similar increases (average, 37%) in the control sites (Islam and Dickson, 2006). It means that the overall income gains in project cannot be directly attributed to the project. When the households were split into five occupation types, poor fisher, poor non fisher, moderately poor fisher, moderately non poor fisher and better-off, it was found that incomes of all types of households increased over the project period.

Table 7 shows that the annual income levels for poor fishers in closed beels was the lowest, 352 dollars in 2002, while the level of income for similar types of households in the floodplain beels was the highest (617 dollars). Average income for poor fishers rose significantly in the project river and floodplain sites (45% and 35% respectively) over the

⁷ Adjusted for inflation

project period. In the project area, poor non fishers' incomes rise in floodplain, open and rivers significantly. Income rise for the poor non-fisher households was relatively higher compared to the poor fisher household in closed, open and floodplain beels.

Table 7: Household incomes (\$/year) by water body type and occupation in project and control, 2002 – 2006.

WB ^{a>}	Poor fisher			Moderately Poor Fisher			Poor Non fisher			Moderately poor non fisher			Better off		
	2002	2006	%	2002	2006	%	2002	2006	%	2002	2006	%	2002	2006	%
Project															
CB	352	420	20	384	435	13	273	335	23	340	376	11	713	924	30
OB	400	504	26	489	539	10	338	446	32	394	522	33	793	1009	27
R	430	626	45	498	852	71	381	514	35	440	830	89	680	1222	80
FPB	617	845	37	693	1022	48	435	598	37	665	919	38	855	1273	49
Control															
CB	272	304	12	432	458	6	286	322	13	252	345	37	784	1043	33
OB	489	574	18	404	671	66	347	472	36	522	834	60	897	1420	58
R	646	601	-7	483	607	26	521	628	21	578	777	34	648	1155	78
FPB	534	465	-13	400	481	20	334	529	58	375	618	65	579	877	52

a> WB stands for waterbodies; CB for closed beel; OB for open beels; R for rivers and FPB for floodplain beels
 Note: T-test for paired samples shows that for the average income of poor fishers, in the project sites, the difference between the periods 2002-2006 is significant at 1% level in open beel, at 5% level in closed beel, rivers and floodplain beels. In the control sites, poor fishers' income was not significantly increased in any of the waterbody types. The difference of income for better off households is significant in all types of waterbodies, while in the control sites, it is significant in open beels and in the rivers. In the project sites, the difference is significant at 5% level for the poor non-fishers in open beels, floodplains and the rivers.

In the control areas, however, average income of the poor fishers did not improve compared to the rise in income of the poor non-fisher households. Poor fisher's income declined significantly in floodplain areas by -13% followed by river areas -7% (Table 7). This clearly indicates that the income gains for the poor fishers in project areas are directly attributed to the CBFM project interventions.

There were large increases in poor fishers' income from fishing in floodplains, rivers and open beels (88%, 37% and 21%, respectively) in project areas. In closed beels, which are usually managed as stocked fisheries, poor fishers' income from fishing fell significantly (23%) over the project period (Table 8).

This seems to reflect unequal distribution of benefits because only those who pay their contribution to up-front costs (lease fee and stocking costs) are able to share in the proceeds from collective harvesting (WorldFish Center, Dhaka, 2006). This suggests that social exclusion of poor households is still an important factor in some of the project closed beel sites.

Table 8: Household fishing incomes (\$) by water body type and occupation in project and control sites, 2002-2006

WB	Poor fisher			Moderately Poor Fisher			Poor Non fisher			Moderately poor non fisher			Better off		
	2002	2006	%	2002	2006	%	2002	2006	%	2002	2006	%	2002	2006	%
Project															
CB	213	163	-23	165	126	-24	7	9	35	14	15	7	35	36	2
OB	233	282	21	235	219	-7	9	10	11	20	8	-60	27	20	-26
R	230	316	37	199	390	96	11	24	118	22	37	68	52	58	11
FPB	243	458	88	212	492	132	21	18	-14	126	30	-76	113	86	-24
Control															
CB	144	118	-18	148	94	-37	5	18	260	11	19	79	17	12	-30
OB	248	305	23	178	239	34	12	43	258	6	17	183	36	59	64
R	397	340	-14	249	276	11	94	15	-84	10	5	-50	10	15	57
FPB	224	204	-9	177	138	-22	41	23	-44	33	51	55	87	92	5

Note: T-test for paired samples shows that for the average fishing income of poor fishers, in the project sites, the difference between the periods 2002-2006 is significant at 1% level in closed beels, open beels, and floodplain beels. In the control sites, none of the waterbody types is significantly different for poor fishers. The difference is significant at 1% level for moderately poor fishers in open beels and rivers. The difference is significant at 1% for the non fisher and better-off households in project closed beel sites. the difference is significant at 1% level for non-fishers in the control sites, for open beels.

Data in the impact survey shows that range of income sources of fishing households in various types of waterbodies in CBFM project and control sites. Fishing is an important source of income for the fishers, the relative importance of poor fishers' incomes as an income source declined in closed and open beels (from 60% in 2002 to 35%, and from 58% in 2002 to 54% in 2006 respectively). However, poor fishers' income from fishing in the floodplains has become an important source (from 41% in 2002 to 55% in 2006), proportion of fishing income remained the same in the rivers category (52%) over the project period (Table 9). This indicates that poor fishers particularly in closed and open beel sites are moving away from fishing and taking up other income generating activities.

Data in the impact survey shows that project fishers' income from farming increased significantly over the project period, followed by petty trade, transport worker (rickshaw/van pulling) and remittance. Poor fisher's earnings from wage laboring showed a significant decline in all types of water bodies except in the closed beels. The relatively higher incomes from agriculture compared to fishing means that fishers are keen to move to agriculture at the first available opportunity (Table 9). Organized fishers income from non-fishing activities increased as the CBFM aimed to achieve, Income from fishing as well as non-fishing activities suggest that CBFM project approach is a viable approach to improve livelihoods of poor fishers.

Table 9 - Household incomes (\$/year) from different income sources by water body type and occupation in project and control sites, 2002-2006

Closed Beel																				
Source of income	Poor fisher				Moderately Poor Fisher				Poor Non fisher				Moderately poor non fisher				Better off			
	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%
Fishing Income	213	60	163	35	7	2	9	3	165	42	126	27	14	4	15	4	35	5	36	4
Farm Income	14	4	65	14	29	11	68	21	67	17	121	27	112	33	146	39	427	60	575	62
Wage Labour	49	14	65	14	119	44	75	23	57	15	74	16	70	21	56	15	14	2	21	2
Business	14	4	31	7	35	13	62	19	18	5	32	7	78	23	57	15	76	11	68	7
Service Rural	0	0	10	2	4	2	4	1	5	1	4	1	6	2	14	4	99	14	140	15
Transport	24	7	55	12	40	15	56	17	10	3	32	7	21	6	19	5	4	1	7	1
Livestock	9	2	13	3	7	3	14	4	12	3	21	5	9	3	18	5	13	2	17	2
Fish Trade	4	1	37	8	6	2	5	1	21	5	26	6	13	4	27	7	20	3	31	3
Remittance	27	8	22	5	23	9	31	10	36	9	21	5	11	3	28	7	24	3	29	3
All Income	354	100	461	100	271	100	323	100	392	100	458	100	336	100	379	100	713	100	924	100
Open Beel																				
Fishing Income	233	58	282	54	9	3	10	2	235	49	219	39	20	5	8	2	27	3	20	2
Farm Income	18	4	48	9	30	9	65	15	68	14	108	19	93	23	105	21	300	38	417	41
Wage Labour	66	16	71	14	103	31	98	23	64	13	55	10	70	17	94	18	13	2	26	3
Business	19	5	17	3	54	16	93	21	23	5	25	4	85	21	94	18	89	11	118	12
Service Rural	3	1	3	1	23	7	36	8	3	1	6	1	27	7	48	9	126	16	169	17
Transport	12	3	16	3	54	16	45	10	6	1	9	2	14	3	21	4	5	1	8	1
Livestock	6	2	11	2	9	3	10	2	15	3	19	3	18	4	12	2	18	2	15	1
Fish Trade	30	7	48	9	7	2	7	2	33	7	54	10	2	0	10	2	31	4	12	1
Remittance	16	4	29	6	46	14	69	16	34	7	68	12	73	18	119	23	183	23	224	22
All Income	402	100	526	100	336	100	432	100	481	100	563	100	402	100	510	100	793	100	1009	100

Table 9 continued

	Poor fisher				Moderately Poor Fisher				Poor Non fisher				Moderately poor non fisher				Better off			
	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%	2002	%	2006	%
Floodplain																				
Fishing Income	243	41	458	55	21	5	18	3	212	31	492	41	126	19	30	3	113	13	86	7
Farm Income	75	12	123	15	57	13	76	13	141	20	199	17	103	15	245	28	325	38	406	32
Wage Labour	129	22	136	16	118	27	162	27	160	23	110	9	88	13	106	12	109	13	34	3
Business	26	4	21	2	166	38	133	22	65	9	11	1	112	17	176	20	27	3	223	17
Service	3	0	10	1	11	2	39	6	18	3	0	0	90	14	46	5	90	11	211	17
Rural Transport	34	6	16	2	34	8	51	9	10	1	31	3	13	2	37	4	0	0	0	0
Livestock	21	4	12	1	23	5	30	5	17	2	21	2	28	4	38	4	21	2	33	3
Fish Trade	68	11	46	5	1	0	7	1	32	5	200	17	26	4	134	15	75	9	63	5
Remittance	0	0	11	1	11	3	87	14	36	5	132	11	80	12	63	7	95	11	217	17
All Income	599	100	833	100	441	100	602	100	692	100	1195	100	666	100	874	100	855	100	1273	100
River																				
Fishing Income	230	52	316	52	11	3	24	4	199	41	390	49	22	5	37	4	52	8	58	5
Farm Income	39	9	86	14	39	10	62	12	123	25	175	22	155	34	251	29	295	43	454	37
Wage Labour	89	20	71	12	137	36	112	21	81	17	88	11	82	18	62	7	23	3	58	5
Business	19	4	30	5	97	26	129	24	22	4	69	9	84	19	278	32	132	19	278	23
Service	0	0	18	3	8	2	40	8	0	0	1	0	33	7	60	7	95	14	165	13
Rural Transport	13	3	34	6	51	13	40	8	8	2	0	0	10	2	14	2	5	1	0	0
Livestock	28	6	5	1	7	2	5	1	16	3	10	1	10	2	7	1	11	2	16	1
Fish Trade	22	5	15	2	7	2	53	10	37	7	27	3	26	6	68	8	19	3	35	3
Remittance	4	1	35	6	19	5	62	12	5	1	33	4	29	6	85	10	48	7	159	13
All Income	442	100	609	100	378	100	529	100	490	100	793	100	452	100	860	100	680	100	1222	100

Note: T-test for paired sample shows that the fisher households, the difference between the two periods (2002-2006) is significant at 1% level for farm income, service and transport in closed beels, at 1% level for farm income and 5% level for livestock in open beels. The difference is significant at 1% level for farm income, livestock, wage labouring for poor non-fishers in closed and open beels. Moderately poor fishers in project closed beels, the difference is significant at 1% level for business in rivers.

6. Regression analysis results

This section presents the results of the regression analysis of livelihood indicators on household welfare. The household annual income was hypothesised to be a function of household asset endowment and household characteristics. The results of regression are presented in Table 10.

The results indicate that variables representing household own land, cultivable land, non-land asset, total amount of total credit and institutional credit received are important predictors of household income in the project area. In the control areas only two variables: household own land and non-land asset variables were significant. It indicates that the contributions of various assets (natural, physical and financial) are important variables in determining household incomes in project sites.

Table 10: Relationships between livelihood assets and household income in project and control sites.

Variables	Model 1: CBFM Project		Model 2: Control	
	Estimated Coefficient	<i>t</i> Statistic	Estimated Coefficient	<i>t</i> Statistic
INTERCEPT	21,948*** (1907.6)	13.7	18,707*** (2,490)	7.5
Income from fishing (taka)	-.032 (.065)	-.501	.152 (.099)	1.53
Household own land (decimal)	33.4*** (3.0)	11.1	26.90*** (3.88)	6.9
Household cultivable land (decimal)	-7.2** (3.39)	-2.1	-.643 (4.93)	-.13
Household other assets (number)	4478.6*** (215.9)	20.7	4899.1*** (290.2)	16.9
Total credit received by household (taka)	-.189** (.084)	-2.25	-.129 (.12)	-1.1
Institutional credit received (taka)	.220** (.077)	2.87	.041 (.115)	.356
Non-institutional credit received (taka)	-.015 (.121)	-.128	-.02 (.173)	-.118
Informal credit received (taka)	.0088 (.054)	1.63	.065 (.091)	.710
Fishing gear value (taka)	.084 (.074)	1.14	.034 (.113)	.302
Household size (no. of members)	-252.27 (259.3)	-.973	65.3 (392.6)	.166
<i>N</i>	1920		805	
<i>R</i> ²	35.3		41.0	
<i>Adj-R</i> ²	35.0		40.2	
<i>F-ratio</i>	104.2		55.1	
<i>F-probability</i>	0.000		0.000	

Dependent Variable: Annual household income (taka)

Standard errors in parentheses

***, ** - significant at 1% and 5% respectively

Table 11: Relationships between livelihood assets and Household income

Variables	CBFM Project					Control Water bodies				
	Coefficient					Coefficient				
	Poor fisher	Moderately Poor Fisher	Poor Non fisher	Moderately poor non fisher	Better off	Poor fisher	Moderately Poor Fisher	Poor Non fisher	Moderately poor non fisher	Better off
Intercept	25125*** (3483)	13620** (5688)	23092*** (3073)	24092*** (3220)	19783*** (3559)	14220** (6830)	7455 (6438)	23928*** (4784)	24497*** (4601)	17680** (6478)
Income from fishing (taka)	-0.032 (0.134)	0.073 (0.22)	-0.036 (0.124)	0.001 (0.135)	-0.200 (0.152)	0.133 (0.267)	0.302 (0.248)	0.104 (0.201)	-0.097 (0.178)	0.238 (0.246)
Household own land (decimal)	12* (7)	42.9*** (11.5)	27.9*** (5.3)	33.9*** (6.4)	49.9*** (6.4)	39** (12)	22.9** (10.98)	22.2** (605)	20.2** (8.5)	29.7** (8.5)
Household cultivable land (decimal)	-8.7 (7.8)	-13.9 (10.7)	-10.1 (6.7)	-5.3 (6.5)	-1.6 (7.5)	-12.4 (9.8)	7.8 (16.5)	3.8 (11.7)	0.8 (8.7)	-2.0 (13.7)
Household other assets (number)	3819*** (439)	4803*** (788)	5431*** (461)	4246*** (430)	4045*** (430)	7218*** (794)	4109*** (722)	3859*** (469)	4821*** (581)	5206*** (885)
Total credit received by household (taka)	-0.4 (0.3)	-0.01 (0.4)	-0.13 (0.2)	-0.3 (0.2)	-0.3 (0.2)	-0.1 (0.4)	-	-	-0.4 (0.3)	-0.3 (0.3)
Institutional credit received (taka)	0.438 (0.371)	-0.296 (0.334)	0.113 (0.105)	0.324 (0.235)	0.689*** (0.17)	0.121 (0.231)	0.127 (0.35)	0.024 (0.198)	-0.062 (0.168)	0.521 (0.467)
Non-institutional credit received (taka)	-0.17 (0.343)	-0.198 0.474	0.051 0.278	0.166 0.197	-0.132 0.277	0.514 0.522	0.047 0.36	-0.807 0.573	-0.286 0.278	-0.252 0.511
Informal credit received (taka)	0.115 (0.102)	0.25 0.344	0.023 0.115	-0.025 0.11	0.145 0.12	0.831* 0.447	-0.295 0.286	-0.155 0.437	0.291 0.329	0.009 0.118
Fishing gear value (taka)	0.172 (0.162)	0.547** 0.284	-0.204 0.147	-0.133 0.165	0.282** 0.133	0.013 0.233	0.153 0.369	0.043 0.166	0.197 0.269	-0.36 0.462
Household size (no. of members)	-585 (572)	1410 919	-446 480	-623 535	-85.9 569	-417 1122	2351** 980	-712 747	-613 666	524 1076
N	354	253	495	460	358	156	117	195	190	147
R square (%)	26.8	31.7	40.6	36.7	48.6	52.7	38.9	43.3	42.1	44.6
Adj-R square (%)	24.7	28.8	39.4	35.3	47.1	49.4	33.7	40.5	38.9	40.5
F- ratio	12.6	11.2	33.1	26.1	32.8	16.1	7.5	15.7	13.1	10.9
F-probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Dependent Variable: Annual household income (taka)

^aStandard errors in parentheses

***, **, * - significant at 1%; 5% and 10% respectively.

The coefficient for both land and non-land assets were significant at one percent level in the project area showing ownership of assets play a very important role in contributing to household incomes. The fishers in the project area have easier access to credit from various institutional and non-institutional sources. The coefficient of micro-credit access was significant at 5% level (Table10).

Results of regression analysis by category of fishing households in the project and non project areas show that moderately poor fishers have performed better compared to poor fishers (Table 11). For moderately poor fishers, the coefficient of households own land and other assets are positively (42.9 and 4803 respectively) linked with the household income and significant at 1% level, while the coefficient of fishing gear value was positively (0.547) linked and significant at 5% level for both moderately poor fisher and better-off households meaning that better-off and moderately poor households own relatively larger gears and take major share of income from fishing operated by poor fishers. This suggests that poor fishers still need their own fishing equipments to increase income from fishing.

The coefficient of other assets is positive (3819) and significant at 1% level for poor fisher households; the coefficient of own land is positive (12) and significant at 10% level (Table 11). The coefficient of institutional credit and fishing gear value were positive (0.438 and 0.172) but not significant. These results indicate that other capital assets are important variable for the poor fishers to increase their income. The results show that income from fishing coefficient is negative (-0.032) for poor fishers and not significant which indicate that some of the poor fishers are moving to other non-fishing income generating activities for earning higher income as well as to reduce fishing pressure as the CBFM project aimed to achieve.

7. Conclusions

This paper presents the impact of Community Based Fisheries Management Organizations (CBO) on fishing households' welfare and their livelihood in Bangladesh. Comparisons were made between different category of households from four types of waterbodies (closed; open; floodplain; and rivers) in CBFM project and non-CBFM control sites.

There were significant increases in physical, natural, financial, human and social assets for poor and moderately poor fisher households in different types of waterbodies over the project period. Poor fishers in CBFM sites were able to increase their cultivable land, house materials, non-land fixed assets, while both poor and moderately poor fisher households increased their value of fishing equipments in closed beels and river sites. Average value of fishing assets owned by poor fishers did not increase in open and floodplain beels over the project period.

There were remarkable increases in average income for poor fishers in project river and floodplain sites, while income rise was relatively lower in closed and open beels. Analyzing the data by category of households: poor fisher, moderately poor fisher, poor non fisher, moderately poor non-fisher, and better off and waterbody types, the results show a large increases in poor fishers' income from fishing in floodplains, rivers and open beels (88%, 37% and 21%, respectively) in project areas, income from fishing in closed beels fell significantly (23%) over the project period. In closed beels, which are usually managed as stocked fisheries, indicates that only those who pay their contribution to up-front costs (lease fee and stocking costs) are able to share in the proceeds from collective harvesting. The proportion of fishing income to total income has become lower for the poor fisher households in CBFM closed beels and open beels over the project period, indicating that fishers are moving away from fishing and taking up other income generating activities.

The project poor fisher households received higher amounts of credit from a range of both institutional and non-institutional sources at the end of the project period. Project poor fisher households have also become less reliant than other households on money lenders (*mohajans*). This is the most exploitative type of lending as they charge very high interest rates.

Principal Component Analysis was used to examine the important social factors contributed to household wellbeing due to CBFM project. Empowerment and trust index were derived from multiple social capital indicators show that the CBFM project had a major impact on attitudes of households in project areas. This means that the awareness training given to CBO members and activities such as drama performances for the wider public have had the desired effect – the people are more receptive to community managed approaches. The findings support a policy by Government, NGOs and donors to invest in pro poor social capital through targeted awareness programmes.

The regression results indicate that household own land, cultivable land, non land capital assets, institutional credit are important variables of household income in CBFM project sites. It shows that poor fishers have improved income from non fishing sources compared to the fishing in the CBFM project sites. Analyzing data by household types, the results show that moderately poor fishers have performed better compared to poor fishers in the project sites. Three coefficients of moderately poor households: own land, other assets and fishing gear are significant, while the poor fisher households, coefficient of land and other assets are the important predictor of income and livelihood. The conclusion is both land and non-land fixed assets are key variables can contributes to poor fishers income and livelihood.

Policy recommendations

Closed *beels* are considered a valuable resource, however this study suggests that actual benefits to poor households have been limited by high operating costs and in some sites, problems with establishing tenure and access. There is an urgent need to reduce lease values for community managed fisheries.

Access to credit for households in both project and control sites has increased in recent years, and in project sites this was from a wide range of sources rather than from the credit line project partner NGOs. Fishers are also developing new occupations with many moving away from fishing to agriculture, thus potentially decreasing fishing pressure on vulnerable stocks. Credit has a part to play in future community managed interventions, however its increasing availability suggests that the best approach may be to create stronger links between households and existing credit providers (such as NGOs) rather than opening new credit programmes.

The overall picture is that community-managed approaches to fisheries have made a significantly positive impact on the livelihoods of households in most CBFM sites. The fishing incomes of 12,000 poor fishers, a particularly vulnerable group in rural Bangladeshi society, have clearly been improved. This supports the strategy of expanding community-managed and co-managed approaches for the inland capture fisheries resource in Bangladesh, particularly in river and floodplain areas.

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