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Impacts of co-management on fish biodiversity and livelihoods of fishers of Baikka beel, Moulvibazar, Bangladesh

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Abstract

Co-management plays a significant role in fisheries and natural resources management. In the case of fisheries, it has most often been taken to mean a sharing of responsibility for sustainable resource management between government and fishing communities. Baikka Beel, situated in Moulvibazar, Bangladesh has been identified and established as a wetland sanctuary by local community members in conjunction with the Management of Aquatic Ecosystem through Community Husbandry (MACH) project. In this study, the role of co-management institutions, including federations of resource user groups (FRUGs) and resource management organizations (RMOs) were investigated on sustainable wetland resource management and fish production and biodiversity in Baikka Beel. Study results shown that the knowledge and attitudes of MACH fishers towards sustainable resource management were positive and optimistic than non-MACH fishers; MACH fishers were involved with AIGAs. The results from independent samples t-test showed that the income of MACH group from fishing was significantly lower than the income of non-MACH group while income from AIGAs of MACH group was significantly higher than the income of non-MACH group. Fishing rights of both MACH and non-MACH fishers are not well established due to current leasing system. Both production and biodiversity of fish has been improved due to community-based sustainable management of Baikka Beel.

Introduction

Bangladesh is a country of wetlands—with 4.90 million hectares of inland water bodies that cover 34 percent of the country—where 18.2 million people are directly or indirectly involved with the fisheries sector for their livelihood (DoF, 2016). Despite the possession of a highly productive inland water area, the continuing decrease in fish catch due to habitat degradation (siltation, loss of natural breeding grounds) and man-made problems like over-fishing, use of destructive fishing gears, use of huge agrochemicals, conversion of wetlands to agricultural lands, catching of young, undersized and brood fish, increasingly threatens the livelihoods of fishers nationwide. These activities have negatively affected the breeding, growth and development of natural fish populations, which has resulted in depleted fish production and unemployment of fishers and reduced animal protein supplies especially for the poor. Thus fish populations are facing continuous stress and are in threat of decline (DoF, 2015). The demands on inland aquatic areas by different stakeholders have also rapidly accelerated the destruction of aquatic resources. Under the current leasing system, where revenue collection is the main target that does not consider biological impact, poor fishers have failed to gain fishing rights, mainly because of high leasing value. In most cases, the fishing rights

are not well established and the fishers are not able to defend their fishing rights. The people who are socially and economically more powerful can conduct unauthorized fishing on the basis of existing leasing system through threats and social pressure.

The management of open water fisheries is principally a matter of fisheries conservation through different approaches. Over the last decade the contribution of open water capture production is declining at a significant pace; while the culture quantum is increasing at an even greater pace. The open water ecosystems and fisheries biodiversity are eroding at a very rapid pace (DoF, 2017). Co-management (CM) has a profound impact on natural resource management (Plumers, 2006). In relation to natural resources, the term management can be defined as the 'right to regulate and transform the resource by making improvement'. These activities can be performed by single individual or jointly by groups of individuals or as a result of cooperation among different groups. Borrini-Feyerabend *et al.* (2004) prefer using the term co-management, which they define as follows: Co-management of natural resources is used to describe a partnership by which two or more relevant social communities collectively negotiate, agree upon, guarantee and implement a fair share of management functions, benefits and responsibilities for a particular territory, area or set of

natural resources. Co-management is the idea that the responsibilities and resources are shared among multiple partners (Pinkerton, 1989; Berkes *et al.*, 1991). More simply, co-management is any sharing of rights and responsibilities between or among governments, users, and other stakeholders (Ahmed *et al.*, 1997).

It is now unequivocally established that much of the success of co-management regime pivots around the performance of Co-management Organizations (CMOs). Developing successful community based co-management arrangements that ensure sustainable wetlands, productive fisheries and meet the needs of resource users and other stakeholders is a challenge. Policy makers, donors and other external actors have a vital role to play in meeting this challenge. The study area of Baikka Beel situated in Hail Haor in Sreemongal and Sadar upazila in Moulvibazar district, a permanent fish sanctuary declared on July 1, 2003 by Bangladesh government (MACH, 2004). The Baikka Beel constitutes one of the most reputed sanctuaries in Bangladesh and composed of three Beels named Chapra, Magura and Jaduria. This is a vitally important site of the Integrated Protected Area Co-management (IPAC) project in terms of fish biodiversity and an established history of co-management. The Management of Aquatic Ecosystem through Community Husbandry (MACH) Project was an innovative pilot program with the aim of developing community-based fisheries management, and to demonstrate sustainable, integrated management of wetland resources including fish, plants, agriculture, livestock, forestry, and wildlife over entire ecosystems. Baikka Beel came under the management of the MACH project, funded by USAID, from 1998 to 2008, which was implemented by the Department of Fisheries as a co-management site. Over eighty percent households of surrounding villages were engaged in fishing in the Haor, many as a full time profession (Chakraborty *et al.*, 2005).

This study focuses on the role of co-management organizations- notably: the federations of resource user groups (FRUGs) and the resource management organizations (RMOs) and the role of alternative income generating activities (AIGAs) on sustainable wetland resources management and the resulting benefits for fish production and biodiversity as perceived by the fishers.

Methodology

Study Area: Based on supplementary information from the Department of Fisheries (DoF) officials, Integrated Protected Area Co-management (IPAC) staff and local communities and a review of previous reports, two villages were selected as the study sites—Hazipur and Uttar Uttarsur. These villages are adjacent to Hail Haor and also very near to Baikka Beel, about five kilometers northwest of Sreemangol upazila and twenty kilometers southwest of Moulvibazar district town (Fig. 1). Due to close proximity of villagers to the Beel, most of the

fishers of these two villages were fully or partially engaged in fishing as their main occupation for livelihoods. A total of forty respondents were randomly selected for collecting data, twenty from Hazipur village and twenty from Uttar Uttarsur village.

In Hazipur, MACH provided AIGAs funds to members of the resource user groups (RUGs) who chosen alternative professions to reduce their dependence on fishing in and around Baikka Beel, but in Uttar Uttarsur there was no MACH presence. In this study, changes in income levels of fishers due to AIGAs in Hazipur village, as well as the difference between the MACH (Hazipur) and non-MACH villages (Uttar Uttarsur) were investigated.

Data collection methods

For this study, both primary and secondary data were collected. Primary data was collected through field visits and observations, semi-structured interview and discussions with community leaders and key informants and through participatory rural appraisal methods such as focus group discussions (FGDs), visits to fish markets and observations of fish catch composition. Prior to selecting the study sites, the area was visited and two villages were selected for data collection. Information was gathered on the local livelihoods, the socioeconomic conditions and fishing activities of the community members, and their management activities in Baikka Beel. Based on this information, questionnaire was designed to collect qualitative and quantitative data for this study. The study area was visited for data collection once a month from August 2011 to December 2011 (five times). This research was conducted by a small USAID fund and the duration of the study period was six months. Considering the research time frame, data was collected during five months taking into account the main fish harvesting season. Secondary data was gathered on Baikka Beel, from the published reports on MACH activities, IPAC activities, previous and present fish catch, and AIGA trainings done by Department of Fisheries, Upazila Fisheries Office and local IPAC office. Using a semi-structured questionnaire, a comparative household survey was conducted in the Hazipur and Uttar Uttarsur villages; Hazipur had a RMO (and AIGAs) and Uttar Uttarsur did not. Twenty (20) respondents from each village were chosen who were engaged in fishing for several years at that site because they could provide information about fish catch and biodiversity. In Hazipur village, all 20 respondents fish around the beel for their livelihoods and all are members of the RUG who received AIGAs training and fund for alternative profession other than fishing. In Uttar Uttarsur village, all 20 respondents also fish around the beel, but they are not members of an RUG and did not receive any AIGAs trainings or funds.

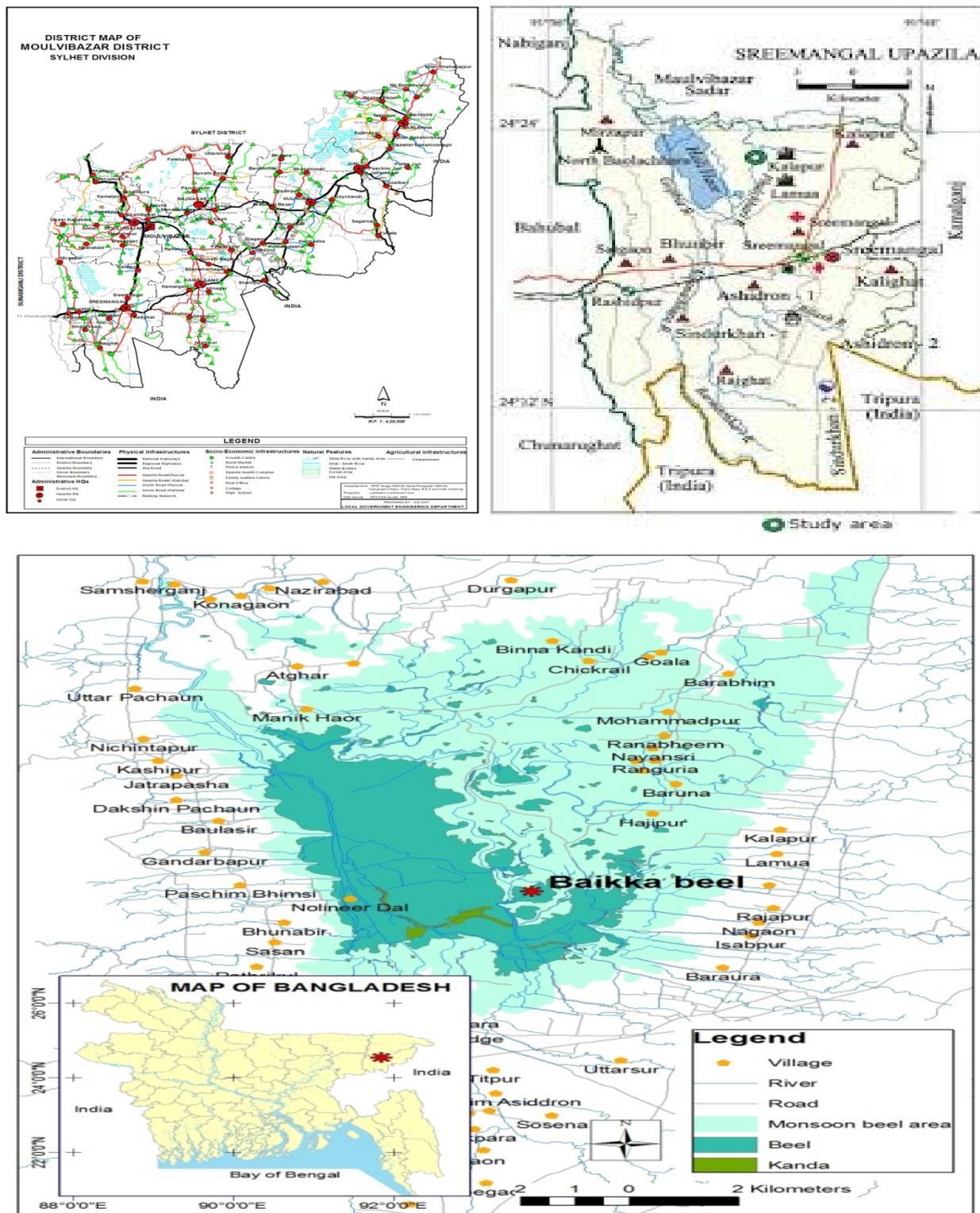


Fig.1. Map of the study area

Two focus group discussions were conducted in these two villages for qualitative data collection, with respondents not included in the semi-structured interview, about the current management practices of the sanctuary, implementation of the Fish Act, attitudes towards the sanctuary, whether they benefited from the sanctuary, current problems with the sanctuary, and

possible recommendations for enhancing its sustainable management.

To determine fish biodiversity, data was collected from the fishermen engaged in fishing in Baikka Beel. The nearby fish markets- Baruna Ghat Bazar, Hajipur Ghat Bazar and Bhairabganj Bazar were visited one

time each to collect data on fish species that were collected from the study area. Secondary sources including MACH project documents, reports and other publications were also reviewed for collecting data on fish biodiversity. The respondents of both villages, respondents of FGDs and key informants were asked about currently available fish species, fish species previously found but not available now (endangered and critically endangered species), currently available fish species that were previously present; the amount of previous and current catch and fish consumption; the types of gear used; implementation of Fish Acts and Rules; fish sanctuaries; excavation; swamp plantation; AIGA fund and activities provided, and management strategies of RUGs, FRUGs, RMOs and also asked whether co-management practices and AIGA activities under MACH/IPAC have brought positive results in the context of their livelihoods and fish biodiversity.

Data analyses

All the collected data from primary and secondary sources were tabulated by using the Microsoft Excel. After tabulation, the data were analyzed accordingly to find out the results. The independent samples t-test was conducted to see the significant difference between MACH and non-MACH fisher groups in terms of their income from fishing and from AIGAs.

Results and Discussion

The role of co-management institutions (RUGs/ FRUGs/ RMOs) in wetland resources management, the income level of members of Resource User Groups (RUGs) and their rights to the fishery, role of AIGAs and their benefits for wetland resources management and the status of production and biodiversity as perceived by the fishers were assessed in the present study.

Role of co-management institutions (RUGs/ FRUGs/ RMOs) in wetland resources management

The results from data of respondents and FGDs, on different factors concerning co-management, such as fish production, AIGA- related training and activities, AIGA funds, fish sanctuaries, habitat improvement, fish fry stocking and some other factors are shown in Table-1. In the MACH village, all twenty respondents (100%) said that fish production has increased, while in the non-MACH village sixteen respondents (80%) recognized it. The respondents from the MACH village were more aware than respondents from the non-MACH village regarding some other issues important for effective co-management and sustainable wetlands resource management, such as establishment of the fish sanctuary, prohibitions on the use of destructive gear, the fishing ban in the sanctuary, biodiversity, habitat improvement efforts, and the introduction of new species (Table 1). However, most of the respondents of MACH village were well informed about co-management and had a positive attitude about sustainable wetland resources management. On the other hand, non-MACH fishers reported receiving little information about these issues and responded less frequently on the importance of conserving wetlands. Results from the study shown that MACH fishers were more aware of co-management; sustainable wetlands resources management and conservation; biodiversity and found them optimistic compare to non-MACH fisher. However, from this study it might be argued that the positive attitude of the respondents of MACH village towards sustainable wetlands resources management due to appropriate role of co-management institutions, community-based organizations and providing fund for AIGAs also.

Table 1. Perception of local inhabitants towards sustainability of co-management

Responses concerning co-management	No. of Respondents	
	MACH village (Hazipur)	Non-MACH village (Uttar Uttarsur)
Fish production has increased	20 (100%)	15 (75%)
Have received AIGA-related training	20 (95%)	3 (15%)
Received AIGAs fund individually	19 (95%)	0 (0%)
AIG-activities (plant nursery, fish nursery, cow big-fattening, goat rearing, driving)	14 (70%)	2 (10%)
Aware of fish sanctuary management	19 (95%)	10 (50%)
Aware of fishing ban	20 (100%)	8 (40%)
Aware of Fish Acts and Rules	19 (95%)	4 (20%)
Stocking/Releasing of new fish species	16 (80%)	2 (10%)
Knowledge on biodiversity and natural resource conservation	17 (85%)	4 (20%)
Aware of destructive gear	20 (100%)	7 (35%)
Aware of habitat improvement	18 (90%)	3 (15%)
Resource sustainability activities (attend RMO meeting, organized training, etc.)	18 (90%)	2 (10%)
Environmental protection (swamp plantation)	18 (90%)	5 (25%)
Savings individually	12 (60%)	2 (10%)

There were 22 RUGs (with 15-30 members in each RUG) active for Baikka Beel management activities. These 22 RUGs were formed of fishers/villagers from three villages, Hazipur, Baruna and Nayanshri. Four FRUGs (Federation of Resource User Groups) was also formed taking their members from their RUGs. There were four FRUGs - three in Sreemangol Upazila and one in Moulvibazar Sadar Upazila. The main function of the FRUG was to maintain and manage a revolving fund provided by the MACH project. The fund was provided to FRUG authority account to provide loan to individual RUG members for AIGAs. Fund disbursements were supervised and controlled by the FRUG. The RMO (Resource Management Organization) was responsible for coordination with the upazila committee and overall management of the Beel. The president and member secretary of the RMO were the members of the upazila fisheries committee (UFC). The RUG, FRUG and RMO were linked with each other and these local community-based organizations had a linkage with the upazila administration which helped in sustainable Baikka Beel management. Bhuiya (2014) examined the role and performance of the CMOs in the Beel management and the challenges faced by the CMO members and the study was conducted in Baikka Beel, Moulvibazar, Bangladesh. He found that CMOs play a vital role in the conservation of wetlands and in the maintenance of biological diversity. Amendment of Protection and Conservation of Fish Act 1950 introduces Sanctuary Act made government better to form a revenue set-up for permanent fish sanctuary. Including of criteria into the amendment for taking part in the jalmohal (deeper wetland in floodplain areas) leasing system by co-management organization (RMO) are also good initiative. A selection system of executive committee may increase the active participation and voluntary spirit.

Income level of members of Resource User Groups (RUGs) and their rights to the fishery

The average monthly income per respondent from fishing and AIGAs/other sources, in Hazipur village was 3,210 BDT (Bangladesh Taka) and 4,895 BDT respectively; and the average monthly income per respondent from fishing and AIGAs/other sources in Uttar Uttarsur village was 4,645 BDT and 1,635 BDT, respectively. The analysis of income level of the respondents of these two villages shown that the average monthly income per respondent from fishing in Hazipur village was lower than Uttar Uttarsur village, but the average monthly income per respondent from AIGAs or other sources was higher in Hazipur village than Uttar Uttarsur village (Fig. 2). It was also found that the combined average monthly income from both 'fishing' and 'AIGAs or others sources' was higher in Hazipur village than in Uttar Uttarsur village. The average monthly higher income per respondent from fishing in Uttar Uttarsur village was due to absence of AIGAs activities done by MACH program and for full dependence on fishing only for earning.

Twenty respondents (100%) from the mach village and 15 respondents (75%) from the non-mach village said that, in the rainy season when all the beels situated around the Baikka beel get connected with each other, fishing remains open to all fishers using environment friendly fishing gears. But in the dry season, when the embankment of each beel is visible, then contract lease holders restrict fishers in fishing. Thus, during the dry season, many fishers of the non-mach village work as daily laborers of contract leaseholders to guard and also to catch fish. This study reveals that the fishing rights of the fishers are not well established due to the current revenue earning oriented leasing system.

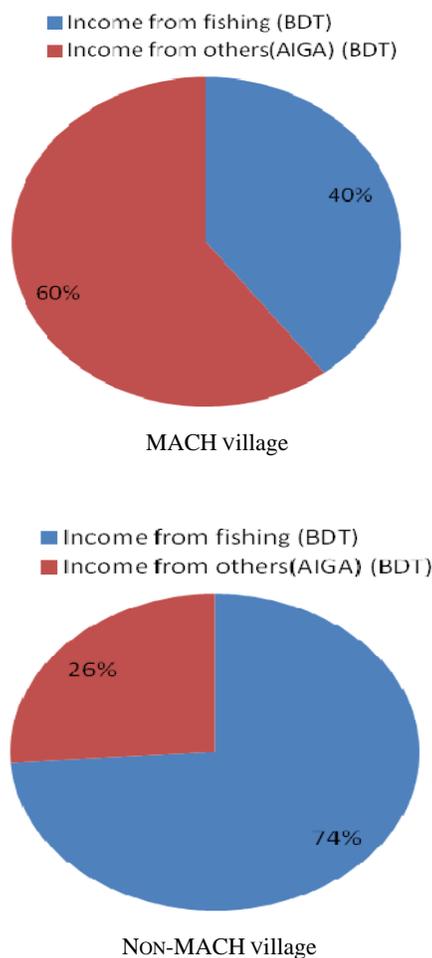


Fig. 2. Percentage of average monthly income from fishing and non-fishing in MACH and non-MACH village

Results from Table 2 shown that the activities done by MACH program really do have an effect on income where income from AIGAs of MACH fishers were increased and income from fishing of non-MACH fishers were decreased. These results suggest that when fishers group is involved with AIGAs, it reduces fishing pressure on natural wetlands which ultimately increases the production and biodiversity of natural water resources.

Table 2. Independent samples t-test for comparison of income from fishing as well as AIGAs between MACH and non-MACH fisher groups

	Income from Fishing				Income from AIGAs			
	Mean	SD	t-value	p-value	Mean	SD	t-value	p-value
MACH	3210	2008.64	-3.130	0.0033	4895	3256.16	4.460	0.0001
Non-MACH	4645	409.72			1635	287.04		

Role of AIGAs and their benefits for wetland resources management

Different types of AIGA-related trainings were provided to the members of RUGs, FRUGs and RMOs of the MACH village: a) plant nursery, b) fish nursery, c) fish cultivation, d) cow rearing , e) goat rearing, f) vegetable culture, g) driving h) weaving, and i) handicrafts production and some others training.

Fund for Alternative Income Generation Activities (AIGAs):

Before ending the MACH project activities, the authority of the project provided two types of funds for the proper and sustainable management of the Baikka Beel water resources—an endowment fund and a revolving fund. The amount of the endowment fund was 13,000,000 BDT. It was deposited in a bank account, which was administered through the joint signature of the Deputy Commissioner and the District Fisheries Officer at Moulvibazar District. The bank gives interest at a rate of 8.25 percent, and 90 percent of the earned interest is expended on maintenance costs of the Resource Management Organizations (RMOs) of Baikka Beel and the Sreemangol Upazila Water Resource Management Committee, while the remaining 10 percent was added to the main endowment fund. In this way, the endowment fund was being increased gradually. The amount of the revolving fund was 8,700,000 BDT, which was also deposited into a bank account run by the joint signature of the president, member secretary and treasurer of the FRUG. The fund was used to provide loans to RUG members at a 12 percent interest rate for AIGAs, and was controlled by the FRUG’s executive committee and reviewed during the FRUG’s general assembly. Fund disbursement was supervised and controlled by the FRUG. The first loan amount for single RUG members was 5,000 BDT and after repayment of this loan within the scheduled time they

can get another loan of up to 40,000 BDT. A total of 450 RUG members were receiving such loans and investing their funds in AIGAs.

The analysis of monthly average income level of respondents in these two villages shown that in the non-MACH village, seventy four percent of their monthly income came from fishing and twenty six percent of their monthly income came from other sources. On the other hand, in MACH village, forty percent of their monthly income came from fishing and sixty percent of their monthly income came from AIGAs or other sources. The previous main occupation of most of the respondents of Hazipur village was fishing and later on involved with different types of AIGAs such as plant nursery, cow big-fattening, goat rearing, fish nursery and culture, driving and others. On the other hand, fifteen respondents (75%) of the Uttar Uttarsur village were engaged in fishing as their main occupation, since they did not receive any AIGAs related trainings and fund from MACH program (Fig. 3). It is assumed that the additional income from AIGAs and others sources of respondents in Hazipur village has increased their monthly income level and reduced their dependence on fishing. There was no AIGA-related training, no AIGA funds, nor any motivational work done in Uttar Uttarsur village. Consequently, there are no community-based organizations (RMOs, RUGs or FRUGs) was functioning in this village. The fishermen of this village are engaged in traditional fishing around the Baikka Beel. They were not very aware or motivated about co-management, Fish Conservation Act and Rules, biodiversity and sustainable wetland resources management. Thus, it might be said that AIGAs help to reduce dependence on fishing and to promote sustainable wetland resources management.

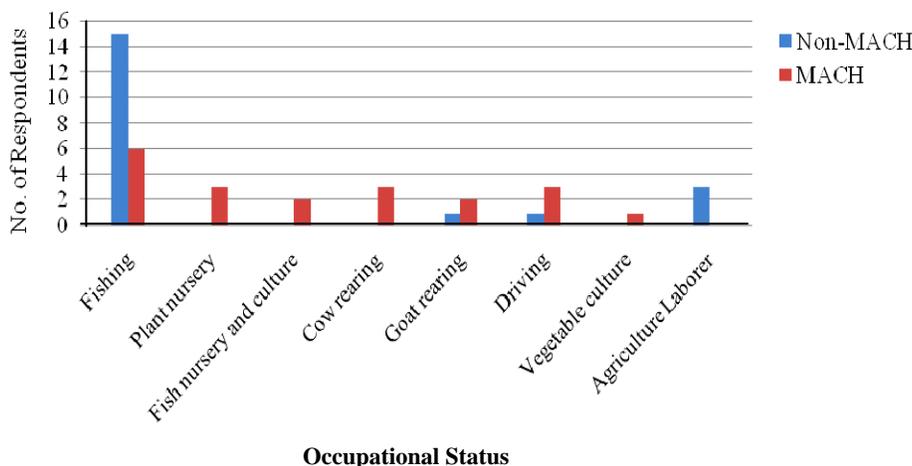


Fig. 3. Present occupational status in MACH and non-MACH village

Ferdousi (2014) conducted a research on sustainable rural livelihoods and co-managements intervention in Mokosh Beel, Gazipur, Bangladesh where MACH project provided AIGAs training and fund to one fishers group and did not provide such facilities to other group. She found that most of the MACH fishers were engaged in different AIG activities and reduced their dependence on fishing. They were motivated through various trainings and awareness-raising programs. Alternative income generation and training activities can lead fishers to shift from sole reliance on fishing for their livelihoods to engaging in other trades and business (Winrock 2007). The main constraints to improving fishers' living standards are the lack of inputs and the debt incurred through the traditional credit system, which binds them to their communities and their occupations (Ruddle 1994).

calculating the average to compare their daily catch with the IPAC fish catch monitoring report, 2011. The MACH report (2011) shown that the daily fish catch by individual fisher was 2.83 kilogram per fisher per day. It was found that the then fish catch was 2.70 kilograms per fisher per day. This was similar to the results of the MACH (2011) study. Twenty MACH respondents (100%) and 16 non-MACH respondents (80%) expressed their opinion that the trend of fish production was increasing in comparison to previous years (Table 3). However, the catch per fisher per day was higher when compared with the MACH (2004) report. To determine the fish biodiversity status, a list of major fish species from the daily catch results of the forty respondents, and from observations of three nearby fish markets were made, shown in Table 3.

Fish production status and biodiversity as perceived by the fishers

The fish production was assumed by asking daily individual catch of forty respondents and then

Table 3. Status of major fish species in Baikka Beel during study period

Sl. No.	Local Name	Scientific Name	IUCN (2015) status in Bangladesh	Present status in study site*
1	Ghonia	<i>Labeo gonius</i>	Near Threatened	Common
2	Rui	<i>Labeo rohita</i>	Least Concern	Abundant
3	Catla	<i>Catla catla</i>	Least Concern	Abundant
4	Mrigal	<i>Cirrhinus mrigala</i>	Least Concern	Abundant
5	Calibaus	<i>Labeo calbasu</i>	Least Concern	Common
6	Koi	<i>Anabas testudineus</i>	Least Concern	Abundant
7	Titputi	<i>Puntius ticto</i>	Vulnerable	Common
8	Sarpunti	<i>Puntius sarana</i>	Near Threatened	Common
9	Shing	<i>Heteropneustes fossilis</i>	Least Concern	Abundant
10	Magur	<i>Clarias batrachus</i>	Near Threatened	Abundant
11	Tengra	<i>Mystus tengara</i>	Endangered	Abundant
12	Gulsha	<i>Mystus cavasius</i>	Near Threatened	Common
13	Chital	<i>Chitala chitala</i>	Endangered	Common
14	Boal	<i>Wallago attu</i>	Vulnerable	Abundant
15	Air	<i>Sperata aor</i>	Vulnerable	Abundant
16	Gutum	<i>Lepidocephalus guntea</i>	Least Concern	Abundant
17	Boro baim or Sal baim	<i>Mastacembalus armatus</i>	Endangered	Common
18	Taki	<i>Chana punctatus</i>	Least Concern	Abundant
19	Gojar	<i>Channa marulius</i>	Endangered	Common
20	Rani mach	<i>Botia dario</i>	Endangered	Common
21	Madhu pabda	<i>Ompok pabda</i>	Endangered	Common
22	Ketchki	<i>Corica soborna</i>	Least Concern	Common
23	Kani pabda	<i>Ompok bimaculatus</i>	Endangered	Common
24	Foli	<i>Notopterus notopterus</i>	Vulnerable	Common
25	Bheda	<i>Nandus nandus</i>	Near Threatened	Common
26	Kholisa	<i>Colisa fasciatus</i>	Least Concern	Common
27	Lomba chanda	<i>Chanda nama</i>	Least Concern	Abundant
28	Lal kholisa	<i>Colisa lalius</i>	Least Concern	Common
29	Kakila	<i>Xenontodon cancila</i>	Least Concern	Common
30	Dhela	<i>Osteobrama cotio</i>	Near Threatened	Common
31	Bacha	<i>Eutropiichthys vacha</i>	Vulnerable	Common
32	Baila	<i>Glossogobius giuris</i>	Vulnerable	Common
33	Darkina	<i>Esomus danricus</i>	Least Concern	Abundant
34	Shol	<i>Channa striatus</i>	Critically Endangered	Common
35	Mola	<i>Amblypharyngodon mola</i>	Least Concern	Abundant
36	Tara baim	<i>Macrognathus aculeatus</i>	Near Threatened	Abundant

*Note: Assessment based on local fisher's perceptions

Among these species, sal baim, gojar, madhu pabda, kani pabda, chital and rani were endangered and shol was critically endangered (IUCN, 2015) and koi, shing, magur, air, bheda and gulsha were in declining manner before the activities of the MACH project perceived by the local fishers. Now all these fish species are commonly found in and around the Baikka Beel. It was found that a number of activities done to increase fish production and biodiversity by MACH project are: a) habitat improvement activities such as excavation of canal to ensure fish migration and spawning; b) establishment of fish sanctuaries; c) restriction of illegal fishing gear by fish conservation act and promotion of use of environmentally friendly gear; d) maintenance of closed area (fish sanctuary zone); e) planting of swamp trees (*hijal, koroch*); f) fish fry stocking; g) restocking of two new fish species; h) restoration of breeding grounds for chital fish. According to a study by IUCN, some 54 fish species were endangered, of which 12 species were either critically endangered or extinct (IUCN 2000). Most of the respondents of the two villages thought that both fish production and biodiversity were increased (Table 3). According to respondents and key informants, seven endangered fish species were revived— sal baim (*Mastacembalus armatus*), gojar (*Channa marulius*), madhu pabda (*Ompok pabda*), kani pabda (*Ompok bimaculatus*), chital (*Chitala chitala*), bheda (*Nandus nandus*), ghonia (*Labeo gonius*). It was found that endangered and declining fish species were revived around Baikka Beel due to completion of a number of habitat improvement activities, establishment of the fish sanctuary and restocking of two fish species, the use of environment friendly gear for increasing fish production and biodiversity by MACH project, and ongoing effective operation of co-management institutions. Mazumder *et al.* (2016) conducted a study on the role of co-management in wetland productivity and biodiversity in Hail haor in Bangladesh. They reported that after the co-management initiative, community awareness increased, and management related training by the authority resulted in more positive attitudes towards conservation of fish and wetland biodiversity and co-management activities increased the fish production as well as fish biodiversity in the studied area. Azher *et al.* (2007) reported that, the impacts of sanctuary on fish production and fish biodiversity was investigated in Dopi Beel in Joanshahi Haor and the total production obtained from the Dopi beel was much higher than before. The fish species deemed as threatened were found to have reappeared in Dopi Beel.

Table 4. Perceptions of local community towards effectiveness of Baikka Beel sanctuary

Perceptions	Number of respondents (percent)
Baikka Beel fish sanctuary effectively increased fish biodiversity	34 (85%)
Baikka Beel fish sanctuary effectively increased fish production	36 (90%)
Baikka Beel fish sanctuary effective increased fish catch and improved fish biodiversity	32 (80%)
Not effective	0 (0%)

Note: Due to multiple response, percentage do not add up to 100%

Conclusion

Considering the potential, possibilities and limitations related to the management of wetland resources, the present research was conducted to determine the socioeconomic and ecological impacts of co-management as implemented in this study area. Co-management and effective co-management institutions help to promote the active participation of community members and sustainable wetlands resource management. Associated management measures, AIGAs and fishing rights can increase the income level of poor fishers by introducing better fisheries management strategies. Based on the findings of the present study, it is believed that the active involvement of fishers in co-management activities, the role of community-based organizations such as RUGs, FRUGs, RMOs and the upazila administration, providing funds for AIGAs are the key factors for sustainable management of Baikka Beel. The fishing rights both of MACH and non-MACH fishers are restricted by contract leaseholders during the dry season. The current revenue oriented leasing system of open water body could be changed into community-based management so that the wetlands come under biological management for sustainability and thus the fishing rights of the actual and poor fishers might be established. The present study may serve as a guideline for policy formulation and be useful for the government, NGO officials, fishers and members of RUGs, FRUGs, and RMOs.

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