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Turning Social capital into Natural Capital: Changing livelihoods of fishers through CBFM

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ABSTRACT

This study investigates the impact of the Community Based Fisheries Management Project (CBFM-2) on household welfare by examining how the various types of livelihood assets contribute to household income. The CBFM projects have been implemented since 1995, through a partnership of the Department of Fisheries, 11 NGOs and the WorldFish Center, working in 116 water bodies with more than 23,000 households living around the project sites. The major objective of the CBFM was to build local fishery community organizations by providing training, building social awareness and giving access to credit facilities, with the aim of enhancing poor fishers' capability to access to livelihood assets.

The study reports on the results from an impact survey of 2,826 households from 40 water bodies in four different regions of Bangladesh. It was seen that CBFM households had significantly improved their social capital and have got better access to land and fishing grounds compared to households in non-CBFM control sites. The results of regression analysis show that the contributions of social capital and natural capital factors were important in improving household incomes. Future policy options need to be considered as a priority to invest more in human, physical and natural capital assets.

INTRODUCTION

Community Based Fisheries Management (CBFM) has emerged as one of the most viable options for managing fisheries resources in many developing countries including Bangladesh. The fisheries of Bangladesh support the livelihoods of millions of poor people but capture fisheries are declining as a result of high rates of exploitation and habitat degradation. More than 70% of households fish in the floodplains either for income or food (Minkin et al., 1997; Thompson et al., 1999). Many of the fisheries resources are state property and management control very often falls into the hands of rich and influential lessees. The leaseholders tend to allow fishing by as many fishers as are willing to pay user fees to ensure that they make a profit (Ullah, 1985; Naqi, 1989; McGregor, 1995).

Access to resources has been a constant debate in rural economies and the livelihoods of rural households. Increased access to resources depends on which assets are more relevant to the types of livelihood. Indicators of livelihood security can be grouped under five types of capitals: social capital, natural capital, financial capital, physical capital and human capital (DFID, 1999).

- Social capital relates to the social resources (networks, membership of groups, and relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods.

- Natural capital represents the natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, and wider environmental resources).
- Financial capital represents the financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options.
- Physical capital is the basic infrastructure (transport, shelter, water, energy and communication), the production equipment and means that enable people to pursue their livelihoods.
- Human capital is the skills, knowledge, labour and good health important to the ability to pursue different livelihood strategies.

Sen (1997) argues that capabilities enhance people's ability to be agents of change. Sustainable rural livelihoods can be conceptualized in terms of recent debates on access to resources (Berry, 1989; Blaikie, 1989), asset vulnerability (Moser, 1998), and entitlements (Sen, 1981).

The fishers have limited access to livelihood assets, they are mostly illiterate, landless, and have poor housing condition, lack of employment, poor capital assets and lack of funds. The security of access to fisheries resources is vital for the livelihood of poor fishers. It is argued that inequality in livelihood assets among the user groups might be associated with different degrees of control and access of the fisheries resources.

COMMUNITY BASED FISHERIES MANAGEMENT

The Community Based Fisheries Management (CBFM) Project, funded by the Ford Foundation and the UK Government's 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 heir 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 Organisations (NGOs). By 2005 the project has facilitated the establishment of 130 Community Based Organisatons (CBOs) in different types of water bodies located in regions throughout Bangladesh representing more than 23,000 poor fishing households.

The water bodies under the project are diverse, comprising mostly of rivers, closed beels, and open beels, but also significant areas of floodplains (largely private land) and small beels (under 8 ha). Each CBO was responsible for the management of a defined area of fish habitat of different types of water bodies. The CBOs were encouraged to implement several management interventions to help manage their fishery resources in a sustainable manner.

In closed and open beels, CBOs had to take over a commitment to pay the lease fees in return for which they secured 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 no access to fishing in those water bodies before the project because the lease was held by a single person or a 'fisherman's co-operative' controlled by a few rich and influential individuals.

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 the floodplain, 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.

The main objective of the project has been to test models for sustainable management of the fisheries, it has also tried to encourage fishers and others living in project areas to develop alternative livelihoods through training and credit support. This paper will provide information on whether poor fishers are benefited in terms of increasing income by efficient and equitable access to livelihood assets.

METHODOLOGY

Sampling and Data Collection

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-2 and an impact study carried out in mid-2006.

The survey covered 1994 households (including both project beneficiaries and others) at 34 project water bodies plus 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 (Table 1).

Table 1 - Household categories

Category	Household type	Characteristics
I	Poor fisher	Fishes for income or both for 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 a tin house, or has a pucca (concrete) house

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 using descriptive statistics to show differences in the key livelihoods indicators according to water body type (closed beels, open beels, floodplains, rivers). Comparisons were also made against households from control water bodies.

Factor Analysis

Social capital cannot be measured by a single variable. A set of variables were used to measure the social impact. Factor analysis was used to construct the indices of social capital. Principal Component Analysis is widely used to find the important principal components as un-rotated factor based on the criteria of eigen values greater than one. PCA extracts a maximum amount of variance to compute the factor scores calculated only from highly loaded factors. The factor scores are weighted according to the factor loadings. To ensure the correlations between the factors, the Bartlett's test of sphericity (Bartlett, 1954) and Kaiser-Meyer-Olkin (KMO) was used. The Bartlett's test of sphericity was significant ($p<0.05$) and considered appropriate. The KMO index ranges from 0 to 1, with 0.6 suggested as minimum value for a good factor analysis (Tabachnick and Fidell, 1996). The variables used in the study are shown in table 2.

Table 2: Definition of Variables

Social Capital Variable
Membership = membership in organizations (5=most important; 1=less important)
Influence = influence over access to resource   (5=strong influence; 1=no influence)
Participation = participation in decision making (number of times)
Knowledge = fisheries management knowledge (5=full knowledge;1=no knowledge)
Trust = level of trust (5=strongly agree; 1= disagree)

Physical Capital Variable
Housing = value of house structure (Taka)
Latrine = value of water sealed latrine(Taka)
Capital assets = Value of a set of household assets (Taka)
Homestead land = area of homestead land (ha)
Fishing equipment = value of equipment (Taka)
Fishing area = measure of fishing area (ha)

Human Capital variable
Education = education of household head (years of schooling)
Age = age of household head (year)
Employment = total employment days

Other assets
Credit = amount of credit received by household (Taka)
Cultivable land = cultivable land owned by household (ha)
Household size = number of household members

Regression Analysis

The 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 as annual household gross income from different sources.

Equation (1) is estimated separately using the survey data from households in the sampled CBFM (project) and non-CBFM (control) areas:

$$Y = \alpha + \beta_1 SC + \beta_2 PC + \beta_3 EDN + \beta_4 CRT + \beta_5 CUL + \beta_6 EMP + \beta_7 AGE + \beta_8 HS + \beta_9 FISA + \beta_{10} ATCM + Error,$$ (1)

Where
Y = household annual income (taka)
α = constant
β_1 to β_{10} = coefficient of variables for household asset endowments and household
characteristics
SC = household endowment of social capital (index)
PC = household endowment of physical capital (index)
EDN = household education (years)
CRT = credit received by households (taka)
CUL = area of household cultivable land (ha)
EMP = employment days of households (days)
AGE = age of household head (years)
HS = household size (number)
FISA= area fished by households (ha)
ATCM= household head attended in community meeting (number)
Error

RESULTS AND DISCUSSION

Impact of CBFM on Household Income

Descriptive statistics show that there were large rises in the annual incomes of households over the four years between baseline and impact. Average household incomes[1] in project areas rose by 31%, and increased significantly ($P<0.01$)[2] in all types of water bodies – by 21% in closed beels, 24% in open beels, 37% in floodplain beels and 57% in rivers. However, these rises were matched by similar increases (average, 37%) in the household incomes of people living in control sites - 22% in closed beels, 42% in open beels, 33% in floodplains and 30% rivers (Figure 3.1). This means that the overall income gains in project areas cannot be directly attributed to the project. There have been substantial rises in average income levels in general – a clear trend that has been recognized in other recent livelihood studies in Bangladesh (Sen 2003; CARE/LMU 2005).

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[1] Adjusted for inflation
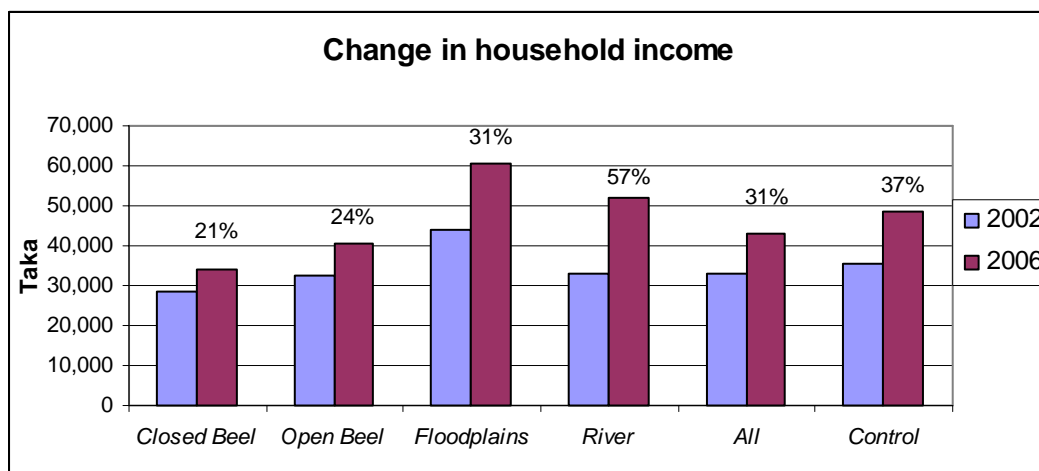[2] $P<0.01$ = highly significant, $P<0.05$ = moderately significant

Fig.1. Household incomes

Incomes from fishing

It was expected that the project activities would result in increase fish production in project water bodies. This suggests that there should be clear increases in fishing incomes, particularly by project fishers. Table 3 shows fishing incomes split by water body type and occupation and compares project fishing incomes against those in control sites.

Overall annual average fishing incomes by fishers in project sites increased by 21% from baseline to impact from Tk 15,035 to Tk 18,189. In control sites, the increase was less, 15%, from Tk 15,076 to Tk 17,286 however this was not significantly less than the increase in project sites.

In floodplains and rivers, fishers' incomes from fishing showed large increases (104% and 60%, respectively), whereas in open beels fishers' incomes from fishing only rose by 9% and fishers' incomes from fishing dropped by 23% in closed beels. The trends in control sites were significantly different to those in project river and floodplain sites indicating that the large increases in fishers' incomes from fishing in these project sites can be attributed to the CBFM-2 project activities. Trends in fishers' incomes from fishing in closed and open beel control sites were not significantly different to those in project sites. Although there was an apparent rise in non-fishers incomes from fishing in control open and closed beel sites, these were from very low baseline levels. Nevertheless it may illustrate that it is easier for people to move into and out of fishing in control areas compared to project areas as there are fewer controls over who can fish and when they can fish.

Table 3. Household fishing incomes split by water body type, occupation and project vs. control (Tk/year)

	Project			Control		
	2002	2006	% rise	2002	2006	% rise

Open Beel	Fisher	15917	17256	+9%	14585	18859	+30%
	Non fisher	913	629	-32%	609	2125	+249%
	Better off	1867	1386	-26%	2441	4012	+65%
Closed Beel	Fisher	12967	9973	-23%	9956	7378	-26%
	Non fisher	731	826	+13%	553	1257	+128%
	Better off	2377	2431	+3%	1150	809	-30%
Flood Plain	Fisher	15599	31761	+104%	13817	12314	-7%
	Non fisher	5023	1590	-69%	2458	2801	+14%
	Better off	7682	5855	-24%	5910	6230	+6%
River	Fisher	14573	23271	+60%	22379	20797	+7%
	Non fisher	1097	1980	+81%	3687	666	-820%
	Better off	3542	3943	+12%	668	1050	+58%
All	Fisher	15035	18189	+21%	15076	17286	15%
	Non fisher	1316	1015	-23%	1509	1773	18%
	Better off	2811	2443	-13%	2392	3304	38%

Household income sources/Income Diversification

Data in the impact survey shows that project fishers' incomes from farming and remittances increased significantly over the project period while their earnings from wage labouring showed a significant decline. Although fishers generally have few landholdings, they are now getting access to land through leasing or share cropping. Asaduzzaman (2003) and Sen (2003) argue that the agricultural sector remains the major sector of the economy and the better off households are in the best position to capitalize on the shift to high-value production. Agricultural growth is playing an important role in rural poverty reduction.

The CBFM study found that fishers have shifted their employment from wage labouring to self employment activities in the agriculture (farming and fishing), however the control fishers still tend to rely on the wage labouring for their livelihoods. The availability of micro-credit and fishing access may be important factors for increasing local employment opportunities.

The increased income from remittances due to out migration was found to be significant in project sites compared to the control sites. For poor households, migration has been stress driven. They usually migrate to other regions or districts for seasonal employment in paddy harvesting, road and building construction, rickshaw pulling and other labouring activities. The CARE/LMU study (2005) found that household members are increasingly residing temporarily away from their village homes to find better work.
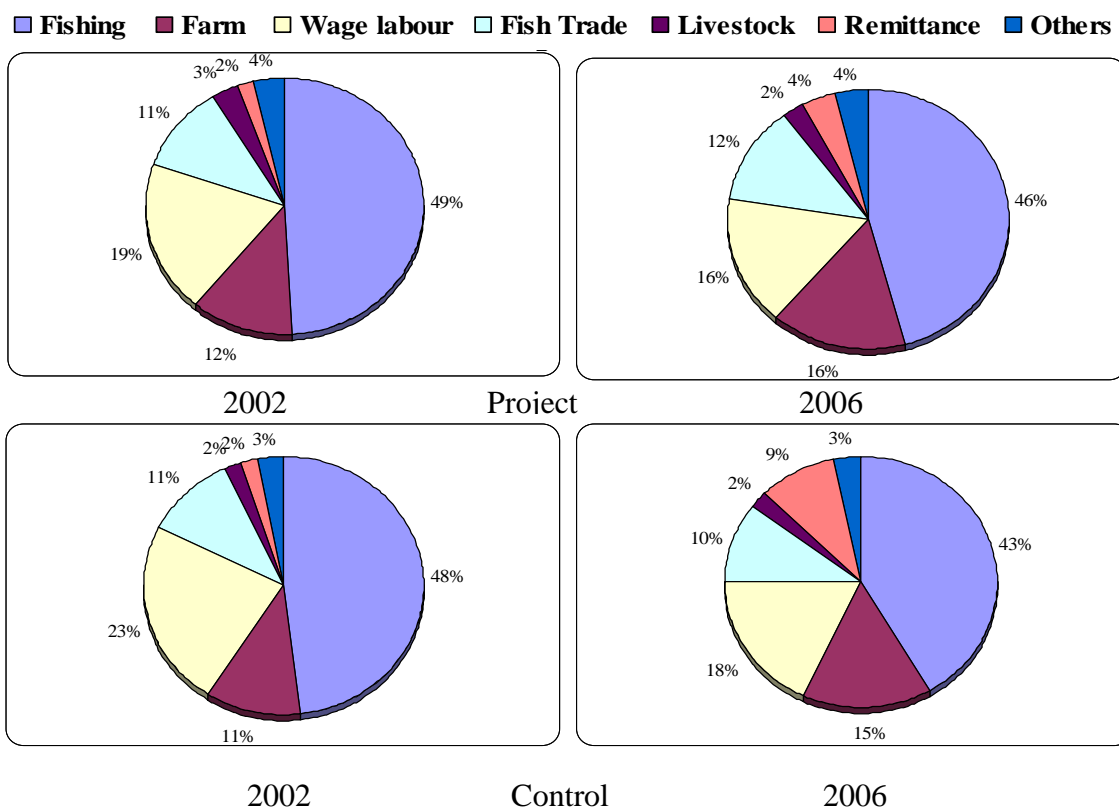
Fishing ■ **Farm** □ **Wage labour** □ **Fish Trade** ■ **Livestock** ■ **Remittance** ■ **Others**

Fig. 2: Fishers income from different sources (% of annual income)

Access to fishing

In most of the CBFM-2 project sites (closed beels, open beels and floodplains) fishers are now able to participate in fishing in the water bodies nearest to their homes compared to the situation before the project where access to water bodies was highly restricted. In the rivers, however, the number of fishers who are fishing in other water bodies has increased. The overall number of fishers who participated in fishing in the closed beels and floodplains in the project sites was less in 2006 compared to 2002 (table 4). In the control sites, the fisher's participation to fishing has not been concentrated in their own water bodies except in the floodplains. It indicates that CBFM-2 fishers have increased their awareness levels and had more of an incentive to use their own fisheries efficiently.

Table 4. Number of fisher got access to fishing by water body types (% of fisher)

	Project			Control		
	2002	2006	% change	2002	2006	% change

Closed Beel						
Single water body	199	196	-1.5	67	62	-7.5
More than one water body	109	77	-29.4	13	17	33.3
All	308	273	-11.4	80	79	1.3
Open Beel						
Single water body	383	437	14.0	157	174	10.8
More than one water body	171	147	-14.0	18	67	272.2
All	554	584	5.4	175	241	37.7
Floodplains						
Single water body	36	56	55.0	43	60	39.5
More than one water body	68	36	-47.1	39	24	-38.5
All	104	92	-11.5	82	84	2.4
Rivers						
Single water body	117	103	-12.0	45	58	29.0
More than one water body	37	50	35.1	19	12	-36.8
All	154	153	-0.6	64	70	9.4

Land and household assets

The baseline and impact surveys recorded land ownership and rented or sharecropped land holdings. Land is regarded as one of the most important assets for poor people. 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. Fishers in project sites increased their land from 31 decimals in 2002 to 43 decimals in 2006 while in the control sites fishers increased their land from 33 decimals in 2002 to 54 decimals in 2006. In contrast, the better-off households reduced their owned as well as shared or rented land over the project period. They have reduced their shared land from 41 decimals in 2002 to 30 decimals in 2006 (Table 5).

The increasing land holdings of fishers correlates well with the finding that agriculture has become more important for many fisher households. This indicates that the poorest people have improved their financial situation allowing them to invest in land over the project period. These self-employment opportunities at their farm and related activities may enable them to resist frequent migration.

Table 5. Land ownership, share cropped and rented land by household category in project and control sites (decimals)

	Project			Control		
Fisher	2002	2006	% increase	2002	2006	% increase
Own Land	34	39	16	31	36	16
Lease/share land	31	43	40	33	54	62

Total	65	83	27	65	90	39
Non fisher						
Own Land	53	56	5	47	56	19
Lease/share land	36	35	0	35	37	6
Total	89	92	3	83	94	14
Better off						
Own Land	334	325	-3	349	362	4
Lease/share land	41	30	-28	43	40	-8
Total	375	354	-5	392	402	2
All						
Own Land	104	102	-2	106	106	0
Lease/share land	35	37	5	36	43	20
Total	139	138	-1	142	150	5

Micro-credit

Households in both CBFM project sites and control sites increased their access to credit from a range of credit sources. NGOs were an important source of credit and both beneficiary and non-beneficiary households more than doubled the amount of credit taken over the last four years of the CBFM project.

Beneficiary households had a 273% increase in the amount of credit from 'interest-free' sources such as might be used for mitigating short term crises, (although this was from a very low initial average amount), while the average amount of credit received from this source by non-beneficiaries in project sites decreased and non-beneficiary households in control sites increased their access to this type of credit by only 50%. This indicates that CBO members have become more trusted in lending and borrowing at the village level.

Beneficiary 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. Households in the control sites have become much more reliant (173% increase) on moneylenders as have non-beneficiary households (163% increase) in project sites, while beneficiary households have only increased their borrowing from mohajans by 34% over the project period (Table 6). The figures also show that all types of households greatly increased their overall exposure to credit meaning that the potential negative impact of mohajan credit did not follow through to affect household incomes.

Table 6. Micro-credit received by beneficiary household category and by source (taka/hh)

Source	Beneficiary			Non Beneficiary			Control site		
	2002	2006		2002	2006		2002	2006	

	Average Tk/hh		%	Average Tk/hh		%	Average Tk/hh		%
Mohajan	562	754	34.1	423	1114	163.0	641	1753	173.5
Grocery shop	140	165	18.2	127	77	-39.6	204	151	-26.3
Bank	280	408	45.8	800	1177	47.1	685	824	20.2
Local society	308	387	25.4	429	446	3.9	291	273	-5.9
Relatives	635	1144	80.2	948	1386	46.2	884	1613	82.4
Someone else	97	363	273.5	356	295	-17.2	437	659	50.9
NGOs	1631	4221	158.7	1065	2443	129.3	1390	2898	108.5
All	3654	7644	109.2	4226	7214	70.7	4637	8343	79.9

Social Capital

In order to measure changes in social capital, an index was constructed using Principal Component Analysis. Six variables with high loadings were then aggregated to form the Social Capital Index.

Table 7. Social Capital - Factor Pattern

Performance Indicator	Factor Loading
Membership in organization	.693
Participation in decision making	.685
Level of knowledge	.622
Influence over decision making	.610

Extraction Method: Principal Component Analysis.

The scores of four separate items were aggregated to form the Social Capital Index. The most dominating factor found in social capital is household's membership in organizations (0.693). The majority of the poorer households have affiliation with production oriented organizations such as NGOs, various cooperative societies and local credit management societies. The reason why the poor fishers are not involved in the social, religious and cultural organization is mainly due to their poverty. Their primary concern is to look for work for their daily food and other necessities. Good leadership exists among the community in three project sites. In both *Chapandaha* and *Hamil beel*, the CBFM participants elected their executives for *Beel* Management Committee through voting. The organized fishers have participated in stocking and other production related activities such as protecting and harvesting fish. Poaching is a common threat for stocked water bodies. This has been controlled through surveillance provided by the fishers in the project sites. It has been observed that there is improvement in fishers' confidence in using fish culture technologies. The second social capital

factor is found that the participants have actively participated in the decision making on fisheries management rules (0.685). Fisheries management rules introduced by the management committee aim to enhance fish production. These rules are fishing restriction in the fish sanctuary, restriction on destructive gear used and three months closed season. The fishers strictly obeyed the first rule but the other two rules were sometimes violated when they could not find any income-earning work. The level of knowledge is important in social capital variable (0.622). Low level of formal education is observed among the fishing communities. Partner NGOs conducted awareness campaigns and training programs on leadership, accounting management, productive activities and fisheries management to improve fishers' level of knowledge. The last social capital variable is the fishers' influence on resource use (0.610). The fishers have exclusive access to use the fisheries resources and can resist outside threat. They can decide who, when and where to fish, and thus they are able to control overfishing on their own.

Physical Capital Index
Generally poor fishers are landless or functional landless. They have small amount of productive assets. Physical assets endowments are a good indicator of income, welfare and livelihood. The study has found that the organized fishers have improved their assets over the last couple of years such as using better construction materials for their houses and fitted with flush latrines. The level of income has increased and they have got some other productive assets to be used in creating additional income such as rickshaw pulling, petty trade (grocery, tea stall and fish), and crop cultivation. Women are now engaged in cattle and poultry rearing using credits from the NGOs.

In constructing the Physical Capital Index using the Principal Component Analysis, the significant variables are house materials, area of homestead land, sanitary latrine and productive assets. These four variables load highly on a single common factor (Table 8).

Table 8: Physical Capital: Factor Pattern

Performance Indicator	Factor Loading
Value of house	**.748**
Area of homestead land	**.744**
Value of sanitary latrine	**.697**
Value of durable assets	**.684**

Extraction Method: Principal Component Analysis.

The scores of four separate items were aggregated to form the Physical Capital Index. Land is a very scarce resource in Bangladesh. The average area of homestead is 0.05 hectare in the study area. Most fisher households do not own any cultivable land. However they cultivate land owned by others either through sharecropping or mortgage arrangements. More and more poor fishers in all survey areas are engaged in high-yielding variety (HYV) *boro* rice cultivation.

This indicates that poorest fisher could be employed in the agriculture and non agriculture sectors. Improvement of housing is found to be an important factor for the rural households. The first important variable is the value of house (0.748). The area of homestead land is the second dominating variable (0.744), followed by sanitation condition (0.697). The CBFM participants have greater awareness in health and sanitation. NGOs have provided with sanitary latrines at low cost to their group members. The last important variable is the productive and household assets (0.684) such as livestock, rickshaw/vans, shallow tube well, bi-cycle, watch, radio and television sets. These assets play an important role as safety nets during unemployment and occurrence of natural crises such as floods, or cyclones which results in loss of fish and other crops.

Human, Financial and Natural capital Assets
The poor fishers are generally illiterate; access to formal education is very limited. Human capital includes age of household head, attendance in community meetings, participate in trainings and access to information. Only the level of formal education variable is significant in the principle component analysis. The role of financial capital is very important to explain livelihood of poor fishers. Fishers have very limited access to credit; they are not able to pay lease money for fisheries resources and can not invest in productive sector to generate income. Financial capital includes the variables: amount of credit received, value of household assets, value of fishing equipment and income from asset sales. Only the amount of credit received variable was significant. The land and fishing ground are considered as natural assets for the fishers. Fishers are generally landless, but they have traditional access to fishing in the floodplains owned by the private landowner or open access common property. Access to fishing to such fishing grounds depends on the extent of social linkages among the community in that particular location.

One variable in each of the three types of assets was found significant in the PCA method: level of formal education for human capital, amount of credit received for financial capital and area of fishing for natural capital (Table 9).

Table 9: Human, Financial and Natural Capital: Factor Pattern

Performance Indicator	Factor Loading
Education level of household head	**.704**
Amount (Tk) of credit received by household	**.690**
Area of fishing by household	**.615**

Extraction Method: Principal Component Analysis.

The mean difference between project and control for the social capital index was highly positive in all types of water bodies (table 10). The comparisons between the project and control households show that the net increment for social capital score is 1.228 and for financial capital is 2.209. In Bangladesh, poor fishermen are deprived of opportunities in making fisheries management decisions. The *jalmahals* are generally controlled by the rural elites and the maximum share of

benefits from fishing goes to them. The fishermen are now on average able to participate in making fisheries management decisions in the CBFM areas. Each of the participants have received 2000 taka more in the CBFM sites compared with the control sites, which indicates that they have the potential to increase their employment and income opportunities due to the project interventions. The value of household physical assets for the project participants is higher by around 500 taka. The fishing area of the participants is higher by 0.827 hectare, however, the level of education does not show any significant difference between the project and control areas (0.027).

Table 10: Mean differences of Household Assets between Project and Control areas

| Variables | Project | | Control | | Difference |
	Mean	Std. Deviation	Mean	Std. Deviation	Project - Control
Social capital index	4.024	2.04587	2.7964	1.31348	+ 1.228
Physical capital index (1000)	5.788	6402.976	5.269	6909.645	+ 0.519
Education (year) of household head	2.42	3.281	2.15	3.217	+ 0.027
Credit (Tk) received by household (1000)	6.038	5647.979	3.829	4120.728	+ 2.209
Fishing area (ha) of household (10)	2.595	25.89290	1.768	25.04423	+ 0.827

Under the CBFM project the government has transferred the use rights of water bodies and provides administrative support to the fishers. The NGOs have full time staffs at the village level that facilitate coordination between the government and the fishers. The organized fisher's participation in making decisions has increased that contributed to better management of fisheries and improved access to livelihood assets. The CBFM participants elect their executives for Beel Management Committee through voting. The fishers have improved social linkages that enhance their ability to gain economic power and livelihood security in the project areas.

3.2 Regression Analysis

Multiple regression analysis is used to examine the link between the household income and various livelihood asset variables. The equation as specified in Section 2.3 is estimated separately for the project and control sites by the Ordinary Least Squares technique. The results of regression are presented in Table 11.

The results indicate that the social capital, employment and area of fishing are important predictors of household income in the project area. In the control areas education, household size and age variables are significant. The contribution of social capital factor is an important variable in determining household income.

Thus social factor plays a very important role in poverty alleviation in Bangladesh.

Table 11: Relationships between livelihood assets and Household income

Variables	Model 1: Project		Model 2: Control	
	Estimated Coefficient	t Statistic	Estimated Coefficient	t Statistic
INTERCEPT	6449.7	.580	20906.6	1.848[*]
SC	2619.4	2.225[**]	995.2	.568
PC	-.206	-.416	-.517	-.980
EDN	413.0	.549	1693.2	2.146[**]
CRT	.576	1.288	.693	1.273
CUL	-19.4	-.793	-3.8	-.129
EMP	50.6	3.005[***]	12.9	.865
AGE	123.9	.641	717.9	3.375[***]
HSZ	-759.9	-.513	-5432.9	-3.914[***]
FISA	-167.8	-1.720[*]	62.0	.698
ATCM	1002.4	1.191	-385.7	-.387
N	120		120	
R^2	0.22		0.21	
$Adj\text{-}R^2$	0.15		0.13	
$F\text{-}ratio$	3.07		2.78	
$F\text{-}probability$	0.002		0.004	

Note: * Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

The impact of human development training conducted by CBFM partner NGOs helped the organized fishermen in gaining socio-political knowledge. Associational involvement encouraged them to participate actively in decision making on livelihood issues. There is also evidence that they have capability to influence their access to livelihood assets.

The coefficient for the social capital factor is significant for the project area, as expected from community based management. The regression model in Table 5 reports positive coefficient for social capital (2619) and its associated t-statistic is significant at the 5% level. The fishers in the project area have got easier access to credit due to their institutional identity. Access to financial capital is not only from CBFM project NGOs, other organizations are also providing credits. Grootaert and Narayan (2004) found that greater access to credit is a spillover effect due to high social capital than human capital in Bolivia.

The coefficient of fishing area is negatively (-167.8) linked but is a moderately significant (at 10% level). The implication of negative relationship of fishing area is that capture fisheries has been restricted by land owners. The land owners have introduced either fish farms called *gher* or cultivate rice crops. The organized community established fish conservation strategies such as setting up fish sanctuaries and imposed closed season ban on fishing for 2-3 months during

fish breeding periods. In the control sites the fishing area coefficient is positive (62.0) but is not a significant determinant of income.

Land is a scarce resource in Bangladesh. The coefficients are negative and not significant in the project (-19.4) as well as in the control sites (-3.8). The poor fishermen in the project areas are involved in farming mainly in share cropped land but their crops are subject to natural calamities. Poor people have limited access to financial assets due to their lack of ownership of other assets. The very poor people are not eligible for formal credit from banks and NGOs. The coefficient for credit in both project and control areas are positive (0.576 and 0.693 respectively) but are not significant predictor for household income. Although credit is very important for the participants, it is not a significant contributor to household income. The possible reason is that the poor participants used their credit for non-productive activities such as household consumption, health care and festivals.

The physical asset coefficient of both project and control areas are negative and are not significant predictors of household income. The important implication of this relationship is that the poor people cannot retain their assets during crisis periods. Flooding and other natural hazards occur almost every year, causing people to sell or mortgage their assets to meet their basic needs such as, food, house repair and health care. Bird and Shepherd (2003) reported a similar scenario in Zimbabwe. A severe natural shock could wipe out productive assets which results in increased livelihood vulnerability and reduced productivity.

CONCLUSIONS AND POLICY IMPLICATIONS

In this paper the impact of CBFM on household welfare is examined by investigating how the various types of assets contribute to household income. Comparisons were made between the sample households from project and control areas.

Fishers income from fishing and non fishing activities increased and the income rise was higher in non-leased water bodies (floodplains and rivers) compared to leased water bodies (open and closed beels). Fishers have diversified their livelihood options and have increased access to land and fisheries in the project areas. Factor analysis shows that social capital has contributed significantly to household livelihood assets in the project area compared to control area.

The project households received higher amounts of credit from multiple sources compared to the control households, they could utilize credit for more productive activities. Beneficiary households of CBFM-2 have got access to non-exploitative sources of credit and have become less dependent on moneylenders compared to non-project sites.

The regression results indicate that the social capital, employment and area of fishing are important predictors of household income in the project area. In the control areas, education, household size and age variables are significant. The contribution of social capital factor is important to household income which indicates that this variable play a very important role in poverty alleviation in Bangladesh.

The important policy implications of this study is that the user groups of community based organizations who primarily depend on fisheries for their livelihood need strong facilitation by NGOs and government to establish access to the fisheries. Posting of experienced staff of DOF and NGOs is vital for the success of CBFM. Fisher households require assets for their security during crisis periods. There would be a strong need for establishing a social safety net so that poor fishers feel secure to use their physical assets as investments. Provision of public works at critical times may be a good option for creating employment opportunities.

Health services are extremely poor in Bangladesh and the poor people spend a good portion of income for health care. The provision of free and effective primary health care facilities at the village level should be given priority. Since the poorest fishers rely on fishing for income and their nutritional needs, the security of access to the fisheries resources need to be taken as a priority in future policy formulation in natural resources management.

The community based approach has been tested as an alternative to the current revenue orientated leasing model. Future policy makers need to consider the successes shown by this new model of community based institutional development for the management of the vast inland fisheries of Bangladesh.

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