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Connecting Communities and Conservation: Co-management Initiatives Implemented by IPAC in Wetlands and Forests of Bangladesh

বন অধিদপ্তর

Department of Environment

Connecting Communities and Conservation: Co-management Initiatives Implemented by IPAC in Wetlands and Forests of Bangladesh

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List of abbreviations

ACF	Assistant Conservator of Forests
ADB	Asian Development Bank
AIGA	Alternative income-generating activities
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Centre for Advanced Studies
BECA	Bangladesh Environment Conservation Act
BNP	Bhawal National Park
BRAC	Bangladesh Rural Advancement Committee
CBAECA	Biodiversity Conservation and Social Protection
CBFM	Community-based fisheries management
CEGIS	Center for Environmental and Geographical Information Services
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMC	Co-management committee
CMO	Co-management organization
CNRS	Centre for Natural Resources Studies
CoP	Conference of the Parties
CPG	Community patrolling group
CRU	Conservation response unit
CWBMP	Coastal and Wetland Biodiversity Management Project
CWS	Chunati Wildlife Sanctuary
DAE	Department of Agriculture Extension
DC	District commissioner
DFO	District Fisheries Officer
DFO	Divisional Forest Officer
DoE	Department of Environment
DoF	Department of Fisheries
EbA	Ecosystem-based Adaptation
EC	Executive committee
ECA	Ecologically Critical Area
ECCO	Bangladesh Environment and Climate Change Outlook
ETP	Effluent treatment plant
FD	Forest Department
FGD	Focus group discussion
FRUG	Federation of resource user groups
FUG	Forest users group
GD	Group discussion
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GTZ	German Development Co-operation
HEC	Human-elephant conflict
HH	Household

IFESCU	Institute of Forestry and Environmental Sciences, Chittagong University
IPAC	Integrated Protected Area Co-management
IPM	Integrated pest management
IRG	International Resources Group
IUCN	International Union for Conservation of Nature
KI	Key informant
LDF	Landscape development fund
MACH	Management of Aquatic Ecosystems through Community Husbandry
MIKE	Monitoring of Illegal Killing of Elephants
MoEF	Ministry of Environment and Forests
MoL	Ministry of Land
MNP	Madhupur National Park
NGO	Non-governmental organization
NRM	Natural resources management
NSP	Nishorgo Support Project
PA	Protected area
PF	People's forum
PRA	Participatory rural appraisal
RKWS	Rema-Kalenga Wildlife Sanctuary
RMO	Resource management organization
RRA	Rapid rural appraisal
RUG	Resource user group
SEMP	Sustainable Environmental Management Program
SNP	Satchari National Park
TGR	Teknaf Game Reserve
TWS	Teknaf Wildlife Sanctuary
UFC	Upazila fisheries committee
UFO	Upazila fisheries office
UNEP	United Nations Environment Programme
UP	Union Parishad
USAID	United States Agency for International Development
VCF	Village conservation forum
VCG	Village conservation group
VIA	Vulnerability and impact assessment

Introduction: Co-management Initiatives Implemented by IPAC in Wetlands and Forests of Bangladesh

Jefferson Fox and M. G. Mustafa

In 2003 the Forest Department of Bangladesh (FD) launched, in associated with the United States Agency for International Development (USAID), the Nishorgo Support Project with the objective of enhancing biodiversity conservation in target protected areas through the active and formal involvement of local communities in the management of these sites. Nishorgo sought to empower local communities to sustainably access benefits from protected areas as a way to counter much greater threats from organized commercial timber theft, extraction for commercial brick fields or sawmills or land-grabbing (Roy and DeCosse 2006). Nishorgo also sought to increase the number of protected areas, improve infrastructure and capacity to receive visitors at parks, develop policies to promote better protected area management, strengthen institutional systems, and build the capacity of key stakeholders. The ultimate aim was to develop a model for protected area management systems that could be replicated throughout the country.

In addition, Nishorgo sought to strengthen the capacity of the Forest Department and local academic institutions to conduct applied research to support the design of new and more appropriate management plans and policies. To this end, Nishorgo and the East-West Center, with support from FD and USAID, arranged a series of workshops for FD officials and local researchers. These workshops enabled participants to develop study proposals, conduct field research in the pilot protected areas, and to write up their results. These workshops resulted in the publication of two edited volumes. The first volume published eight papers focusing on issues of rural livelihoods in the pilot co-management sites (Fox *et al*. 2007); and the second volume contained eleven papers that analyzed the co-management initiatives implemented by Nishorgo to assess their overall effectiveness (Fox *et al* 2008).

In 2008 the Bangladesh Ministry of Environment and Forests (MoEF) and Ministry of Fisheries and Livestock (MoFL) launched, in association with USAID, the Integrated Protected Area Co-management (IPAC) program as a successor to Nishorgo and MACH. The Management of Aquatic Ecosystems through Community Husbandry (MACH) project was launched in 1998, also with the assistance of USAID, to develop community-based participatory approaches to wetland management. The project continued until 2005 and during that time officials worked with partners to secure dry season water rights, establish fish sanctuaries, reduce fishing pressure by exploring alternative income generating activities, promote policy-level coordination, link resource users, and improve local wetland habitats (USAID 2007).

IPAC seeks to improve the management of both protected wetlands and forests. The program was designed to meet the needs of co-management arrangements at national, regional, and local levels including policy development, institutional capacity building, and support for site-specific implementation. IPAC operates under the Government of Bangladesh's Nishorgo Network, a national network of protected areas.

As with Nishorgo, IPAC also sought to strengthen the capacity of the Forest Department, as well as the Department of Fisheries, the Department of Environment, and local academic institutions to conduct applied research to support the design of new and more appropriate management plans and policies for protected forests and wetlands. In collaboration with WorldFish, the East-West Center ran another series of workshops to enable participants to develop study proposals, conduct field research, and to write up their results. The first volume in the IPAC series but third in the Nishorgo/IPAC series contained eleven papers that focused on co-management and livelihoods in the protected sites (Fox *et al*. 2011).

For this fourth and final volume, we invited an analysis of co-management initiatives implemented by IPAC in wetlands and forests in the Nishorgo Network sites. We invited applications from participants prepared to analyze questions surrounding co-management in wetlands and forests, and to explore strategies for conserving resources while improving the livelihoods of rural peoples. Among the types of questions we were interested in exploring were:

- Participation and Governance - what is participation and how is it implemented? Who are the key stakeholders and how do we put participation into the context of power relations? To what extent do government policies and/or institutional systems and capacity of government departments (Forests, Fisheries, and Environment) inhibit or facilitate the performance of co-management in protected areas?

- Livelihoods - what is the impact of co-management on the rural poor, especially women and ethnic minorities? In light of the economic activities under way at the sites, who are the current and expected beneficiaries? What benefits (products) do rural people derive from wetlands and forests and what services do they provide in return?

- Resources - does co-management lead to conservation? What are the impacts of co-management on biodiversity, ecosystem services, quality of forest and fishery resources? How do local people monitor the quality of protected areas, and how does that perspective relate to participatory monitoring efforts supported by IPAC? Does co-management increase a community's awareness of methods for adapting to and/or mitigating climate change?

Participation and governance

Participation is a common theme in research and programs on conservation and protected area management, and figures prominently among the papers in this volume. Public officials often see participation as a binary variable on a checklist – you either have it or you don't. In reality, however, participation is considerably more complex and elusive. Arnstein (1969) notes that participation occurs on a "ladder" with multiple possible rungs or degrees, from outright manipulation to full, unfettered involvement in decision-making. In practice, participation often falls somewhere between these two extremes, in the realm of "tokenism": the limited involvement of local actors through informing, consultation or placation.

Brechin *et al.* (2002) argue that much of the debate on biodiversity protection has relied on a false dichotomy between rural livelihoods and biodiversity conservation. In contrast they suggest that establishing a legitimate process to constructively work with people is the most feasible and morally just way to achieve long-term nature protection. They suggest that since conservation is a human organization process, the goal of biodiversity protection depends on the strength and commitment of social actors. They posit that successful biodiversity conservation will ultimately be based the adoption of three broad principles that local people must have the right to: 1) participate at all levels of the policy making process as equal partners; 2) self-representation and autonomy, and 3) political, economic, and cultural self-determination. Co-management should mean that local users and stakeholders provide input for the decisions that affect their livelihoods and access to resources. This input can take the form of participation in decision forums within their own communities, as well as representation and influence in higher-level governance bodies that incorporate multiple communities and various other local and non-local stakeholders.

In this volume, ***Ariful Hoque Belal*** writes that co-management committees have been established and functioning in Teknaf Wildlife Sanctuary for the last six years despite various limitations and complexities. He found that the diverse stakeholders are represented in co-management committees; that these committees conduct regular meetings and engage in collaborative activities including patrol groups, installing improved cooking stoves, and alternative income generating activities (AIGAs). He concludes that co-management is having a positive impact on local livelihoods and the conservation of forest resources. ***Rafiqul Islam Chowdhury*** compared co-management in Satchari National Park where it has been practiced since 2005, and in Bhawal National Park, which does not have a co-management initiative yet. In contrast to Belal, Rafiq argues that the sustainability of co-management through policy supports and financing has yet to be ensured; co-management committees have yet to be developed into institutions for promoting conservation, and ensuring representation from various stakeholders is still a problem; collaboration between the FD and IPAC is minimal; community patrolling groups lack support for AIGAs; and existing project support for AIGAs is not sufficient or sustainable.

Clearly the tension between these two papers show the many dimensions of the social relations involved in community based resource management and the difficulties of fostering learning across relationships. They paint a picture that is often messy, complex, and not always successful. They show where theory is difficult to implement. It is precisely these experiences that we hope will advance the development of better resource management in protected areas of Bangladesh.

On the fisheries front, ***Umme Kulsum Ferdousi*** found that people who did not fish around Mokosh Beel were actively engaged in co-management decision-making and the preparation of management plans, whereas people who did fish were not involved in decision-making and planning. Contrarily, she found that both fishers and non-fishers were engaged in the implementation of activities including the establishment of fish sanctuaries, excavation of canals, awareness raising programs, and the distribution of micro-credit. Respondents in the study area expressed a great desire to continue co-management practices, although they feared inconsistency in co-management activities due to improper supervision after termination of the IPAC project. ***Abul Bashar's*** paper found that the MACH and IPAC projects have worked with various partners to improve dry season water management, establish fish sanctuaries, reduce fishing pressure by introducing AIGAs, promote policy-level coordination, link resource users, and carry out other activities with the overall goal of improving local wetland habitat. Bashar concludes that the active engagement of fishers in co-management activities around Keuta Beel reduced fishing pressure resulting in an overall increase in fish production in this region.

Livelihoods

The papers in this volume review alternative income generating activities being implemented by IPAC. AIGAs are a form of payment for environmental services (PES). A review of PES programs concluded they are concentrated in four fields: carbon sequestration, watershed protection, biodiversity benefits, and landscape beauty (Landell-Mills and Porras 2002). While these approaches are motivated by environmental concerns, there is increasing interest in their potential to also deliver development benefits. Yet it remains unclear to what extent the two objectives of environmental conservation and development can be achieved simultaneously through market-based mechanisms.

Grieg-Gran *et al.* (2005) found a key obstacle to scaling up PES initiatives was insufficient ability to pay for environmental services. For example, a payment scheme in Costa Rica was heavily oversubscribedon the supply side. If all applications from landowners for PES enrolmentwere to be accepted, three to four times the amount of financing currently available would be needed (Rojas and Aylward 2003). A PES project in Ecuador was obliged to rethink its scope and not sign further contracts, as a result of reduced financial backing (Grieg-Gran *et al*. 2005).

The AIGAs examined in these projects involve communities in ways where the service buyer ''is viewed not as a development partner, but as a paternalistic charity. There was no contract, either implicit or explicit, detailing the communities' or (the buyer's, i.e., IPAC) rights and responsibilities'(Asquith *et al.* 2002). These initiatives are thus much closer to traditional Integrated Conservation and Development Projects than to quid pro quo initiatives. It remains to be seen if these AIGAs can be sustained or will be discontinued in the future. On the other hand, growing pressure on forest and wetland resources in Bangladesh opens up windows of opportunity for new market-based environmental service initiatives. This topic will grow in importance, so it is essential to discuss its developmental implications from the early stages.

In this volume***, Ranadhir Kumar Das*** reviewed AIGAs as a means of improving the livelihoods of villagers living around Madhupur National Park. He found that only about ten percent of households received AIGAs. Likewise, ***Mahbub Morshed*** found unanimous agreement among stakeholders in Rema-Kalenga Wildlife Sanctuary that natural resource depletion had been reduced and that local communities had benefited from AIGAs. He found, however, that the AIGAs were insufficient in terms of both the amount dispersed and the number of beneficiaries. His study questioned the institutional sustainability of CMCs because of insufficient AIGAs.

In the fisheries arena, ***Fozlul Kabeer*** studied co-management in Baikka Beel, a MACH project site. He found that participants in the MACH program were more positive and optimistic about sustainable resource management than non-participants; incomes of MACH fishers were higher than that of non-MACH fishers; MACH fishers had AIGAs, non-MACH fishers did not; fishing rights of both MACH and non-MACH fishers are not well established due to current leasing systems; and fish production and biodiversity have been improved due to community-based sustainable management. He concluded that AIGAs and secure fishing rights increased the income level of poor fishers by supporting strategies for better fish management. ***Jahir Uddin Akon's*** research in the Sundarbans found that AIGAs had a small but definite impact in this area, slightly reducing the surveyed households' dependence on fishing and on local moneylenders. However, the AIGAs provided thus far are insufficient; individual AIGA loans/grants should be larger, and more households should have access to AIGAs. There is also a need for programs supporting greater awareness of sustainable practices, and it is crucial that more effort be put into halting fishing with poison. ***Solaiman Haider*** studied Hakaluki Haor, one of the most important wetlands in Bangladesh in terms of the goods and services it provides to local communities but also as a precious ecosystem with global significance for migratory birds that visit the wetland each year. He found that AIGAs had positive impacts on the livelihoods of the community and strongly supported the institutionalization of AIGA initiatives for the betterment of both the community and ecosystem.

Resources

Traditional conservation models have depended heavily on the knowledge and priorities set by professionally trained biologists, foresters, and government officials, with little regard for the needs and preferences of local resource users. Assuming that rural resource users are the cause of forest and wetland degradation and that local people are not interested in conservation, protected area professionals have focused on controlling and policing the local people rather than learning from their experiences. However, the solution is not a total reversal of this situation as some have implied. While the involvement of the community is critical, in many cases both government agencies and local institutions are too weak to handle the various levels of park or wetland management independently. Berkes (2004) cautions that in shifting the balance of power from professionals to local communities, decision-making authority should be shared across stakeholder groups in order to more effectively deal with complex management issues. Monitoring and evaluation of conservation projects, then, should not only (a) incorporate local ecological knowledge and participatory data collection, but also (b) address the responses of the local resource users to the management systems themselves.

Both these aspects of monitoring and evaluation the use of traditional ecological knowledge and local responses to co-management activities are addressed in this volume. **Jahidul Kabir** studied elephant habitat conservation and human-elephant conflict in Chunati Wildlife Sanctuary. He found that co-management brings positive changes among participating members in terms of increasing awareness about elephant habitat conservation and the Wildlife Act, and may help to reduce forest dependence to some extent. He also found that human-elephant conflict increased during the last two to three cropping periods, and that the increase in the number of elephants is contributing to increased human-elephant conflict.

Mahbub Ul Haque examined fish biodiversity in beels adjacent to and removed from protected areas, fishing practices, perceptions among local community members about the effectiveness of the Baikka Beel Sanctuary, and benefits that local fishers derive from the sanctuary. He found that 31 species of fish were reported in Balla Beel and 24 species in Sixty Two Beel. Boal (*Wallago attu*) is the dominant species found in the beels adjacent to Baikka Beel. Exotic species like grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) are also common in both wetlands. Indigenous species like *Ompok bimaculatus*, *Puntius sarana*, *Nandus nandus*, *Labeo gonius*, and *Chitala chitala,* which were rare before the establishment of the fish sanctuary, are now common in both beels.

Mohammad Abdur Rouf studied the present status of fish biodiversity, as well as the impacts of co-management on fish biodiversity, at Dhali-Baila Beel (a MACH site) and Shaitandaha Beel (a non-MACH site). Forty-four fish species were recorded at the MACH site and 15 fish species were found at the non-MACH site.

The average fish production was 313 kilograms per hectare at the MACH site, and 196 kilograms per hectare at the non-MACH site. Eleven fish species were found to be endangered at the non-MACH site, compared to only one species at the MACH site. Furthermore, eight fish species were revived at the MACH site and no fish species was revived at the non-MACH site. His results suggest that fish biodiversity at the MACH site is richer than at the non-MACH site, and that the impacts of co-management on fish biodiversity conservation in this important wetland ecosystem have been positive overall.

Summary

Bangladesh is among the most poor and densely populated nations on the face of the globe. The difficulties government officials and NGO activists face in promoting the conservation of flora and fauna are among the most severe found anywhere. This joint project of the East-West Center, WorldFish, and IPAC encouraged employees of the Bangladesh Forest Department, Department of Fisheries, Department of Environment, and local academic institutions to conduct field research on the impacts and implications of protected areas on the livelihoods of people living in and around the chosen protected areas.

The papers in this volume are the results of this initiative. These papers point to several important conclusions about linkages between rural communities and conservation in protected area management. First, they illustrate the importance of developing constructive ways of involving local stakeholders in conservation and sustainable resource use practices based on the goals, interests, and understanding of the people living in and around the protected areas. These case studies confirm that protected areas cannot be managed successfully on the basis of simple and incorrect assumptions about how local people use natural resources. The authors of these case studies unanimously argue for incorporating local people and their knowledge into park and wetland management decisions through some type of co-management system. These authors suggest that establishing a process to constructively work with people is perhaps the most important step that can be taken on the road to sustainable protected area management. The process by which decisions are made about resource management may be more important that any product or plan protected area managers can produce.

Second they suggest that strategies to link rural livelihoods and conservation are not a universal panacea for conservation problems. AIGAs may give local communities incentives for protecting these species, but this may have little or no impact on overall habitat conservation. These papers suggest that no one strategy will work everywhere and indeed, probably no one strategy can work on its own at any given site. It may be possible to link AIGAs, for example, in only one part of a protected area, and use other approaches in other parts of the park. To make conservation happen, park and wetland managers need to be able to understand the

specific local conditions at their project site, both at the start of the project, and as they change over time. They need to develop the appropriate mix of strategies that include incentives and other strategies such as education and awareness. In addition, they need to monitor the results of their interventions, analyze the data, and use it to make appropriate responses in a process of adaptive management.

As Salafsky and Wollengberg (2000) suggest, establishing linkages between livelihoods and conservation may be necessary for improved resource management, but it may not be sufficient for conservation to take place. Salafsky *et al.* (1999) suggest that successful conservation strategies require that projects generate cash and noncash benefits for the stakeholders and that the stakeholders have the capacity to take action to mitigate internal and external threats. Other factors include the biophysical, social, and institutional context that the project is operating in and the skill of the project team. Ultimately we may face a tradeoff between achieving better rural livelihoods and better resource management. Communities, and those institutions supporting communities such as NGOs and donors, must struggle to find the most appropriate balance between achieving the objectives of better resource management and more equitable distribution of access rights to resources.

Protected forests and wetlands may not ultimately help people escape the poverty trap. This raises the questions for advocates of co-management about how far these initiatives can go towards alleviating poverty. The answer may depend upon whether poverty reduction is seen as a relative goal, where improvement of the current situation is the aim, or an 'absolute concept', not related to the perceptions and relative situation of the social groups. Community based resource management initiatives are evolving into a form of social action that is concerned with broader issues beyond resource management such as governance and democracy.

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Effectiveness of Co-management Committees in Teknaf Wildlife Sanctuary

Md. Ariful Hoque Belal

Abstract

Successful conservation of protected areas (PAs) depends largely on the active involvement of local communities in their management. The management mechanism needs to be functioning smoothly and effectively to achieve the desired benefits from the resources. In Bangladesh, a mechanism to promote the conservation of PAs and benefit local communities through co-management was initiated in 2004 by establishing the Nishorgo Network of forest and wetland PAs. Co-management committees (CMCs) form the institutional backbone of co-management initiatives. Thus, their proper formation and effective functioning is key to the success of co-management overall. This research studies the formation, activities, and effectiveness of CMCs in Teknaf Wildlife Sanctuary (TWS). The following questions are addressed: (1) Are diverse stakeholders represented in the CMCs? (2) Do the CMCs conduct regular meetings and activities? (3) Do the CMCs operate as per the Terms of Reference? and (4) What have been the impacts of the CMCs on: (a) reducing illegal resource collection; (b) increasing biodiversity; and (c) improving livelihoods? This study aims to help policy makers, resource managers, local community management organizations, and community members to better understand the role of CMCs and their effectiveness in achieving conservation and management goals for PAs in Bangladesh. Secondary information was collected from various reports, journals, publications, and circulars of the Integrated Protected Area Co-management (IPAC) project, the Nishorgo Support Project (NSP), the Forest Department, and other recognized institutions. Primary data were collected through interviews and focus group discussions using a semi-structured questionnaire. Twenty households from three villages were selected randomly. CMCs have been functioning in TWS, as per the framework and guidelines set by the government, for the last six years despite various limitations and complexities. This could have positive impacts on local livelihoods and the conservation of forest resources. Therefore, the effectiveness of CMCs and support from all concerned is a must to ensure better PA management.

Introduction

To be successful, the conservation and management of protected areas (PAs) must involve local communities. The 2003 United Nations list of PAs states that they cover 18.18 million square kilometers, or 11.5 percent of the global land surface (Chape *et*

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al. 2003). This is impressive, as the IVth International Union for Conservation of Nature World Parks Congress, held in Caracas in 1992, declared that PAs should cover at least 10 percent of the total land area by 2000. However, in South Asia, PAs make up only about six percent of the total land area. While countries like Bhutan and Nepal have planned to designate about 27 percent and 18 percent of their territory as PAs, respectively (Sharma and Yonzon 2005), in Bangladesh only 1.7 percent of the territory has been given such official protected status (Merrill 2011). Conflicts associated with PAs are growing as population growth, resource scarcity, climate change, expanded consumption, and continued use of inappropriate technologies create challenges for their viability. Such challenges threaten the significant role that PAs can play in securing the productive future of the people (McNeely *et al.* 1994). One particularly crucial issue is economic sustainability whether the livelihood needs of local communities can be met and whether sustainable funding mechanisms to support the management of PAs can be devised. Facing all of these challenges, our forests will only be conserved when local and national stakeholders become partners in conservation. This will also help to ensure sustainable economic development for local communities, because PAs can make important contributions to supporting rural economic development and lowering the costs of achieving sustainable growth (ICEM 2003).

In Bangladesh, PA conservation through co-management initiatives is still in a nascent stage. Recognizing the need to conserve the country's most productive ecosystems, the Government of Bangladesh established the Nishorgo Network of forest and wetland PAs in 2004, and empowered local communities by involving them in the protection of natural resources through a collaborative management (co-management) approach. This approach aims to promote the conservation of PAs while also benefiting local communities.

The management of open natural resources like forest ecosystems is difficult, and a number of challenges exist for the proper functioning of co-management systems. A huge population density is creating extensive demand for, and pressure on, forest resources. Moreover, the socio-economic and political scenario, power relations, and local beliefs such as the attitude that state-owned property means nobody's property (i.e. the tragedy of the commons) provide a critical challenge for the effective functioning of co-management organizations. However, it is vital that co-management mechanisms function smoothly in order to achieve the desired conservation outcomes. The institutional backbone of co-management initiatives is the co-management committee (CMC). Thus, the overall performance of the management system, as well as the expected livelihood and conservation outcomes, depends primarily on the proper constitution, functioning, and active engagement of the CMCs.

This study assesses the formation, activities, and effectiveness of CMCs in Teknaf Wildlife Sanctuary (TWS). In Bangladesh, the government established a framework and working guidelines for CMCs in PA management. CMCs are mandated to meet

regularly and to execute a set of specific activities. CMCs make decisions and plan future actions for promoting resource conservation and community livelihoods that lead to achieving the co-management objectives. This research seeks to address the following questions about CMCs in TWS:

1. Are diverse stakeholders represented in the CMCs?
2. Do the CMCs conduct regular meetings and activities?
3. Do the CMCs operate as per the Terms of Reference?
4. What have been the impacts of the CMCs on: (a) reducing illegal resource collection; (b) increasing biodiversity; and (c) improving livelihoods?

This study will help policy makers, resource managers, local community management organizations, and community members to get a better idea about the current role of the CMCs and their effectiveness in achieving conservation and management goals for PAs in Bangladesh.

Background

Teknaf Wildlife Sanctuary is situated in Teknaf Upazila of Cox's Bazar District in southeastern Bangladesh. It is bordered on the east by the Naf River and on the south and the west by the Bay of Bengal. To the north it borders on other parts of the Cox's Bazar South Forest Division and Myanmar. The sanctuary lies between 20°52' and 21°09' north latitude and between 92°09' and 92°18' east longitude (Figure 1) and runs along the entire eastern length of the forest from north to south, along the Teknaf highway. The sanctuary is also bounded by another road that runs along the entire western boundary of the forest, along the beach between Cox's Bazar and the town of Teknaf. The total population of Teknaf Upazila is 152,557, including 125,651 rural residents, of whom 64,530 are male and 61,121 are female (Bari and Dutta 2004). Mollah *et al.* (2004) have recorded a total of 115 settlements or villages, which are locally called *paras*. The villagers have various degrees of reliance on TWS for their livelihoods. Fifty-three villages (46%) are located inside the reserve boundaries, primarily on forest land. The rest are located adjacent to and outside of the forest area. Bengali, Rakhaine, Tanchangya, and Rohingya (refugees) are the major ethnic groups living in Teknaf Upazila.

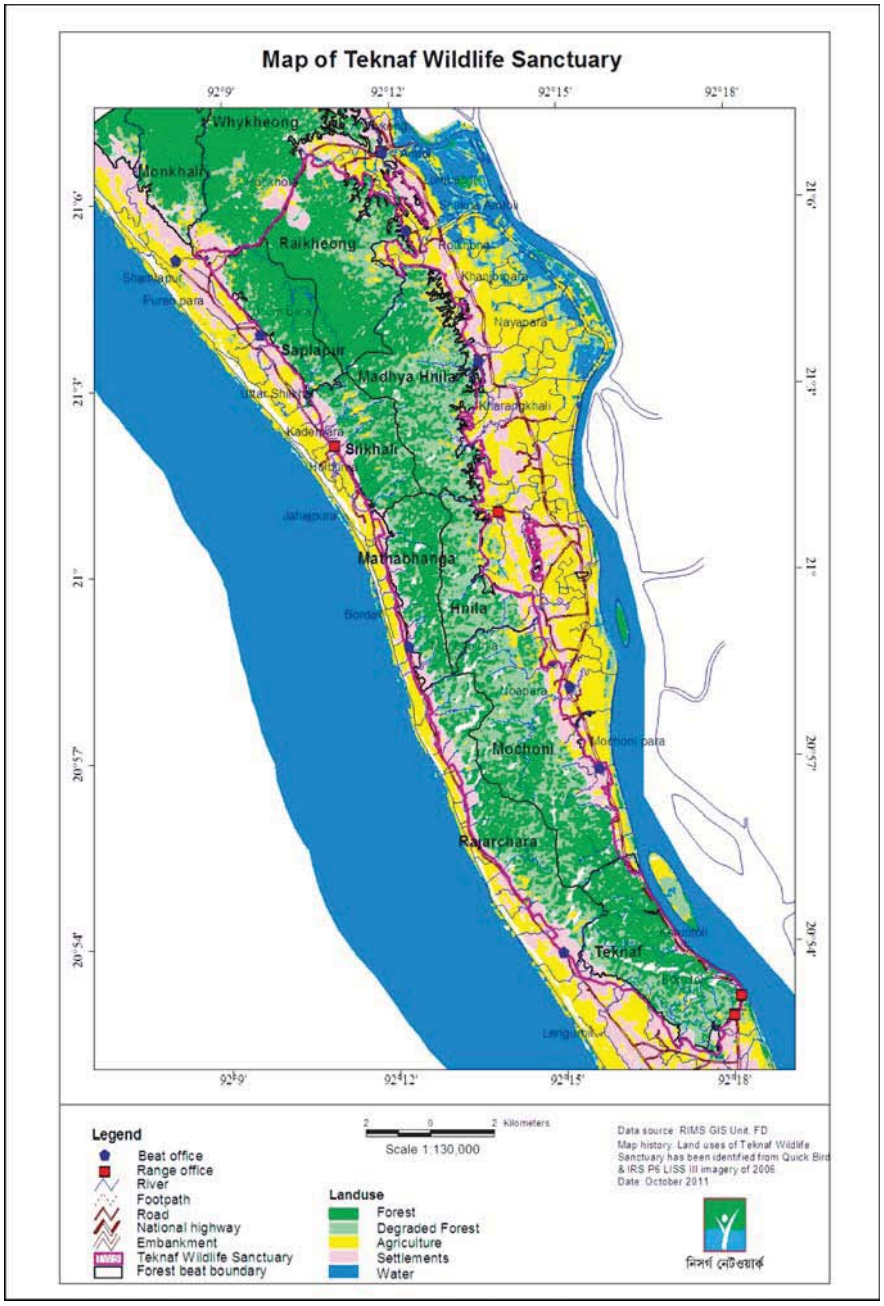

Figure 1: Map of Teknaf Wildlife Sanctuary (Source: NSP)

TWS is one of the largest and most biologically diverse PAs in Bangladesh. Teknaf Game Reserve (TGR) was established in 1983 with a reserve forest area of 11,615 hectares. Recognizing its importance for biodiversity conservation, the government declared it Teknaf Wildlife Sanctuary in 2009 (GoB 2009a). Management of the forest area that constitutes TWS started with the promulgation of its legal status as a reserved forest in 1907. Timber production for revenue generation was the then imperial government's main focus for forest management. To this end, permits were issued to cut selected trees based only on their diameter. The first management plan for the forests of Cox's Bazar District was prepared in 1935. The main prescription in this plan was the conversion of natural forests to plantations of several timber species, including teak (*Tectona grandis*), an exotic native to India and Southeast Asia, as well as indigenous species like *Dipterocarpus turbinatus* (garjan), *Hopea odorata*, and *Artocarpus chaplasha*. Several management plans followed similar prescriptions. The Government of Bangladesh imposed a moratorium on tree felling in 1989. Some plantations were continued, mainly in new areas, on denuded and bare forest lands.

In 1998, the Asian Development Bank funded the Forestry Sector Project (1998–2006). Under this project, TGR was divided into a central core zone with a buffer zone covering an outer strip of forestland. Through community participation, a plantation of approximately 2,000 hectares was successfully established and maintained according to the Forest Department's Social Forestry Rules. While the plantation initiative was successful, nothing was done to improve the habitat of TWS's banner species, the Asian elephant, or to preserve other wildlife and biodiversity. In fact, no specific wildlife conservation measures have been taken, and no wildlife management plans were prepared until the initiation of co-management activities (Bari and Dutta 2004).

Since the declaration of TGR (now TWS), resource extraction has been banned within its boundaries. Thus, legal tree felling has ceased. However, illegal resource collection as well as the degradation and deforestation of natural forests has continued unabated. Mollah *et al.* (2004) found that forest patrolling is poor, partly due to inadequate manpower and partly due to a lack of logistical support, such as camp/patrol posts, vehicles, petrol, arms, communication devices, and office equipment. There are only 45 staff members working for forest protection and management, including *malis* (the lowest ranking staff members engaged in raising and planting seedlings); and there are no staff members working specifically to manage biodiversity in the sanctuary. Moreover, it is estimated that, on average, only one Forest Department staff member is engaged in and responsible for managing each 258 hectares of the forest in TWS, which is under tremendous pressure from the large number of forest-dependent villagers.

The Nishorgo Support Project (NSP) introduced the idea of co-management in TWS in 2004. NSP has made a comprehensive effort to improve the management of five PAs in Bangladesh through a new co-management approach (FD 2006). In this

regard, in 2006, the government created eight CMCs at these five sites. Since then, through these local institutions, park managers and local people have made collective decisions and shared responsibilities for resource management. The CMCs have been granted rights to collect revenues from forest-based activities such as ecotourism, with 50 percent of revenues generated from park entrance fees being dedicated to the CMCs to support community participation in forest conservation.

Three of the eight initial CMCs were formed in TGR due to its large area. They are still in operation today. Karim (2008) found that the alternative income-generating activities (AIGAs) begun by the co-management initiatives under NSP were functioning well. He also observed some coordination gaps among the NSP, the Forest Department (FD), and the CMCs. In this study, I aim to further examine these gaps through a qualitative assessment of the performance and operation of the CMCs. In addition, I examine the community's feelings towards resource conservation, and the presence and role of CMCs. Finally, I question whether the existence and functioning of CMCs in TWS is essential or not.

Methods

At the beginning of the research study, I collected secondary information and reviewed various reports, journals, publications, and circulars of the Integrated Protected Area Co-management (IPAC) project, NSP, the FD, the Government of Bangladesh, and other recognized institutions.

To become familiar with the field situation, the CMCs' working modality, and coordination among the different stakeholders, I made a preliminary visit to the research site. During this visit, I observed important community functions related to resource conservation, identified major interventions planned by the CMCs, designed sampling procedures, and scheduled interviews and discussions with major stakeholders, key informants, and focus groups. I then finalized my research plan based on an assessment of the duration and number of interviews and other interactions, as well as other areas and aspects to be explored.

I collected primary data through interviews and focus group discussions in December 2011. The interviews were held with individuals and households using separate checklists of questions to guide these interactions. During the field visits, I also conducted five focus group discussions. These discussions provided information about the CMCs' functioning, activities, and results. The type, location, and number of focus group discussions, as well as the number of participants in each, are outlined in Table 1.

Table 1: Target group, location, and number of focus group discussions and participants

Target group	Area	Number of discussions	Number of participants
Forest Department staff	Cox's Bazar	1	3
	Teknaf	1	4
IPAC staff	Cox's Bazar	1	3
	Teknaf	1	5
CMC members	Shilkhali	1	5
	Teknaf	1	3
Community patrolling group members	Shilkhali	1	5
	Whykong	1	5
Total		8	33

I randomly chose three villages for the household survey, one from each CMC area. Then I randomly selected 20 households, half of which were involved in co-management initiatives as village conservation forum (VCF) members and/or recipients of AIGA support, and half of which were not associated with co-management activities in any way (see Table 2). I used a semi-structured questionnaire to investigate the impacts of CMC activities on the entire community.

Table 2: Study villages and number of households surveyed in each

CMC name	Village name	Number of households surveyed	
		Within CMC initiatives	Outside CMC initiatives
Shilkhali	South Shilkhali	3	4
Teknaf	Leda	3	3
Whykong	Lambabil	4	3
Total	3	10	10

Results

Are Diverse Stakeholders Represented in the CMCs?

In TWS, CMCs are constituted and act according to the legal status granted to them via a gazette notification from the Ministry of Environment and Forests (GoB 2009b). The gazette states that these committees will act as an executive body for performing co-management activities in their respective PAs. The gazette notification also states that the CMCs should include representative members from different stakeholder groups. In my visits and interviews in TWS, the major stakeholders I identified in the PA included FD officials, local leaders, government officials, ethnic community members, and forest resources user groups. Table 3 shows the number of CMC members for each of the stakeholder groups in the three CMCs.

Table 3: Composition of CMCs

Stakeholders	Designated number of committee members*	Actual numbers of committee members		
		Shilkhali CMC	Teknaf CMC	Whykong CMC
Local government	3	3	4	3
Forest Department	9	8	8	8
Law enforcing authorities	2	1	2	2
Other government agencies	1	1	1	1
Civil society groups	2	2	2	2
People's forums	6	6	6	6
Village conservation forum (VCF)	2	2	2	2
Resources users	1	1	1	1
Ethnic community	2	2	2	2
Community patrolling group (CPG)	3	3	3	3
Total	31	29	31	30

*Note: According to the gazette notification

According to these results, the selection of committee members in the three CMCs provides a good representation of the respective stakeholder groups as per the gazette notification.

The key informants, focus group members, and respondents also recognized the composition of the CMCs as a fair representation of stakeholders in the area. They mostly emphasized the recognition of CMC decisions by government authorities, for example the Upazila Administrator and the FD officials. TWS exhibits serious conflicts of forestland encroachment. Respondents voiced a strong preference for inclusion of the Assistant Commissioner of Land (Upazila Administration) in the CMCs, because issues pertaining to land administration and legality are under his jurisdiction. Key informants acknowledged that the CMCs represent the local communities and hence are useful for understanding and addressing local needs, as well as for protecting local resources. They asked for more support to enhance the functioning of the CMCs.

Do the CMCs Conduct Regular Meetings and Activities?

The gazette states that CMCs will act as executive bodies accountable to the co-management councils. The CMC members meet monthly to review regular activity reports and to discuss these reports and other issues regarding PA management. Table 4 shows the number of meetings held by each committee last year. All the CMCs held regular meetings and discussed PA management with committee members.

Table 4: Status of CMC meetings in 2011

CMC name	Date of formation of past CMC	Date of formation of present CMC	No. of members	No. of meetings held in 2011
Teknaf	August 6, 2006	October 25, 2010	29	10
Shilkhali	September 27, 2006	August 18, 2010	27	12
Whykong	August 29, 2005	December 2, 2010	28	11

The Nishorgo Support Project initiated CMC formation and co-management interventions at various sites between 2003 and 2008. Besides the formation of the three CMCs in TWS, NSP initiated the formation of 15 community patrolling groups (CPGs), consisting of 595 people, to strengthen FD's law enforcement capacity with a view to enhancing resource protection. For reducing dependence on forests, NSP also formed 102 forest users groups (FUGs) consisting of 1,750 households. NSP provided these households with training in one of 20 possible trades, such as cow fattening, nursery establishment, fish cultivation, fishing, pig rearing, poultry rearing, small trading, rickshaw-van pulling, manufacturing of improved cooking stoves, and eco-tour guiding. NSP also established six environmental libraries and six nature clubs, which provide training on biodiversity preservation, forest conservation and protection, nursery and plantation raising, and climate change awareness. These groups promoted mass awareness-raising and environmental education for diverse stakeholders.

Under three of the CMCs, NSP developed three ecotourism sites in TGR: Kudum Guha in Whykong, Teknaf Nature Park, and Shilkhali Garjan Forest. In addition, provisions were made for allocating 50 percent of the entry fees from these sites to the respective CMCs for a community development fund.

NSP concluded its activities in 2008. It was followed by the Integrated Protected Area Co-management (IPAC) project. In TWS, IPAC activities include counseling and organizing of the CMCs, CPGs, village conservation forums (VCFs), people's forums (PFs), Nishorgo student clubs, ecotourism guides, Nishorgo Shahayak (volunteers), hiking guides, support for AIGAs, and landscape development funds (LDF). Table 5 summarizes the IPAC activities carried out in the three CMCs. Table 6 summarizes the type and number of AIGAs provided by IPAC.

Table 5: NSP and IPAC outcomes in the three CMCs, 2004–2011

Co-management outcome variable	Teknaf CMC	Whykong CMC	Shilkhali CMC
No. of VCFs	43	39	32
No. of PF members (2 from each VCF)	86	78	64
Number of CPGs (and members)	5 (168)	3 (108)	3 (92)
No. of Nishorgo clubs (and members)	3 (123)	3 (123)	3 (119)
No of improved cooking stoves installed	446	31	-
No. of Nishorgo Shahayak members	43	39	32
No. of popular theater groups	1	-	3

(Source: IPAC 2011a)

Table 6: IPAC project AIGA support for April to June 2011

Site name	VCF name	No. of house-holds in VCF	No. of AIGA target house-hold	Type of AIGA	Inputs (in-kind support)	No. of bene-ficiaries to date	IPAC support per household (BDT)	Total I PAC input support (BDT)
Shilkhali	Kaderpara Male	30	30	Bamboo	Bamboo, Cane	6	1,210	7,260
Shilkhali	Kaderpara Female	30	30	Bamboo	Bamboo, Cane	4	1,737	6,946
				Handi-crafts	Net making, Rope	5	1,470	7,350
Shilkhali	Hazompara	31	30	Bamboo	Bamboo, Cane	10	1,647	16,470
Whykong	Kombonia-para	30	30	Agri-culture	Ladies Finger, Cucumber, Brinjal, Turmeric	30	1,557	46,700
Whykong	Nayapara	37	30	Fisheries	Fingerlings, Fishfeed	10	1,800	18,000
Whykong	Kharinga-ghona	40	30	Fisheries	Fingerlings, Fishfeed	10	1,300	13,000
				Fisheries	Fingerlings	29	1,500	43,500
Whykong	Lambabeel	30	30	Handi-crafts	Net making, Threads	13	1,470	19,110
				Bamboo	Bamboo	6	1,732	10,389
Teknaf	Lechua-prang	40	30	Agriculture	Seed, Compost, Fertilizer	30	980	29,400
Totals		**268**	**240**			**153**		**218,125**

(Source: IPAC 2011b)

Do the CMCs Operate as per the Terms of Reference?

The specific responsibilities of the CMCs, as delineated in the 2009 gazette notification (GoB 2009b), include performing and supervising regular activities; preparing an annual work plan for the PA; involving and supervising local community members in implementing management activities in the PA according to the annual work plan; promoting the economic development of local communities through equitable distribution of PA benefits; selection of participants for social forestry through land zoning; managing and maintaining all infrastructure within the PA and planning new facilities to promote tourism; appointing patrolling groups for resource conservation; presenting all activities before the Co-management Council (responsible for the policy aspects and approval of the CMC's work activities) for approval; and maintaining accounts for revenue-generation and financing of the PA.

As per the gazette provisions, three CMC members are elected as office bearers. These are the president, vice-president, and treasurer. One accountant/administrative officer is appointed to assist each CMC. This officer is responsible for maintaining financial and office records.

Focus group discussants reported that decisions regarding PA management and community development are taken through discussions in the forum. CMCs operate within their Terms of Reference (TOR) and do not take decisions or act beyond their TOR. Discussants expect that, as per the CMCs' TOR, and to promote effective conservation, the CMC will execute more actions in the future. FD respondents suggested that CMC members need to be more responsible and give correct information and assistance to FD officials for resource conservation.

IPAC now funds most of the activities in the study site, and the CMCs execute project activities with direct assistance from IPAC. However, the continuity of these activities after completion of the IPAC project is at risk. Most respondents expressed concern about the long-term viability of these project-funded activities.

The three CMCs in TWS have developed their own annual work plans. They have registered with the Directorate of Social Welfare to generate and collect funds as an NGO. Although they have not yet collected substantial funds, they are taking steps to raise more funds in the future. In this vein, the three CMCs have submitted project proposals to the Climate Change Trust Fund under the Ministry of Environment and Forests. However, the CMCs should make an effort to generate their own funds to ensure sustainable future operation of development activities, as well as community development and resource conservation.

What Have Been the Impacts of the CMCs on Illegal Resource Collection, Biodiversity, and Livelihoods?

In response to the question of whether they have observed any effects of PA management due to the formation and functioning of CMCs, two thirds of the respondents said that impacts are apparent, and the remaining third reported no significant impacts. FD officials raised some questions about the ability of CPG members to control illegal fuelwood collection and even suggested that some CPG members may be supporting these activities themselves. But when asked if they thought that the situation would be better in the absence of the co-management model and the CMCs, all respondents replied no, acknowledging the success achieved through CMC activities.

Results of the focus group discussions and the household surveys suggest that AIGAs significantly affect the livelihoods of local people. Respondents suggested that, because of AIGAs, forest offences and the illegal collection of forest resources have

declined. In fact, the vice-president of the Shilkhali CMC stated, "There is only one incidence of tree felling found within the last eight years, whereas a huge number of garjan trees were cut earlier."

Respondents suggested that before co-management was implemented, seedlings, saplings, and shrubs were used as fuelwood, affecting natural regeneration and forest regrowth. After the implementation of co-management initiatives, illegal resource collection has declined and livelihoods have improved through activities such as AIGAs, revenue-sharing from tourism, the introduction of innovative technologies such as improved cooking stoves, and awareness-building through trainings, meetings, and publicity efforts. Karim (2008) also found that AIGAs have certain positive impacts on community livelihoods and on reducing dependence on forest resources.

In 2008, a participatory bird survey was conducted to assess the impacts of protected area management (Khan 2008). The survey included eight indicator bird species. Since all eight of the indicator birds are primarily forest birds, any change in the condition of the forest would have an impact on their population densities. Local people perceived an increase in the bird population. They also replied that illegal hunting in TWS was gradually declining and that Asian elephants faced fewer casualties. Finally, they mentioned increased undergrowth in recent times, indicating enhanced biodiversity conservation.

Conclusion

CMCs are the key to resource management through co-management initiatives. Effective functioning of CMCs leads to the successful conservation and management of resources. This study has sought to determine whether CMCs in TWS function effectively or not. The CMCs in TWS are comprised of a representative group of local stakeholders and hence can cater to diverse local needs and attitudes towards resource conservation. So far, the CMCs execute regular meetings and co-management activities. The CMCs are functioning as per the framework and guidelines set by the government. Despite some limitations and complexities, they have been performing according to the TOR. Still, there are some goals that have not yet been achieved, including development of a fund for future operations and development interventions. Positive attitudes and support from policy makers, the FD, and the local administration towards CMCs are also imperative.

The CMCs' functioning has implications for the resources as well as the wellbeing of the community. Illegal resource collection can be decreased through raising local peoples' awareness, promoting AIGAs and other types of support, and through community patrolling efforts. Improved biodiversity conservation has been demonstrated by the presence of more undergrowth and less logging and hunting in

the area, as reported by the local stakeholders. Local livelihoods are improved through awareness-raising, AIGA support, and other trainings and community development interventions.

Through the involvement of local stakeholders, CMCs achieve a better understanding of the PA, as well as the needs and perceptions of local communities. CMCs can discuss local issues, communicate with different forums, and seek suggestions and assistance to overcome challenges. They can also raise and mobilize funds for better PA management and community economic development activities. Furthermore, they can garner local financial and human resources for resource protection and conservation. Thus, the effective functioning of the CMCs has strong implications for both local livelihoods and forest conservation. This study reveals that CMCs can play a positive and critical role in promoting the conservation of natural resources and livelihood enhancements. Therefore, all concerned stakeholders need to nourish the CMCs and facilitate their work in order to achieve optimum resource conservation and maximize community benefits.

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Attitudes towards Co-management: Is Satchari National Park a Suitable Model for Bhawal National Park?

Rafiqul Islam Chowdhury

Abstract

The forests of South Asia serve as common pool resources for local communities to meet their livelihood needs. Colonial rulers established state property rights that weakened community-based forest use and management. Protected areas (PAs) in Bangladesh are managed by the Forest Department (FD) according to Bangladesh Wildlife (Preservation) (Amendment) Order 1974, with no legal scope for community participation in their management and conservation. However, over time co-management practices have evolved in many South Asian PAs and local communities have initiated collective efforts to stop the degradation of forest ecosystems. Donor-funded projects have supported such collaborative approaches, and a number of co-management initiatives have shown success in countries like India and Nepal. The Nishorgo Network platform and the Integrated Protected Area Co-management (IPAC) project have promoted such collaborative management approaches in Bangladesh with the involvement of diverse stakeholders.

This study was carried out in Satchari National Park, in northeastern Bangladesh, where co-management has been practiced since 2005, and in Bhawal National Park, which does not have a co-management initiative yet. Focus group discussions and key informant interviews with key stakeholders involved in co-management suggest that there are several issues regarding sustainable, effective co-management: The sustainability of co-management through policy supports and financing has yet to be ensured; co-management committees (CMCs) have yet to be developed into institutions for promoting conservation, and ensuring representation from various stakeholders is still a problem; collaboration between the FD and IPAC is minimal; community patrolling groups lack support for alternative income-generating activities (AIGAs); and existing project support for AIGAs is not sufficient or sustainable. The future success and sustainability of co-management of PAs in Bangladesh depends on successfully addressing these issues through gainful partnerships with key stakeholders. Considering the distinct overall situation of each PA, the modality of co-management should be site-specific rather than generalized. With respect to a future co-management project at BNP, the existing government order that establishes CMCs is not suitable. Instead, a village conservation forum model that includes the Forest Department and local people is more suitable for co-management at BNP. Second, it is imperative that policy formulation at BNP be bottom up rather than top down, with input from field-level experience. Third, more policy support will be needed for

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CMCs to be sustainable at BNP, including provisions to keep 50 percent of the entry fees at the PA site; a revision of national forest policies to accommodate co-management; increased support for CPGs; and increased support for AIGAs, which should go to groups rather than individuals.

Introduction

Over the last decade, the conservation of protected areas has undergone a paradigm shift as resource managers switched from focusing on restricting human involvement towards encouraging the involvement of local people in the management of these areas (Borrini-Feyerabend 1996, 1997; Kiss 1990). In both developed and developing countries, incorporating local participation is now seen as an essential component of successful conservation initiatives.

Co-management, "a situation in which two or more social actors negotiate, define and guarantee among themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources" (Borrini-Feyerabend *et al.* 2007), has been recently adopted for some protected areas (PAs) in Bangladesh. Prior to 2004, the Forest Department (FD) had been responsible for the management of forest resources, using scientific principles. Under this paradigm, there was a prominent trend of resource depletion, in large part caused by the exclusion of local users from resource management. Government officials, development partners (donors), and scientific communities advocated for a shift in management from a strict protection focus to a multi-stakeholder management regime. In 2004, the Government of Bangladesh initiated forest co-management in five PAs in Bangladesh through the Nishorgo Support Project (NSP), with funding from the United States Agency for International Development (USAID). Upon termination of the NSP in 2009, the Government of Bangladesh initiated another USAID-funded initiative, the Integrated Protected Area Co-management (IPAC) project. Under IPAC, co-management expanded to 18 PAs (IPAC 2011).

Since the NSP began, many lessons have been learned from the co-management of protected areas in Bangladesh that have implications for the scaling up of this approach to other PAs. Currently co-management is implemented in a similar way across different PAs according to government orders published in the Bangladesh Gazette. In Satchari National Park (SNP), co-management was initiated under the NSP and has been continued under IPAC. Considering the similarities between Bhawal National Park (BNP) and SNP that do not exist in other PAs in Bangladesh in terms of land cover, encroachment, and pressures from ethnic communities, political and elite groups, and visitors I determined that co-management at SNP could potentially provide a model for co-management at BNP.

Thus, the purpose of this study is to determine whether the co-management model currently used for PAs in Bangladesh is suitable for Bhawal National Park, drawing on the experience of SNP. Because the Forest Department is responsible for the overall management of PAs, and because policy makers play significant roles in the formulation of new policy, this study aims to inform these decision makers about effective strategies for co-management.

Background

Protected areas in Bangladesh cover some 272,490.49 hectares, or about two percent of the country's total area. There are 17 national parks and 17 wildlife sanctuaries (FD 2012). Bangladesh's national parks can be defined as relatively large areas of natural beauty where the flora and fauna are protected and preserved for the enjoyment and education of the public. Himchari National Park of Cox's Bazar was declared as the first national park in Bangladesh in 1980 in order to conserve the biodiversity of that area. All protected areas, including national parks, are managed by the corresponding Forest Divisions at the district or sub-district level, which are under the supervision of the Forest Directorate of the Ministry of Environment and Forests (MoEF). Bhawal National Park in Gazipur District was established to preserve an important ecosystem and to create opportunities for recreation, education, and research. BNP is noted for its coppiced sal (*Shorea robusta*) forests. It is located about 40 kilometers north of Dhaka city and is situated along the Dhaka-Mymensingh Highway (between approximately 23^0 55' to 24^0 00' north latitude and 90^0 20' to 90^0 25' east longitude). The park offers a serene reprieve from the bustle of the city for Dhaka's residents, as well as a taste of the vast sal forests that once ran nearly uninterrupted from Dhaka to Mymensingh in northern Bangladesh.

The land that now comprises Bhawal National Park was formerly the private hunting grounds of the Bhawal king. In 1950, this forest area was nationalized and put under the jurisdiction of the Forest Department in order to improve its management. The area comprising Bhawal National Park covers approximately 5,022 hectares (FD 2002). It was declared a protected area through the Bangladesh Wildlife (Preservation) Order of 1973, which was subsequently amended to become the Bangladesh Wildlife (Preservation) (Amendment) Act of 1974 (GoB 1974). Bhawal National Park was declared on May 11, 1982 (as per Gazette Notification Number II/For-66/88/318 dt.11.5.1982), and includes eight *mouzas* (smallest unit of land according to the settlement department of Bangladesh) of Gazipur District.

Bhawal National Park was managed under the Dhaka Forest Division until January 2008, when it was handed over to the Wildlife Management and Nature

Conservation Division of Dhaka. Overall responsibility for the park is assigned to the Divisional Forest Officer (DFO), while one Assistant Conservator of Forests (ACF) is designated as the officer in charge of the park.

BNP has some unique features compared to other protected areas of the country, in terms of its (1) proximity to urban areas; (2) encroachment by diverse populations; (3) the prevalence of private land within its boundaries; and (4) pressures from rapid industrialization. These differences are discussed in more detail below. Most national parks in Bangladesh are situated far from major urban centers. BNP is the only one that is located close to the capital city of Dhaka. This proximity renders it vulnerable to a number of influences that most other parks do not face. In particular, while the management of most national parks is influenced by the political priorities and affiliations of local leaders and elites, national political parties and leaders also influence BNP, with strong connections to local leaders and economic interests. These national influences frequently interfere in the management activities of the park.

In addition, compared to other national parks, the local population living in and around BNP is highly heterogeneous with diverse backgrounds and occupations, including a combination of long-standing local residents, recent settlers, and non-permanent residents from different parts of the country who have migrated from other rural and urban areas and have settled in the buffer zone. Furthermore, there are different ethnic communities, such as the Kuch, who live within the park boundaries.

One of the impacts of BNP's diverse population and its proximity to Dhaka is the pressure for private land for agriculture within the park (NSP 2005). BNP is the only protected area in the country with private land inside its boundaries (see Figure 1). Specifically, within the forest there are pockets of private land known as *baid* lands (lowland areas where paddy agriculture is practiced). There are agricultural lands within other PAs, but the ownership of those lands is vested in the government through the FD. In BNP, the FD has no authority over the management of the private lands.

Another consequence of BNP's proximity to the urban area of Dhaka, as well as its incorporation of private land, is the presence of a large number of industries located in and around the park. In fact, it is the only national park in Bangladesh with industries inside the core area of the park, where a denim and a spinning mill are currently operating. In addition, there are more than 150 industries in the buffer zone and the areas immediately surrounding the park, with thousands of workers from these industries residing in the buffer zone area.

Bhawal National Park contains two forest ranges: the National Park Range and the Bhawal Range. The National Park Range contains three beats (Park, Baupara, and Bankharia), while the Bhawal Range has four beats (Rajendrapur West, Bishawakuribari, Baroipara, and Bhabanipur). For management purposes, BNP is divided into two zones a core area and a buffer zone area. The core zone is the area where extensive protection measures are taken. Specific economic activities, such as the setup of industries, the extraction of all sorts of forest products, and the planting of exotic species, are prohibited. However, all of the above activities are allowed in the buffer zone area. Only the Park Beat is designated as the core zone and the rest of the beats are located in the buffer zone.

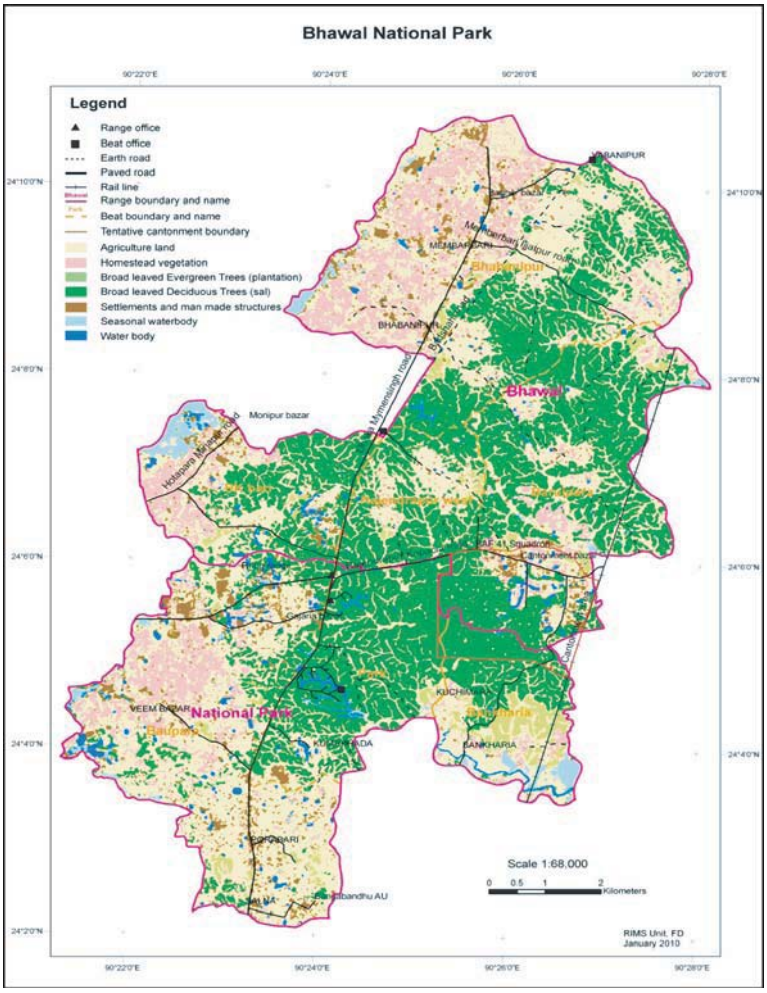

Figure 1: Map of Bhawal National Park (Source IPAC).

A large number of visitors come to BNP during the winter, mainly to enjoy picnics and observe nature. The Government of Bangladesh earns considerable revenue from the park. In 2010, gate receipts totaled BDT 8,810,000 (USD 124,000) from about 10,000,000 visitors, an amount that nearly doubled in 2011 to BDT 15,150,000 (USD 214,000). Visitors walking through the park often disturb wildlife because they are not restricted to footpaths and designated areas. They go everywhere, including sensitive wildlife areas. In fact, there are too many visitors, more than the park can sustain.

Extensive fuelwood collection, a major and very visible activity in Bhawal National Park, is another practice that poses a threat to forest biodiversity. While this activity occurs year round, extraction is most intense during the dry season. Fuelwood is collected for both household consumption and commercial purposes. Most of the collectors are adults, both male and female, and adolescent boys. Most collectors are poor and supplement their income by selling fuelwood.

Encroachment is one of the main reasons for forest habitat degradation. This occurs through the expansion of agricultural lands, the development of new settlements, and the establishment of industries, such as garment manufacturers, spinning mills, and dying, pharmaceutical, and poultry feed industries. Almost 70 percent of the forest habitat has been destroyed due to such practices over the last four to five decades. As mentioned above, there are extensive small pockets of private land inside the national park. The most critical issue arising from this occurs when private landowners sell their plots to industrialists who then establish industries. As a result, conflicts arise between FD officials and local people over land use, particularly with owners of disputed lands.

Ground fires are a common phenomenon in Bhawal National Park as well. These are usually set by local people to facilitate the collection of fuelwood. Due to ignorance about the conservation of forest resources, people employ such practices without thinking of their short- and long-term detrimental effects. Fires destroy flora, kill subsoil insects and other fauna, and disrupt the balance of the ecosystem. Many medicinal herbs and shrubs have all but disappeared due to such practices. Attempts to increase forest biomass through timber tree plantations, often with exotic monocultures, were carried out by the FD through the planting of fast-growing trees of short rotation. They also planted bamboo and cane species as undergrowth. Because encroachment is a major problem, fast-growing species were selected to cover the area, and thereby resolve the encroachment problem. However, these reforestation efforts pose their own threat to the diversity of both plants and animals in the park.

Different resource users also collect various other resources from Bhawal National Park. People living in the villages adjacent to the forest harvest vegetables and fruits from the forest. They mainly collect these fruits for their own consumption; in

addition, local people sometimes hunt jungle fowl and wild boar for household consumption.

By contrast, Satchari National Park (SNP) stands on the old Dhaka-Sylhet highway about 130 kilometers northeast of Dhaka, between Teliapara and Srimongal, in northeastern Bangladesh, near the border with India. It is in the Paikpara Union of Chunarughat Upazila in the district of Habigonj. The forest is located within the Satchari Wildlife Range under the jurisdiction of the Wildlife Management and Nature Conservation Division office in Maulvibazar. It is divided into two forest beats: Satchari and Telmachara.

The Satchari Reserve Forest covers an area of about 1,760 hectares (IPAC 2009) and is governed by the Forest Act 1927 and its subsequent amendments. In 2005, SNP was declared under the Wildlife (Preservation) (Amendment) Act 1974 to preserve the remaining 243 hectares of natural hill forests of the Raghunandan Hill Reserve Forest. The forest area is undulating, with slopes and *tilla* (hillocks), ranging from 10 to 50 meters. It is drained by a number of small, sandy-bedded streams. These streams dry out at the end of the rainy season in October and November and are subject to intensive commercial harvesting of sand during this time.

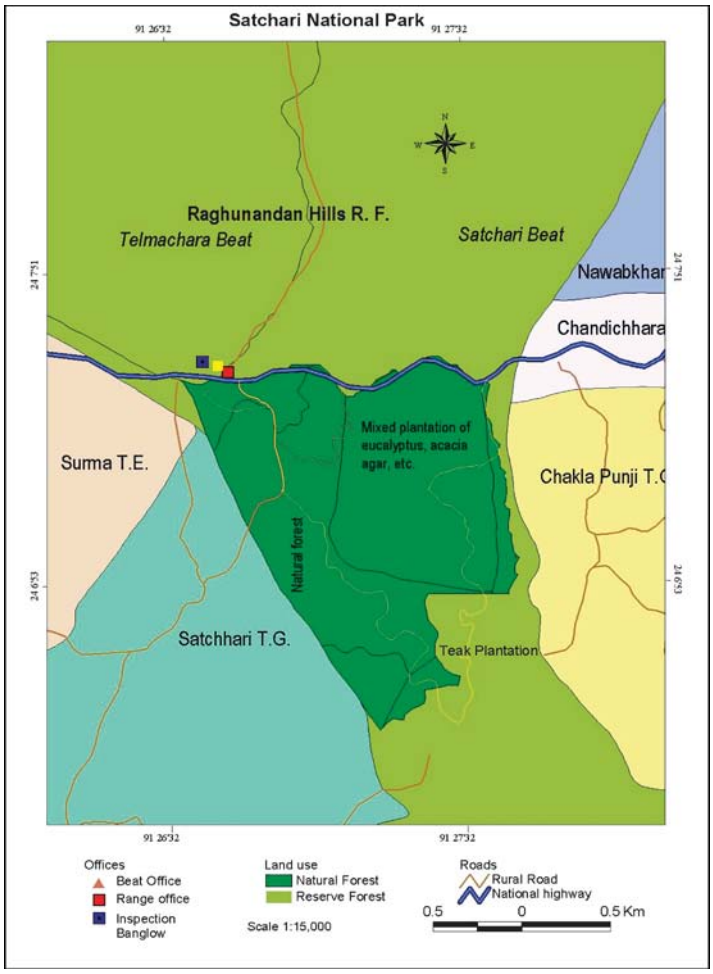

Figure 2: Map of Satchari National Park (Source NSP).

Although there is no private land within the park's core zone like in BNP, SNP is faced with the problem of illicit harvesting of forest products. Members of the Tripura ethnic group live in and around SNP and are engaged in lemon cultivation inside the park to support their livelihoods. The Bangladesh–India border divides the traditional lands of the Tripura. Those living on the Bangladesh side have retained their connection with communities living in India, and through these connections they are involved in smuggling small amounts of timber and other forest products (but mainly deal in other non-forest products such as oil and garments). Though small in scale, these activities affect the wildlife habitat, especially for breeding purposes. Such influences are not present in BNP, since it is not near any international borders. Moreover the trees found in BNP are not as commercially valuable as those found in SNP.

Methodology

This study relied on a combination of primary and secondary data and various qualitative research methods. First, I reviewed the experiences of co-management of natural resources in the context of developing countries through journal publications and gray documents like project reports. To get further background on Bangladesh, I studied reports of the Nishorgo Support Project and Integrated Protected Area Co-management project.

Next, I employed qualitative methods, including focus group discussions (FGD) and key informant (KI) interviews, to compare the characteristics and management of BNP and SNP in order to derive lessons for the future management of BNP. I used a structured checklist (Appendix I) to conduct FGDs with FD staff members at both parks and with people associated with the co-management committees (CMCs) and community patrolling groups (CPGs) at SNP, as they are key stakeholders who play significant roles in PA management.

To obtain additional information, and in some cases to clarify and expand upon queries raised by the FGDs, I interviewed key individuals who are concerned with the parks, using a pre-defined checklist (Appendix II). Selected key informants included the IPAC Chief of Party, the IPAC Project Director, the FD Wildlife Circle Conservator, the Chief Executive of the Aaranyak Foundation, the site coordinator from each park, and a range officer at each site.

I selected BNP as an indirect site under the IPAC project because there is a plan to launch co-management there in the near future. Because BNP has unique features, as described above, the modality of co-management needs to be chosen to maximize the opportunities for success and sustainability. As it is currently implemented, the modality of co-management is identical for all PAs in Bangladesh. SNP is an ideal site to observe the strengths and weaknesses of co-management, and to assess the appropriateness of this model for BNP. I am currently working as an Assistant Conservator of Forests (ACF) as the officer in charge of BNP, so I have a vested interest in this research. I visited SNP on October 21–22, 2011, as a researcher, to explore firsthand the implementation and practice of co-management.

The co-management committee is an executive body with representation from different stakeholders who are interested in the use of resources in and/or near a PA. I identified key CMC representatives, especially those who had a direct role in PA management, and invited them to be participants in the FGDs. Officials who played a significant role in policy formulation and implementation of co-management, from both donor and governmental perspectives, were the key informants. Through this comparative, multi-method approach, this study strives to illustrate the strengths and weaknesses of co-management as practiced in SNP, while also assessing the particularities of BNP, and combining these data to develop site-specific lessons and recommendations for co-management at BNP.

Results

Focus Group Discussion with Community Patrolling Group in SNP

I conducted a focus group discussion with members of a community patrolling group in SNP. There is only one such group in the area, which has 20 members, all of whom are forest villagers. Ten members were present during the discussion. Two of the CPG members are also members of the CMC; one CPG member had received an alternative income-generating activity (AIGA) loan from the CMC to open a small grocery store. FG discussants reported that they were involved in FD activities prior to co-management and that they had always had good relations with the FD, as they are all forest villagers.

CPG members regularly patrol the park, earning BDT 50 per day under NSP. Since the inception of IPAC, however, they report that their patrolling duties have increased but they are not receiving any cash incentives. CPG members have mixed reactions to co-management. They state that co-management has not resulted in any remarkable change in forest conditions or in their livelihoods. Participants commented that, in some ways, their livelihoods were better prior to co-management when they could still raise grains and fruits in the park through *jhum* (shifting cultivation), a practice which they have now stopped. However, they remarked that their lives are better now in other ways, because they have good relations with the FD and the co-management institutions.

All CPG members received AIGA loans of BDT 5,600 (USD 65) for livelihood development from the Aaranyak Foundation, a foundation that received its core funding in a grant from USAID. AIGA loans from the Aaranyak Foundation are different than those from the CDC. FG participants reported that they were not interested in the interest-free loans from the Aaranyak Foundation because the loan amount is insufficient for investing in any project that would return an income. The CMCs also allot AIGA loans to selected villagers. FG participants reported a gap between CMC decisions about whom to give AIGA loans to and the interests of people who receive these loans. They suggested that rather than giving loans to individuals, the loans should be allocated to a group of people. All group members would be responsible for the loan but the amount of the loan would be sufficient to invest in a significant project. After one year, the loan amount would be paid back to the CMC and a new group of people would be selected for the loan. FG discussants felt that when AIGA loans were distributed to individuals the amount of the loan was insufficient to be useful, and that CPG members were not properly trained before the disbursement of the loans. CPG members felt that the proper and sustainable utilization of AIGA loans required training and orientation for how to use the loans appropriately.

Focus Group Discussion with a Co-management Committee in SNP

I also conducted a FGD with CMC members in SNP. There are 23 members of the committee (four females and 19 males) who were selected for the CMC, in accordance with rules established by a government order. Fifteen CMC members participated in the FGD. I observed that because the CMC consists of a wide variety of stakeholders with different interests, the opinions of the CMC members that took part in the FGD often differed.

Some members, especially representatives from the CPG, commented that the procedures for selecting non-government CMC members should be changed because there was political interference that led to selecting elite group members. FGD participants reported, for example, that some CMC members sought to give AIGA loans to their own relatives or to those of influential CMC members rather than to people who are directly dependent upon forest resources. Other FGD participants stated that some influential CMC members interfered in the selection of participants for tree reforestation projects in the buffer zone, which had prevented the selection of participants for the last few years. Some FGD participants also stated that some decisions taken during the CMC meetings were not implemented because they failed to get approval from FD officials.

FGD participants stated that CPG members were not receiving any benefits from the CMC and felt that CPG members would not continue with their duties if they did not get cash incentives. While all CPG members received AIGAs from the Aaranyak Foundation and one member received an AIGA from the CMC, they did not consider AIGAs to be compensation for patrol duty. This is partially because the NSP program used to pay cash for this duty. FGD participants felt that co-management faced a critical shortage of funding.

Other FGD members reported that "godfathers" (politically and financially influential people who remain behind the scenes but force the implementation of their desires) are still active in illegal activities in the park. Many people feel the amount of money available through AIGA loans is insufficient to develop income-generating opportunities and hence they are afraid that the AIGA loans will become a burden to pay back.

Focus Group Discussions with FD Staff Members in SNP and BNP

During my study, I conducted FGDs with FD staff members in both SNP and BNP. In the FGD at SNP I met with all officials working in the park including the *mali* (gardener), forest guards, beat officers, range officers, and the Assistant Conservator of Forests. In this section, I discuss these FGD participants' observations regarding co-management.

CPG members are patrolling less because they are not receiving a cash benefit. FD staff members reported that some CPG members help timber smugglers and sometimes are involved in timber smuggling themselves. FD staff members reported that the CMC prevents them from taking action against CPG members who engage in illicit activities. The local Union Parishad (UP) chairman, for example, is a CMC member who directly prevents FD staff members from taking action against timber smugglers. Similarly, CMC members interfere in the selection of participants for buffer zone tree plantations. FD staff members report that this is why participant selection has not been finalized for the last few years.

FD staff members report that CMC members act as if they believe they should receive incentives from the PA for the time they spend in CMC activities. FD staff members also report that activities of IPAC staff members suggest that they think that the FD manages the PA inefficiently and that they (IPAC) are developing the PA and making it workable. For example, under NSP, FD staff members maintained tree reforestation plots. But presently, IPAC staff members maintain these plots and FD staff members only supervise the work. FD staff members believe that this is because IPAC staff do not trust them to do the work.

According to FD staff members, co-management is a good idea but only if the right people are in key positions to implement the will of co-management. They believe that the lack of such people is why the CMC is not functioning as it should.

In the FGD at BNP, all staff members working in the PA were present. They felt that, while community involvement is necessary for better and more sustainable PAs, co-management should be under the leadership of FD staff members. BNP staff members believe that co-management as it is being currently implemented in different PAs is based on the participation of people who are looking to receive personal benefits from the PA rather than those seeking to improve PA management. Thus, they feel that too much involvement and control by these people could have an adverse impact on the management of BNP.

FD staff members also report that, although CMCs do not exist in BNP, IPAC is already distributing small AIGA grants to local people. FGD members report that IPAC staff members are distributing these grants to people who are not dependent on the forest and are not involved in forest-related activities, and without consulting the FD. FD staff members feel that co-management should be implemented in such a way that the FD plays the key role in facilitating collaboration with community people. Considering the socio-economic conditions in Bangladesh, it is very difficult to handle peoples' expectations, especially the expectations of elite groups. FD staff members feel it would be wiser to base co-management on the involvement of both FD staff members and community people rather than on the participation of all stakeholders.

Key Informant (KI) Interviews

As key informants, I interviewed four people from IPAC and four staff members from the FD who have each played significant roles in PA co-management in SNP. The key informants I interviewed from IPAC stated that co-management ensures participatory management of natural resources. They commented that co-management is effective because it has improved communication and linkages between local communities and government agencies. Co-management also provides additional resources to the FD, leading to the development of CPGs to conserve biologically significant resources. They acknowledged that it is difficult to conserve protected areas without the help of local people.

I also interviewed the Chief Executive of the Aaranyak Foundation, who stated that proper orientation is required for both the FD and community members to introduce a new approach. Presently, people from line agencies such as the Upazila chairman, the Upazila Nirbahi officer, police, and others are represented on the CMC. Line agency staff members usually try to impose their thoughts on the CMC, without making a sincere effort to understand the issues and management needs, which ultimately negatively impacts conservation efforts. Therefore, he felt that the participation of line agency staff members is not optimal, or perhaps not even necessary, for the proper functioning of CMCs. Rather, he felt the involvement of local people was essential for the conservation of natural resources. Since co-management was implemented about seven years ago, however, the involvement of local people has not met his expectations. He also stated that, because the MoEF has not yet declared (through a gazette order) a co-management approach for PAs, key policy instruments are missing.

The key informants I interviewed from IPAC felt that community empowerment was key to effective PA management. To achieve this, they believe it is necessary to further develop the human and institutional capacities of the CMCs. Furthermore, long-term financial support for the CMCs is vital to their sustainability, and to achieve long-term support for the CMCs requires that additional sources of money be identified and tapped. The government treasury is one source but it is cumbersome to access. An alternative source of funding would be to allow PAs to keep the entry fees they collect rather then sending them to the government treasury. These funds could then be used to support community and CMC activities.

Presently a lack of political commitment for the sustainable management of PAs prevails. Political and economic elites interfere in almost all PA activities. If local people have secure use rights to resources in the PA, then they will ensure the sustainable conservation of the PA, but people do not yet seem to feel they have such secure rights.

Co-management is an ideal tool for the conservation of PAs. Over the last seven years it has been developed to some extent but, based on past experience and observations, it may take another five to seven years to become self-sustaining. Support from the government of Bangladesh and their development partners is crucial for the long-term sustainability of co-management.

BNP is a unique site among PAs in Bangladesh. IPAC is providing limited support to BNP for developing a co-management platform, and it is also providing livelihood support for the densely populated neighboring communities. Some IPAC project members have commented that, while NGOs need to be involved in activities like forming groups of local people, co-management at BNP should be based on cooperation between the FD and local community members. In BNP a different model could be implemented where the FD and local communities work together directly to develop a co-management framework, rather than using a blueprint approach applied in other protected areas. If proper attention is not paid to the development of a strong foundation for co-management, the CMCs will face huge challenges to their sustainability when IPAC leaves.

The key informants that I interviewed from the Forest Department believed that the FD has not had sufficient collaborative management initiatives in the past. Under the Forest Resources Management project, for example, nine conservation management plans were developed but communities were not involved in the preparation and implementation stages. NSP introduced the co-management concept for PA conservation in Bangladesh. The FD key informants felt that co-management could be sustained if it were based on a framework of direct community engagement, without the involvement of other agencies, and funded on a regular basis.

Some key informants who work at SNP opined that other members, who are influenced by elite people, elect the CMC chairman a key role and one held by those who often try to impose their views on PA management. Because the CMC chairperson is usually a member of the local elite, it is not possible for the PA authority to ignore decisions that he or she makes. Though democracy ostensibly exists, it does not prevail in practice. Other officials represented on the CMCs do not make significant contributions to PA management instead they play largely symbolic roles.

Key informants from the Forest Department felt that AIGA loans should be based on need and provided to groups, not individuals. Since the amounts are not sufficient to develop profitable AIGAs, it creates problems for loan repayment, leading to illegal activities and creating new problems rather than improving local livelihoods and supporting sustainable PA management. Presently, co-management is almost totally facilitated by IPAC and its subcontractors, and the FD provides minimal leadership. This will affect project sustainability after IPAC leaves. Co-management can be imposed on PAs, but it will neither succeed nor be sustainable if FD officials do not feel that they have ownership of it.

FD key informants claimed that some changes are visible in PAs since the introduction of co-management, including a decrease in illicit felling, positive changes in people's attitudes towards the FD, and improvements in biodiversity. The government of Bangladesh has yet to develop protected area rules that will ensure an enabling legal and policy environment for local people to actively participate in conservation.

Key informants from the FD felt that BNP is a unique site because deforestation is not a key problem, but that degradation and encroachment are major concerns. Furthermore, industrialization is causing pollution and environmental degradation in BNP. A strong CMC could become a voice of the local community to compel industrialists to undertake environmental treatment measures. FD key informants expressed that co-management could be introduced in BNP, but that its model should be different from that practiced in other PAs in Bangladesh. Some key informants, however, commented that co-management is not required in all PAs because it has failed to prove an effective tool for sustainable management in some instances.

Discussion

Community members have long been dependent on protected areas for their livelihoods. From my focus group discussions and key informant interviews, it is evident that villagers feel that co-management imposes restrictions and responsibilities on them, but that they receive few benefits from their participation. In spite of this, community members still want to be involved in PA management in some way. IPAC staff members consider co-management to be superior to traditional top-down methods of PA management because co-management builds linkages and friendly relationships between communities and the FD, which allows for enhanced consultation and collaborative management. FD staff members also appreciated co-management as a more sustainable form of PA management, but they have serious concerns about the way in which it is currently being implemented in Bangladesh.

Regarding participation in co-management, community members indicated that they are represented in decision making in groups like the CMCs, but they feel that their active participation at the grassroots level has not yet been achieved. IPAC respondents feel that all stakeholders have achieved a level of democratic participation, while FD staff members observed that there is minimum involvement of FD staff members because policy makers are imposing everything without any consultation with local officials about the reality in the field. FD officials also recognize that they do not have sufficient staff members to manage PAs without the support of local people.

The livelihoods of community people have been based on collecting timber and non-timber resources from the forests, which have been designated as PAs for a number of years. In order to reduce the dependence of local people on PAs, IPAC has sought to provide AIGAs to community members. The amount of funding available for AIGAs,

however, is insufficient to meet their needs and to wean them from using forest resources. Moreover, the AIGA support that has been given to individuals has frequently not been provided to the right people. Elite members of the CMCs have influenced the selection of recipients for AIGA loans; and respondents from both the FD and the donor community have suggested that, in addition to insufficient funding, AIGA loans would be more useful if they were given to groups rather than to individuals. FD staff members feel that project support should be need-based and given to groups rather than individuals. Moreover, both IPAC and FD staff members feel that the sustainable co-management of PAs requires sufficient and sustainable funding to meet the needs of CPG members and AIGA loans.

My interviews also suggest that a number of different stakeholders are involved in co-management and that these stakeholders have different expectations and opinions of PA management. It is difficult to manage multiple stakeholders as their expectations and opinions differ most of the time. Those involved in co-management naturally desire to receive benefits from the PAs, and people expect to receive rewards from or incentives for participating in co-management. But because of limited resources, it is difficult for all stakeholders to achieve positive benefits from PA management. Moreover, almost all respondents have suggested that politically influential people are interfering in PA administration while maintaining linkages with illegal resource extractors.

Some of the important key informants I interviewed, who are responsible for co-management in SNP, commented that more time is required to make co-management function in a sustainable manner. In SNP, a PA where co-management has been practiced for the past seven years, project activities have failed to develop ideal conditions for sustainable co-management. Adequate and sustainable policies and funding instruments are still missing, and there is a need to build further capacity of both the FD staff and community members.

FD staff members believe that IPAC staff members do not trust them to achieve project goals. They cite tree planting efforts that were previously undertaken by the FD, but that are now maintained by IPAC, as an example of this failure in trust. FD staff members feel that IPAC staff members do not cooperate with them adequately, do not consult with them sufficiently on project activities, and have built CMCs that are not well linked to the FD.

Conclusions

Based on my interviews, I conclude that there are five main issues that need to be considered regarding sustainable and effective co-management: (1) The sustainability of co-management through policy supports and financing has yet to be ensured; (2) CMCs are still politically influenced and have yet to be developed into institutions for

promoting conservation, and ensuring representation from various stakeholders is still a problem; (3) FD and IPAC collaboration is minimal; (4) CPGs, the forest monitors from the communities, are sometimes aligning with illicit tree fellers due to lack of support for AIGAs from the project and the CMCs; and (5) existing project support (AIGAs) at the individual level is not sufficient or sustainable.

Considering these five issues with respect to BNP, the following considerations need to be taken into account when initiating co-management there. First, the existing Government Order that establishes CMCs is not suitable for BNP. Instead, a Village Conservation Forum (VCF) model that includes the Forest Department and local people is more suitable for co-management at BNP. Based on suggestions from key informants and my practical experience in India, I believe that collaborative management functions best when the FD is directly involved with only the community people. Second, both the NSP and IPAC design and implementation phases lacked adequate consultation with local FD officials. Before the onset of these projects, there was minimal consultation with the FD field officials who are the main implementers. That is why many FD officials are not aware of these programs. As a result, a number of problems were observed during the implementation stage. Before the formulation of such programs, it is imperative to have field-level discussions about addressing existing realities. Policy formulation should be bottom up rather than top down, with input from field-level experience. Third, although some progress has been made through government orders for example, 50 percent of the entry fees is now returned to the individual PAs-more policy support is needed for CMCs to be sustainable. These include provisions to keep 50 percent of the entry fees at the PA site (rather than submitting it to the government and having it returned); a revision of national forest policies to accommodate co-management; increased support for CPGs; and increased support for AIGAs and making grants to groups rather than individuals.

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Appendix I

Checklist for FGD at SNP and BNP sites

No.	For SNP	For BNP
1.	How were the interactions between FD and the community prior to co-management? How do stakeholders participate in co-management of the park now?	How do FD staff and different stakeholders interact in the management of the park?
2.	What are the major challenges in conservation of the PAs? How does co-management address these challenges?	What are the major challenges in the conservation of the PAs?
3.	What changes have resulted in the park from the co-management approach? How do FD officials evaluate co-management? How do local stakeholders evaluate co-management?	What are the potential benefits of the co-management approach? What are potential threats that co-management could bring to park management?
4.	How are the local co-management committees (CMCs) formed?	What are the existing informal/formal institutions facilitating/affecting the FD's management of the park?
5.	How do you value the roles of CPGs? How does the CMC manage the CPGs?	What are the existing protection mechanisms in the park? Are there areas where CPGs can provide additional support to improve the effectiveness of FD patrols?
6.	How does the CMC address the livelihood dependence of local forest user groups (FUGs)?	How does the FD address the dependence of local people on park resources?

Appendix II

Key informant interviews

1. What is your experience of protected areas in Bangladesh?
2. Please mention major challenges/threats for conservation of PAs (especially in SNP and BNP)
3. How do you see the existing management of FD for BNP? Please provide your personal judgment.
4. How do you evaluate co-management in SNP based on its potential and field experiences?
5. Do the CMCs reflect the representation of all stakeholders of the Park?
6. What changes has the co-management approach brought in SNP Park?
7. What were the expectations from the CMC and to what extent has it achieved them in the context of SNP, in particular, and other PAs with co-management, in general?
8. What are the major challenges and threats faced by the CMC?
9. Can co-management lead to better PA conservation? If yes, how can it be sustained? If not, what are the reasons behind this?
10. Please share your experience with the CMC formulation and its functioning (open remarks).

Sustainable Rural Livelihoods and Co-management Intervention: The Case of Mokosh Beel, Gazipur, Bangladesh

Umme Kulsum Ferdousi

Abstract

Co-management is a tool for promoting the sustainable management of inland fisheries resources whereby water bodies are collaboratively managed by local communities and government entities. This study investigated inland aquatic resource management and its interdependence with the livelihood patterns of beneficiaries involved in the co-management system in Mokosh Beel of Bangladesh. Mokosh Beel has been under ecological pressure from both fishing and the presence of highly polluting industries in the surrounding area. Data were collected through focus group discussions and semi-structured interviews. In this study, I investigated the institutional arrangements of co-management in the study area. Resource management organizations (RMOs), resource user groups (RUGs), and federations of resource user groups (FRUGs) have participated actively in the co-management system and worked together with local fishers and with other relevant organizations concerned with different national issues. I also assessed the resource users' awareness and knowledge of co-management practices. The results reveal that most respondents were interested in engaging in increasing fish production and alternative income-generating activities. Results further show that the non-fisher group was actively engaged in co-management decision-making activities and plan preparation, whereas fishers were not, and that both fishers and non-fishers were engaged in the implementation stage. I identified about 20 direct and indirect benefits that improved the livelihoods of respondents. Respondents in the study area also expressed a great desire to continue this co-management practice, although they feared inconsistency in co-management activities due to improper supervision after termination of the project. I argue that the sustainability of the co-management approach depends on the active participation of all members of co-management organizations. At the same time, the government should take measures, including direct interventions, to stop pollution by the industries.

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Introduction

Co-management is a tool for the sustainable management of inland fisheries resources whereby water bodies are operated and managed by local communities in an effort to ensure equal rights and access to and sustainable use and management of their resources. The success of co-management depends on the motivation and active participation of community members (Thompson and Colavito 2007).

Bangladesh is endowed with extensive floodplains and wetlands, which are home to hundreds of species of aquatic plants, birds, and other wildlife and are rich in fisheries. These wetlands provide critical habitat for millions of migratory birds and are an important source of livelihood and nutrition for millions of Bangladesh's rural poor, especially for fishers, who are primarily dependent on these wetlands for their economic well-being. The historical contribution of inland fisheries to the livelihoods of rural people is reflected in the traditional popular saying, "Fish and rice make a Bengali." About 1.28 million rural households nationwide undertake fishing to help meet their subsistence needs (DoF 2011). The wetlands also help to prevent floods, protect shorelines, cleanse polluted waters, and recharge groundwater aquifers. This is why wetlands are known as the "kidneys of the landscape" (Mitch and Gosselink 1993). Wetlands have also been called a "biological supermarket" because they support an extensive food web and a wide range of biodiversity (Mitch and Gosselink 1993). Over the years, fisheries in *haors* (floodplain areas that are inundated during the monsoon season) and *beels* (deeper depressions where water remains throughout the year) have been allowed to follow an open-access regime, without consistent, well-organized, or effective management policies for preserving aquatic biodiversity (Ahmed and Hossain 1990).

There is increasing evidence that inland aquatic resources are drastically declining in both quantity and quality, and there is a severe loss of aquatic biodiversity due to over-exploitation of aquatic products, siltation, and the conversion of more and more wetlands into agriculture to meet the demands of a rapidly growing population (Mustain Billah 2003). Given the critical importance of natural aquatic resources in the economic lives of rural people, they have played a central role in maintaining poor people's livelihoods in Bangladesh. Over the past couple of decades, community-based management of natural resources, or common-pool resources, has become a common strategy for both improving resource management and empowering local communities, based on concepts such as co-management, local ecological knowledge, the recognition of local institutions, and the establishment of common-property regimes (Sultana and Thompson 2003).

In Mokosh Beel, the project study area, co-management has been carried out over the past decade (2000–2010), through both the Management of Aquatic Ecosystems through Community Husbandry (MACH) project and the Integrated Protected Area Co-management (IPAC) project, to promote sustainable aquatic resource management

and rural poverty alleviation. This research focuses on how the co-management approach has impacted sustainable management of resources in beels, as well as the rural livelihoods of poor people and fishers, who earn their livelihood from these open inland water bodies.

I have critically analyzed the different interventions that were undertaken through these projects to ensure sustainable fisheries management in beels and the positive impacts on the livelihoods of the rural poor. The findings from this research may serve as a guide for policymakers, government officials, and NGO workers, and could be useful for the beneficiaries of wetland resources, namely fishers, resource user group (RUG) members, federation of resource user group (FRUG) members, and resource management organization (RMO) members.

The overall aim of this study is to determine how the co-management approach contributes to sustainable wetland management and rural people's livelihoods. The specific objectives are to:

1. Analyze how, specifically, the co-management arrangement contributes to the sustainability of fisheries resources;
2. Assess the impact of co-management on the livelihoods of members of resource management organizations (RMOs) and resource user groups (RUGs); and
3. Identify the roles and responsibilities of members of RMOs and RUGs under the co-management arrangement.

Background

Mokosh is a perennial beel located to the west of the Turag River in Kaliakair Upazila of Gazipur District. The Turag-Bangshi site is located just north of Dhaka and is typical of most low-lying floodplains of Bangladesh. The bee1 is connected to the Turag River via the Saturia-Solahati canal. At the beginning of the rainy season, as floodwaters enter the upstream portions of the Bangshi, water spills over the riverbanks through different canals that connect the river to adjacent beels, including Mokosh Beel. Through these canals fish move from the river to the beels and the adjacent floodplain areas for spawning or nursing, and then later - as water recedes after the monsoon - the fish move into the deeper perennial portions of the beels or back into the river. In the dry season, water levels in the local rivers and in Mokosh Beel are reduced due to vast ground and surface water extraction for *boro* (dry season rice) irrigation. During drought years, flows cease in the otherwise perennial Turag River, while fish remain only in the deepest portions of the beels and the river. Thus, annual fish production depends largely on the size of the breeding populations that survive in the dry season (Chowdhury and Clemett 2006). In the monsoon season, the area of this beel is around 323.89 hectares and in the dry season, it is only about 8.09

hectares. There are about 2.32 hectares of *khas* land (state-owned property managed by the local government administration) in the beel. The beel is surrounded by several villages, including Taltoli, Baraibari, Saturia-Solahati, Haturiachala, Laskarchala, Mazukhan, Ratanpur, Gopinpur, Amdair, Kouchakuri, Matikata, and Sinabahor (see Figure 1).

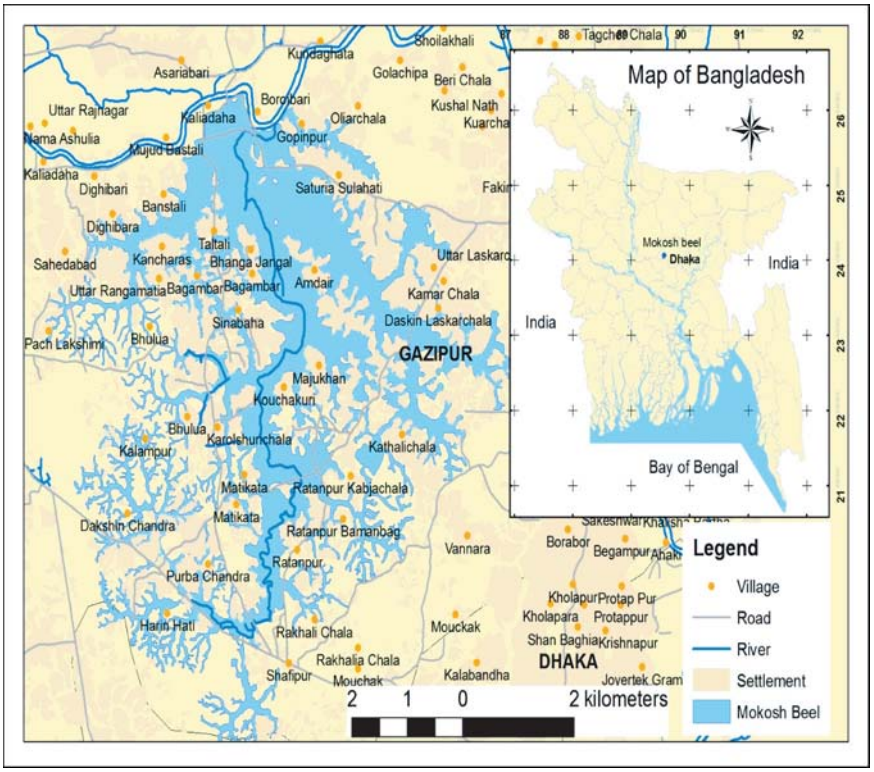


Figure 1: Map of Mokosh Beel and the study area (Source: IPAC)

Methods

I chose Mokosh Beel as the study area because it has been an established and successfully running co-management site since June 1999 (Winrock 2010). The area has also been identified by the IPAC project as an important protected area. Both RMOs and RUGs are actively involved in the area. I was thus able to measure the benefits that fishers derive from co-management around the beel and also assess to what extent their standard of living has improved. The study was conducted from August to December 2011, during which time I made eight visits: two to Mokosh Beel, once in September (wet season) and once in December (dry season); and six visits to three villages (two to each).

I collected both qualitative and quantitative primary data from members of one RMO, three RUGs, and one federation of resource user groups (FRUG). I used field visits and observations, consultations with community leaders and key informants, personal interviews, and focus group discussions (FGD). Relevant secondary data were also collected from the Department of Fisheries (DoF), the Forest Department (FD), the Department of Environment (DoE), other relevant government organizations, the WorldFish Center, the local IPAC office, the MACH project, and NGOs that have worked on wetland resources management and promoting rural people's livelihoods in Bangladesh.

I selected three villages-Haturiachala, Amdair, and Gopinpur-based on the fact that they are predominately surrounded by the beel, easily accessible, and contained a majority of MACH beneficiaries. I used random sampling to select a total of 30 members, both male and female, from the three different RUGs in the villages. Interviews were conducted using a prepared semi-structured questionnaire. Each interview took 25 to 30 minutes. Respondents did not maintain written records, so they answered me based on their memory. I made all possible efforts to minimize recall errors from respondents. If any respondent had difficulty understanding any questions or technical issues, utmost care was taken to clarify these.

The qualitative data were collected through focus group discussions with RMO and FRUG members, concerned local and central government officials, project-implementing staff involved in Mokosh Beel resource management, and other stakeholders. At the beginning of each focus group discussion, I introduced myself, explained my research objective, and then invited them to join the discussion. For the focus group discussions, I used a list of pre-determined questions to explore their understanding of different issues: co-management and the overall management of the beel; the benefits, problem-solving capacity, experiences, and responsibilities in co-management and fisheries conservation; the impact of pollution on beel fisheries; and the sustainability of co-management practices.

Finally, I checked, edited, and recorded the collected data digitally, and arranged these data according to my research objectives. Although all of the interviewed people received benefits from co-management interventions in Mokosh Beel, I categorized respondents into two major groups: (1) fishers who directly or indirectly depend on fishing and (2) non-fishers who gain their livelihoods from professions other than fishing. The research employed both qualitative (descriptive) and quantitative analysis techniques.

One limitation of my study was that I could not find a RUG that included both male and female members, so I selected one male RUG from Gopinpur (a fishing village), another male RUG from Haturiachala (a non-fishing village), and one female RUG from Amdair (another non-fishing village).

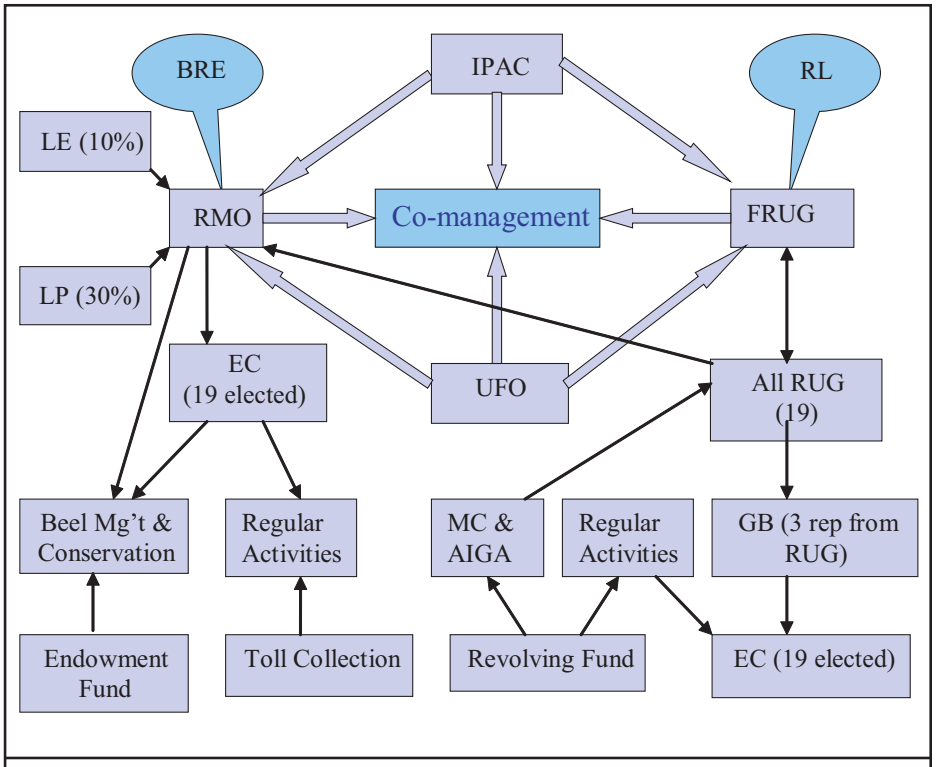
Results and Discussion

Institutional Arrangement of Co-management in the Study Area

The Mokosh Beel RMO, which consists of 166 members 60 percent of whom are RUG members, 30 percent of whom are local people, and 10 percent of whom are local elites is a community-based institution developed in the Mokosh Beel area for wetland resource management. Women represent 30 percent of all RMO members. During my field study, all respondents from different strata including local stakeholders, local leaders and elites, and IPAC personnel openly explained that RMOs had positively changed the traditional pattern of beel management. This happened because the RMO has linked poor community people and resource users' rights to beel fisheries and created an interface between the community and aquatic property regimes.

There are nine fish sanctuaries, of which one was an initiative by the government and the other eight were established locally. These sanctuaries provide permanent habitat for fish and other aquatic wildlife. Fish harvesting is strictly restricted throughout the year. Other parts of the beel are also controlled during the three month breeding season from March to May, when the fishers are provided with additional livelihood support, including supplies of livestock and small loans for these or other alternative income-generating activities (AIGAs). From March to May, the Fish Conservation Act is enforced with the collaboration of the RMOs and the Kaliakair Upazila fisheries office (UFO) through different kinds of initiatives, such as arranging regular monthly meetings between the UFO and rural community members, and instituting a mobile court (a "court" arranged on a boat, whereby a fisheries officer is granted judicial authority to interpret and enforce the Fish Conservation Act, to discourage use of destructive gear and fine guilty fishers). The goal of the RMO executive committee (EC) is to manage fisheries resources and to create awareness among local people and group members by holding village meetings, making loudspeaker announcements, conducting rallies, and creating human chains, demonstrations, dramas, and so on. Key informants told me that the Mokosh Beel resource management organization is governed by 19 elected executive committee members, five of whom are women. Management and conservation duties and responsibilities such as maintenance of the sanctuary, toll collection, guarding of the beel, and helping the mobile court to collect small-mesh gill nets and other destructive gear are well defined for all group members. The MACH project established an endowment fund in the joint account of the District Commissioner (DC) and the District Fisheries Officer (DFO) to provide technical and institutional support. Furthermore, the executive committee prepared a proposal incorporating sanctuary maintenance and an awareness-raising program to submit to the Upazila Fisheries Committee (UFC) in order to collect the required resources from the endowment fund in their joint account (president, secretary, and treasurer). The interest gained from this fund is used to support the activities of the RMO and the UFC, and locally collected tolls are used to meet the different costs of the executive committee.

The Mouchak-Madhyapara federation of resource user groups (FRUG) consists of 372 members of whom most are poor and landless, and about 50 percent are women. Members are directly engaged in co-management activities and are provided with resources for AIG activities, training, and small loans (Mohammod 2009). The executive committee of the FRUG has 19 members who are elected every two years in a democratic way. The tasks and responsibilities of these EC members vary. The committee organizes regular monthly meetings with a specific agenda, distributes small loans to facilitate AIGAs, discusses different problems and probable solutions, and observes various national days. The MACH project created a revolving fund to promote AIGAs among the RUG members. The interest from this fund is used to support different activities of the EC. Figure 2 shows the institutional arrangement of co-management organizations in the Mokosh Beel area.



KEY:
BRE = beel resources and environment; RL = rural livelihood; LE = local elite;
LP = local people; MC = micro credit; GB = governance body; EC = executive committee

Figure 2: Co-management institutional arrangements in Mokosh Beel

It is essential to design suitable institutions that can efficiently contribute to protecting the dynamic capacity of natural aquatic biodiversity as well as to securing human well-being (Hanna *et al.* 1996). The MACH intervention tried to develop institutional capacity, through the RMOs, RUGs, and FRUGs, to ensure sustainable management of aquatic resources and the livelihoods of local aquatic resource users.

At present, the activities of the MACH project are being continued by the Integrated Protected Area Co-management (IPAC) program, which is directly monitoring AIGAs and providing technical assistance to the RUGs. I found that, as a result, the RMOs, FRUGs, and RUGs are working properly and that this institutional arrangement has organized people systematically to support their livelihoods and to enhance the beel fishery. These results differ from those of Momi (2011), who found that fishers of Alua Beel did not know about the activities of the IPAC program.

Impact of Co-management Initiatives on Rural People

Demographic features of respondents. I divided respondents into two major categories, fishers and non-fishers. First, I analyzed their demographic characteristics and then tried to identify the benefits they received from co-management. The respondents were of different ages. Among the 30 respondents, the largest age class was 30–40 years (40%), followed by 41–50 years (30%), below 30 years (23%), and above 50 years (13%). I also collected data regarding the education levels of the respondents. Most of the respondents (33%) had completed primary education, while 30 percent have no formal education (i.e. they could sign their names, read, and calculate only), and 27 percent had completed secondary education. There are a few respondents who could only sign their names, and no respondents were found to have completed school above the secondary school certificate level. Among the five categories, 60 percent of the respondents had completed their basic education. Most of the people in the fishers group were less educated before (they could sign their names only), but their education level has improved through a literacy campaign under the MACH project.

Reasons for joining co-management organizations. I asked participants why they joined the co-management organizations. They expressed different reasons, which I categorize into three major categories economic, social, and cultural. I found that most of the respondents (61%) joined the co-management organizations to derive economic benefits, followed by those who participated to achieve cultural advantages (37%) and those who joined for social reasons (21%). The specific reasons that respondents gave are shown in Table 1.

Table 1: Reasons for joining co-management organizations

Reasons for joining	Percentage of respondents*
Economic reasons (61%)	
Increase availability of fish in terms of production and types of fish	12 (40%)
Create alternative income and employment opportunities	18 (60%)
Increase savings	22 (73%)
Collect loans for alternative income-generating activities	25 (83%)
Increase in monthly income	15 (50%)
Social reasons (21%)	
Conserve beel fishery and wildlife	7 (23%)
Protect aquatic environment	5 (17%)
Social welfare	3 (10%)
Social empowerment	8 (27%)
Increase social security	9 (30%)
Cultural reasons (37%)	
Get training	11 (37%)
Improve literacy	8 (21%)
Increase knowledge	9 (30%)
Decrease dependence on fish	17 (57%)
Increase mobility	10 (33%)

* Note: Due to multiple responses, percentages do not add up to 100 percent.

Micro-credit and AIGAs. The MACH project established a revolving fund (1.3 million BDT) for the Mouchak-Madhyapara FRUG in the joint account of the president, secretary, and treasurer to disperse micro-credit loans to the RUG members for developing their livelihoods through AIGAs. Ninety percent of the respondents took loans ranging from 5,000 to 15,000 BDT. As a result of this, some respondents switched to new occupations. Through my survey, I determined that 30 percent of the informants were engaged in fishing, 17 percent worked in agriculture, 13 percent were involved in business and small trade, and 7 percent were engaged in other work including tailoring and cow fattening. One third of my interview subjects were female. All of these were housewives, but they also earned money by rearing cows or poultry or engaging directly or indirectly in small trade. I found that most of the participants were engaged in different AIG activities, supported by taking small loans from the FRUG, as their primary or secondary sources of income. They were motivated through various training and awareness-raising programs. According to the MACH completion report published in 2007, respondents chose various types of AIGAs, including dairy production (19%), small trading (19%), fish resale (20%), cattle rearing (14%), poultry rearing (7%), rice husking or resale (21%), and rickshaw pulling (11%), which were different from those in my data. This is most likely because I selected a limited sample of 30 participants, of whom 10 were women (housewives), whereas the MACH report had a total of 4,058 respondents. In the fishers group, about 33 percent collected fish year round, and the other 67 percent fished only during the season when fish were most available. During the lean season

of fishing, they engaged in different income-generating activities, such as small trade, agricultural labor, and day labor. It is interesting that only 10 percent (three participants) are full time fishers. This could be a result of increased involvement in co-management. 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 businesses (Winrock 2007). The occupational status of respondents is represented in Figure 3.

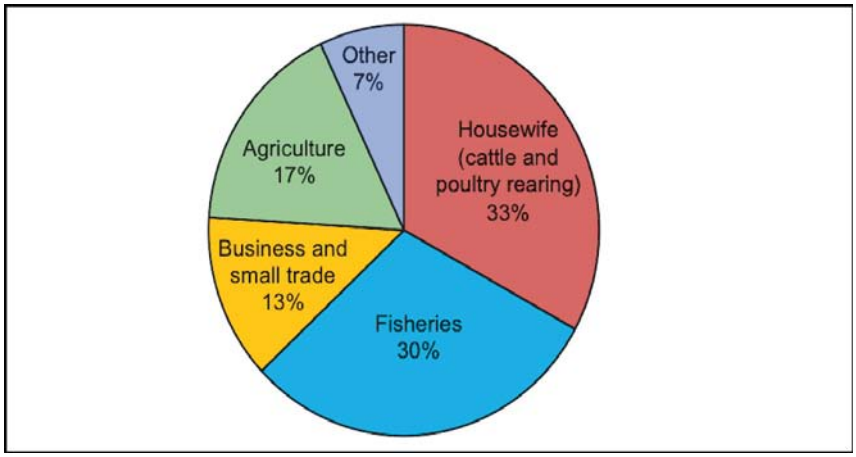


Figure 3: Main occupations of RUG members

The analysis also revealed that most of the respondents (43%) were moderate earners, earning only 3,001 to 5,000 BDT monthly to meet their family expenditure, while 37 percent earned less than 3,000 BDT per month, and 17 percent earned from 5,001 to 7,000 BDT per month. The average monthly income varied in the different villages due to differences in the occupations and educational levels of respondents. In Haturiachala, respondents' incomes were higher than those in the other two villages. This may be due to the fact that they were more educated and derived their income from a greater variety of sources. Most female respondents in Amdair village had very low incomes (less than 3,000 BDT) as they are mainly housewives engaged in cattle and poultry rearing. The average per capita annual income of beneficiaries in the study villages is 49,218 BDT, which is about 4.2 times higher than the per capita annual income (11,700 BDT) of beneficiaries observed in a baseline survey conducted by MACH project personnel in 1999 (Winrock 2007). The distribution of monthly income of respondents is presented in Figure 4.

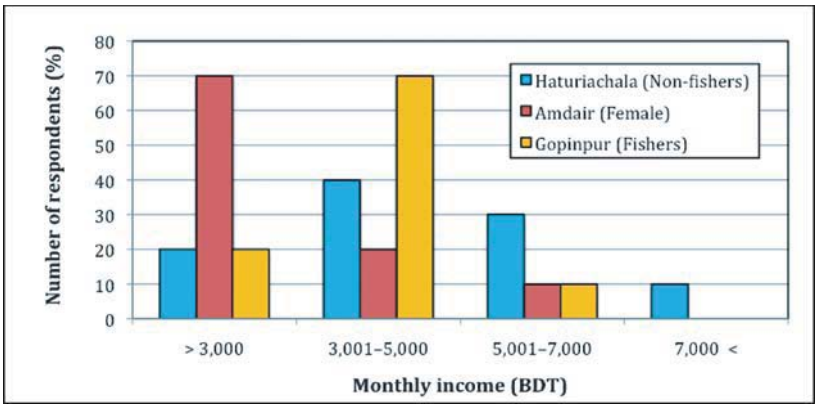


Figure 4: Average monthly income of respondents

Through my survey, I identified the housing conditions and land ownership status of the participants. I observed that among the 30 respondents, about 19 (63%) live in a mud house with a tin roof, seven (23%) live in a house made of tin, two (7%) reside in semi-permanent houses, and two (7%) live in permanent houses. All respondents own the land for their house, ranging from 0.016 to 0.121 hectares, while some of them have no cultivable land. Respondents noted that their housing condition and land status had improved, due to an increase in income. The land area occupied by the beneficiaries is shown in Figure 5.

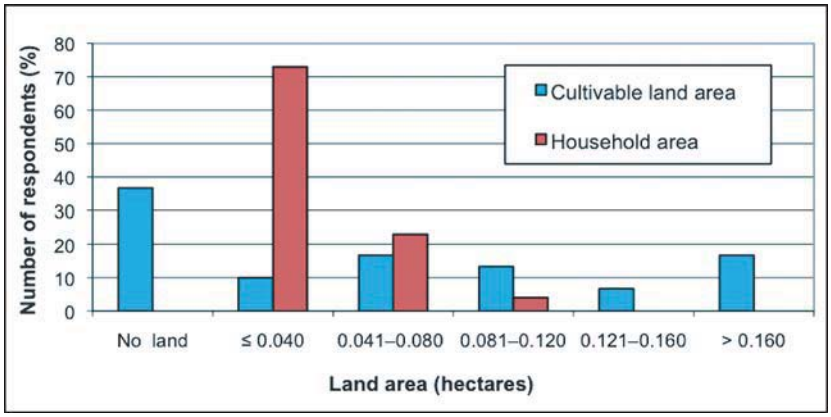


Figure 5: Land status of respondents

Benefits from aquatic resource management and conservation. I conducted two focus group discussions (FGDs) to gather data about the socio-economic benefits gained by the resource users from the management and conservation of beel resources. I collected different types of data and categorized them accordingly. I determined the direct and indirect benefits received by the beneficiaries through co-

management intervention in the study area by asking different types of questions. The results are classified in Table 2 by type of benefit.

Table 2: Respondents' perceptions of direct and indirect benefits from co-management

Direct benefits	Number of respondents (percentage)*	Indirect benefits	Number of respondents (percentage)*
Increased monthly income	24 (80%)	Improved sanitary facilities	27 (90%)
Increased savings	23 (77%)	Increased awareness	20 (67%)
Employment opportunity	20 (67%)	Improved educational facilities	15 (50%)
Alternative income source	18 (60%)	Social welfare	14 (47%)
Wetland restoration	16 (53%)	Social empowerment	13 (43%)
Awareness and observation of national/international holidays (e.g. Women's Day)	16 (53%)	Establishment of infrastructure (e.g. roads, market, health center, schools)	12 (40%)
Increased fish consumption	12 (40%)	Increased women's mobility	12 (40%)
Improved management skills	9 (30%)	Development of housing facilities	11 (37%)
Increased fish catch	8 (27%)	Environmental protection	7 (23%)
Higher catch of different fish species (*Cirrhinus mrigala*, *Nandus nandus*, *Labeo rohita*)	7 (23%)	Enhanced social (livelihood) security	6 (20%)

*Note: Due to multiple responses, percentages do not add up to 100 percent.

The co-management approach has had positive impacts on the livelihoods of the people living around the Mokosh Beel area. I categorized these impacts into five types of changes: economic (e.g. income, small loans, employment, production); cultural (e.g. changed attitudes, increased awareness), social (e.g. social empowerment, social welfare); health and education; and other changes (e.g. women's mobility, improved environment). The types of changes experienced by respondents are shown in Figure 6.

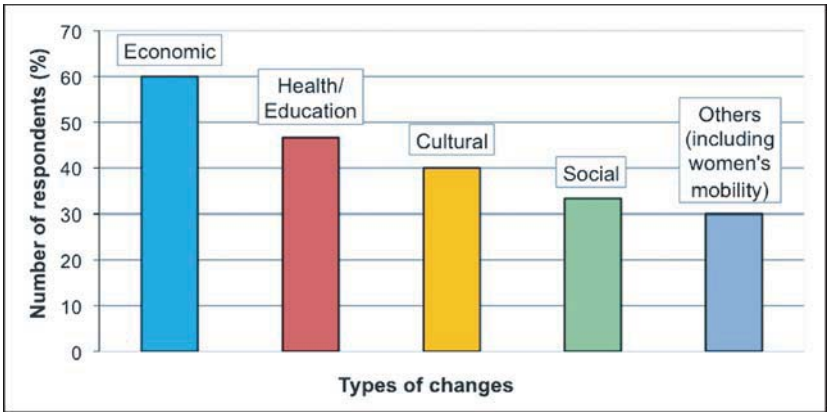


Figure 6: Changes in well-being among participants

Respondents' roles in wetland resource management and conservation. In my study, most of the respondents and local people around the Mokosh Beel area were familiar with the main objectives of co-management interventions to uphold rural people's livelihoods and to enhance the sustainability of management of aquatic resources through different co-management techniques. One of the reasons behind this awareness could be that they have actively participated in various awareness-raising and social activities, which are specifically designed to help people comprehend the short-term and long-term effects of wetland resource management and conservation. Respondents were exposed to different awareness-raising activities, including village meetings, loudspeaker announcements, rallies, human chains, and participation in mobile courts, to motivate villagers, family members, and others. During the MACH period, they also took part in folk dramas to raise people's awareness about wetland management and conservation.

Many common fish species are found in Mokosh Beel, including small hilsha (*Hilsa ilisha*), mrigal (*Cirrhinus mrigala*) and rui (*Labeo rohita*). My research shows that meni (*Nandus nandus*) is a revived fish species in Mokosh. Further, kalibaus (*Labeo calbasu*), ghaira (*Clupisoma garua*), nandina (*Labeo nandina*), bagha ayre (*Bagarius bagarius*), pabda (*Ompak pabda*), batashi (*Pseudeutropius atherinoides*), and kakila (*Xenentodon cancila*) are all rare species, and tatkini (*Cirrhinus reba*), fasa (*Setipinna phasa*), chital (*Notopterus chitala*), and sarpunti (*Puntius sarana*) are extinct in Mokosh Beel.

I also investigated respondents' roles and responsibilities regarding the management and conservation of the beel. I gathered data from the participants of fisher and non-fisher groups about their responsibilities at four stages: decision making and planning, organization, monitoring, and implementation. From the FGDs, I discovered that local elites and non-fishers dominated the decision-making and planning stages, and most respondents (both fishers and non-fishers) contributed in the implementation stage, during which most fishers engaged in the guarding and maintenance of the sanctuary. Respondents of these two groups helped ensure that the duties and responsibilities at both the organizational stage (organizing monthly meetings, arranging village meetings, folk dramas, and rallies) and the monitoring stage (monitoring destructive gear use and availability of fishes) were met. Table 3 presents the knowledge of duties and responsibilities reported by the RMO respondents.

Table 3: Knowledge of duties and responsibilities of respondents in the RMOs

Duties and responsibilities	Non-fisher group Number of respondents (percent)	Fisher group Number of respondents (percent)
Decision-making stage		
Decision making	1 (3%)	0 (0%)
Activity planning and preparation	2 (7%)	0 (0%)
Budget preparation	2 (7%)	0 (0%)
Establishing rules and regulations	1 (3%)	0 (0%)
Organizing stage		
Organizing monthly meetings	2 (7%)	0 (0%)
Arranging rallies, folk dramas, village meetings	3 (10%)	2 (7%)
Monitoring stage		
Monitoring fishing ban periods, use of destructive gear, fish catch amount/size	4 (13%)	7 (23%)
Toll/tax collection	2 (7%)	1 (3%)
Implementation stage		
Rice cultivation	7 (23%)	4 (13%)
Fishing activity	4 (13%)	11 (37%)
Poultry and cattle rearing	6 (20%)	2 (7%)
Tree planting and maintenance	3 (10%)	0 (0%)
Sanctuary protection and maintenance	8 (27%)	8 (27%)
Establishment of seasonal sanctuary	2 (7%)	7 (23%)
Beel protection/guarding	3 (10%)	9 (30%)

The success of co-management depends on the active participation of members at all levels, but my research showed that non-fisher elites seem to be the main decision makers, although they have tried to share the benefits equally with all members. This contradicts the argument made by Rahman *et al.* (2002) that the rich and powerful elites capitalize more aquatic resources and take most of the benefits from traditional state management structures by using their political power, authority, bureaucracy, and market mechanisms. The reason behind this may be that, at present, the resource users are more aware of their rights due to their participation in different co-management interventions and institutions.

The participants in the FGD also mentioned some problems, such as industrial pollution and land encroachment by private entrepreneurs. Effluents discharged from various industries in the Mokosh Beel area including textile production (dyeing,

printing, and washing), large-scale commercial poultry farming, and pharmaceutical manufacturing have had a large impact on the beel environment and wetland biodiversity, as well as on human beings. Due to ongoing pollution, there has been a steady reduction in fish production, aquatic biodiversity (aquatic flora and fauna), biomass, and migratory and aquatic bird populations in Mokosh Beel. Pollution has also contributed to the prevalence of asthma, various skin diseases, and a loss of food security in the area. Moreover, private entrepreneurs have occupied wetlands to develop housing facilities, which have also decreased the overall area of the beel. The amount of industrial effluents discharged into the Mokosh and Turag-Bangshi water systems has been estimated at 30 billion liters annually (Winrock 2007). According to secondary data collected from the IPAC office, fish production in Mokosh Beel was 147 kilograms/hectare per year in 2010–2011 (IPAC 2011). This production is much lower than Bangladesh's average beel fish production of 615 kilograms per hectare per year in 2010 (DoF 2011). The only reason mentioned by the respondents for this phenomenon is pollution. They added that if there were no pollution, beel fish production would increase to four to five times the present production rate. My survey results, which confirm the findings of Akter (2011), indicate that some fishers may have switched to other professions due to the decline in the availability of fish caused by pollution. Local people have taken many initiatives, including meeting with the industrialists and forming human chains to protest such activities, but they haven't made significant progress in this regard. They have demanded government intervention to mitigate such problems, since the government has established the DoE to monitor environmental hazards.

In addition, I asked the participants if they would be able to run a co-management program themselves after termination of the IPAC project. They expressed doubt, indicating that, if monitoring were not run in a proper way, then some beneficiaries could use it for their personal interest and gain. This would likely hamper the sustainability of the co-management approach.

Conclusion

Co-management has played a great role in improving rural peoples' livelihoods as well as in wetland conservation. Recognizing the interrelationships between rural community livelihoods and aquatic resource conservation, the MACH project has systematically executed a wide range of interventions to restore the productivity of wetland ecosystems by introducing sustainable aquatic resource management practices with the joint involvement of community people and local government officials. The duties and responsibilities of the RMO and FRUG members are very well defined and their activities are supported by different funding sources. Rural people are engaged in co-management organizations mainly for the purpose of getting loans, increasing their income, saving money, and supporting increases in fish production and biodiversity.

My research revealed that a wide range of MACH interventions like the establishment of beel sanctuaries, excavation of beels and canals, different awareness-raising programs, trainings, and the distribution of micro-credit for AIGAs have contributed to the enhancement of both beel productivity and rural peoples' socio-economic and cultural status. One very important point is the participation of women in co-management organizations. Currently, women are 30 percent and 50 percent of the members of the RMO and the FRUG, respectively. Women's participation in co-management organizations has increased the women members' mobility, organized them, and empowered them to make decisions. Although many are housewives, they have also engaged in income-generating activities through microcredit loans and training. In my analysis, I found that approximately 90 percent of the resource group users were aware of the co-management interventions, and most people observed the fishing ban rules, motivated other people, and actively participated in different awareness-raising programs. Different AIGAs like tailoring, small trading, cow rearing, and poultry rearing are now popular among the participants. The annual income of respondents has increased significantly, and their housing and land status has also improved. Furthermore, they are very interested in supporting the next generation, both socially and culturally.

In my study, I found that management and conservation activities in Mokosh Beel are on the right track. Some fish that had been extinct at the site have been revived due to co-management interventions. I also identified some fish species that have become rare or extinct due to pollution. Pollution resulting from unplanned industrialization is very alarming in this area. Rapid population growth, unplanned urbanization, industrial growth, and land encroachment have all had negative impacts on rural people's livelihoods and the wetland environment. Over the last decades, this growth has reduced the availability of fisheries resources and disturbed wildlife. As a result, populations of many migratory birds and a variety of aquatic flora and fauna have decreased. This has also reduced people's recreational opportunities and adversely affected human health. People are losing their ability to make a livelihood from fishing and have thus switched over to other professions. Men have also involved their wives in the RUGs, resulting in an increase in the number of female RUG participants in the Mokosh Beel area. This may have a positive impact on rural peoples' livelihoods, though this requires further study. These new members in the RUG demand training for AIGAs, but the present IPAC project only monitors activities in the RMO and FRUG, and gives technical assistance to them, which is not sufficient to meet the needs of all stakeholders who rely on the beel. I have three recommendations to rectify these shortcomings:

1. The Government of Bangladesh should take a strong initiative to reduce industrial pollution through proper planning, active monitoring, and ensuring the use of effluent treatment plants (ETPs) by industries.
2. The Department of Environment should make significant efforts to improve the present situation of pollution.

3. IPAC support should be broadened to include different training programs and to increase support for AIGAs among rural people.

Finally, all participants, including officials from the local and central governments, recognize the positive achievements of the MACH and IPAC interventions, but the sustainability of the co-management approach may be hindered after termination of the IPAC project due to a lack of proper monitoring and biased and dishonest management by some of the beneficiaries.

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Impact of MACH Project Activities on Socio-economic and Environmental Conditions in Keuta Beel of Sherpur District

S.M. Abul Bashar

Abstract

The co-management approach is an effective tool for sustainable wetlands management. Through this approach, water bodies are operated and managed by local communities. The Management of Aquatic Ecosystems through Community Husbandry (MACH) and Integrated Protected Area Co-management (IPAC) projects have worked with various partners to improve dry season water management, establish fish sanctuaries, reduce fishing pressure by exploring alternative income-generating activities (AIGAs), promote policy-level coordination, link resource users, and carry out other activities with the overall goal of improving local wetland habitat. For this study, data collection was carried out through focus group discussions and semi-structured interviews. The results indicate that participation in co-management through AIGAs may contribute to certain socio-economic benefits, and that non-AIGA households who are heavily dependent on fish resources also benefitted from and supported co-management activities. I found that MACH and IPAC project activities have a positive impact on the socio-economic and environmental conditions of Keuta Beel and the surrounding area. In particular, the active engagement of fishers in co-management activities around Keuta Beel has helped to reduce fishing pressure, resulting in an overall increase in fish production in this region.

Introduction

Bangladesh is a nation of wetlands, rich in aquatic resources, particularly fish, which accounts for 58 percent of the animal protein consumed in the country (DoF 2011). Fish and fisheries play a momentous role in the economy of Bangladesh in the context of nutrition, employment, household income, and foreign currency earnings. Today, wetland environments and fish resources are threatened by the competing needs of a growing population and expanding agriculture and industry. It is a great challenge for the fisheries sector to continue to meet the increasing demand for

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protein in this densely populated and growing country while facing these multiple threats.

Although small-scale fishers are central and indispensable constituents in the fisheries sector in Bangladesh, they often have difficulty earning a livelihood and face many economic pressures. The daily income of 27 percent of coastal fishers is less then 50 BDT (USD 0.59) (Ahmed 1999). In general, fishers are considered to be one of the most marginalized and vulnerable communities in Bangladesh because their socio-economic conditions are so poor (Paul 2003). They are burdened with food scarcity, insufficient drinking water access, insecure shelter, continuous debt, low healthcare access, poor sanitation, and illiteracy.

The wetland resources of Bangladesh must be wisely managed in order to maximize the sustainable production (harvesting) of fish, and to improve the socio-economic status of local fishers. Wise resource management should limit resource destruction and degradation and improve resource productivity. The Management of Aquatic Ecosystems through Community Husbandry (MACH) project was launched in several districts, including Sherpur District, in 2000, as a response to these socio-economic and environmental concerns. The project was designed and implemented by the Government of Bangladesh, with support from the United States Agency for International Development (USAID), and emphasized community-based participatory approaches to wetland management. The MACH project secured access rights to several key inland fisheries across Bangladesh and enlisted the help of local fishers and others to design and implement conservation schemes. The project worked with partners to improve dry season water management, establish sanctuaries, and reduce fishing pressure by promoting alternative income-generating activities (AIGAs), encouraging policy-level coordination, linking resource users and administrators, and improving local wetland habitats. The MACH project concluded in June 2008, leaving behind an endowment fund. The interest acquired from this fund can be used to support the activities of the *upazila* (local government unit) fisheries co-management committees in perpetuity.

Currently, management of protected areas in Bangladesh is being supported by the Integrated Protected Area Co-management (IPAC) program. IPAC began in 2008 with support from a variety of international organizations, including USAID, the East-West Center, the WorldFish , and the World Wildlife Fund. The program's main goal is to scale up collaborative management of natural resources in both policy and practice.

Wetland areas in Bangladesh consist largely of rivers, *haors* (large areas in the floodplains of major rivers typically inundated during the wet monsoon season), and *beels* (smaller low-lying perennial water bodies in depressions that are usually connected to larger haor systems during monsoon). The fishers of Keuta Beel in Sherpur Sadar (*sadar* is a small unit of local government) continue to support the goals of the MACH project through ongoing co-management activities. Different development and management programs and measures have been executed in the beel, such as the establishment of fish sanctuaries, the stocking of fingerlings, the rehabilitation of endangered species, and the implementation of fish policies and legislation. The aim of this study is to examine any changes in social and economic conditions that have occurred in Keuta Beel due to IPAC and MACH activities. I will determine if the fishers experienced benefits from co-management activities around the beel and what those benefits have included. More precisely, the objectives of this study are:

- To assess and compare the economic status of fishers who have received AIGAs with that of those who have not, on the basis of income, fish consumption, and employment patterns.
- To assess and compare the social status of fishers who have received AIGAs with that of those who have not, on the basis of food, shelter, education, healthcare, and sanitation facilities.
- To determine the impact of AIGAs and other co-management activities on fish production (harvesting) in the beel.
- To make recommendations for more effective management and use of the area's wetland resources.

Background

Sherpur District is located in north-central Bangladesh. Geographically, the area is part of the Garo and Tura Hills, and includes the catchment areas of the upper Kangsha and Malijee watersheds. This district contains many water bodies, such as beels, canals, rivers, and *jharna* (narrow hill streams that flow from upstream rivers). Most of the people in the district are poor, with limited employment opportunities. A large number of them, particularly those who reside in villages near water bodies, fish for subsistence and/or commercial purposes.

Keuta Beel is situated in Sherpur Sadar Upazila about 10 kilometers east of Sherpur town (see Figure 1) and is one of the more established and successful co-management sites supported by the MACH and IPAC projects. The beel covers an area of 40 hectares and is surrounded by five villages in three unions. There are both resource management organizations (RMOs) and federations of resource user groups (FRUGs) operating in the beel. The IPAC project has also identified this site as an important protected area (IPAC 2008). The Keuta Beel FRUG consists of 27 groups with 567 members (mostly poor and landless people), 39 percent of whom are women. Different types of professionals are involved in the group. Members are directly involved in co-management activities and are provided with training, small loans, and resources for AIGAs.

Figure 1: Map of the study area (Source: LGED)

For many years, the natural productivity and biodiversity of the beel has been declining due to irrigation systems in the area (both because of the diversion of water from the beel and the presence of agricultural pollutants) and intense fishing pressure (Shajahan 2011). The beel has also been threatened by siltation and soil erosion caused by farming practices in the surrounding area (Shajahan 2011). As a result of these pressures, the lives of poor villagers and local residents who depend on fish and aquatic plants for income and food have grown increasingly desperate. To address this problem, members of the FRUG and other fishers who live near the beel have set up small fish sanctuaries, planted trees, stocked threatened fishes, stopped harmful fishing practices such as poisoning or draining ponds to catch fish, and overseen

fishing bans when fish are spawning. As a result, fish catches have grown throughout the beel and small fish, birds, and plants are also increasingly found there. The majority of households in the surrounding villages are still engaged in fishing, although for those households that formerly relied primarily on fishing it is becoming a part-time and/or seasonal occupation. Traditionally, residents in these villages have caught fish throughout the year and sold them to intermediaries on the riverbanks, or taken them to nearby markets themselves. In this study, I look at changes that have occurred as a result of the implementation of the MACH and IPAC projects.

The MACH project was launched in Keuta Beel in 2000. In 2001, it provided loans to fisher/day laborer households who met certain criteria they had to be fully dependent on the beel resources for their income, have less than 40.46 square meters of land, have a monthly income of less than 3,000 BDT, and have poor housing conditions. The MACH/IPAC projects not only have provided AIGAs to fishers, but have also established a co-management program and institutions, and an endowment fund (of 250,000 BDT) so that all of the fishers can benefit from these resources either directly or indirectly.

Methods

This study relies on both primary and secondary data. I gathered secondary data by consulting relevant published and unpublished MACH documents, as well as related reports from the Department of Fisheries (DoF), the Department of Agriculture Extension (DAE), the Department of Environment (DoE), and other relevant organizations.

I collected primary data from fishers through a household survey, using an open-ended questionnaire. Fieldwork was conducted over a period of six months, from August 2011 to January 2012. An open-ended survey instrument was prepared, tested, and revised before going to the field for final data collection. To ensure data accuracy and objectivity, the interview questionnaire was kept simple and relevant to the main research objectives and the selected fishers were interviewed separately. Questions were asked systematically and explanations were given whenever necessary. All respondents were interviewed, regardless of their membership in a FRUG.

In total, I interviewed 20 households: 10 in a co-management village receiving funds through AIGAs; and 10 in a village that was not under co-management and did not

receive support for AIGAs. The sampling was done randomly. I chose to collect data in two of the five villages located in the immediate area, namely Bakarkanda, a co-management village situated in Dhala Union and receiving AIGA support; and Barogoria, a non-co-management village situated in Kamaria Union of Sherpur Sadar Upazila and not receiving AIGA support. The main criteria for choosing these villages were:

1. They are predominately surrounded by the beel area and villagers have easy access to it.
2. The fishers living in both villages are direct beneficiaries of Keuta Beel.
3. These fishers have been fishing in Keuta Beel for more than five years.

I also conducted five secondary interviews and one informal group discussion with other local community members who did not receive AIGA support, but nonetheless benefitted from the beel, to cross-check responses and to get a clearer picture of the views of local people and how they could use the wetlands more effectively.

Results and Discussion

In this section, I first describe the changes in the economic and social conditions of fishers using standard economic indicators (income, savings, and economic opportunities) and some common measurements of basic needs, comparing those who received support for AIGAs with those who did not. Next, I look at the impact on fish production in terms of trends that have occurred due to the co-management of wetlands. I also look at the specific benefits that fishers have received from co-management activities around the beel, including AIGAs. All respondents were direct resource users. Of the 20 respondents from the two villages, the age class with the most respondents was 35–45 years old (45%), followed by 55 years old and older (25%), 46–55 years (20%), and finally, 34 years old and younger (10%).

Assessment and Comparison of Economic Aspects

In this section, I compare AIGA and non-AIGA households according to key economic indicators, including annual income levels, savings, monthly fish consumption, and employment patterns (i.e. occupation).

Fishing is the major, and in some cases only, source of income for fishers in the Keuta Beel area. However, many individuals undertake a variety of additional economic activities, which can constitute a substantial part of their annual income. Fishers have limited options for non-fishing activities, such as wage labor in other sectors like

agriculture, construction, and cattle and poultry farming. My research reveals that the highest annual income among AIGA households was 120,000 BDT, while the lowest income was 38,000 BDT. According to my analysis, the number of AIGA households in each range of average monthly income is as follows: one household (10%) for "Up to 44,000 BDT"; no households for "45,000–54,000 BDT"; three households (30%) for "55,000–65,000 BDT"; and six households (60%) for "Above 65,000 BDT." On the other hand, the highest annual income among non-AIGA households was 84,000 BDT and the lowest was 26,000 BDT. According to my analysis, the number of non-AIGA households in each range of average monthly income is as follows: three households (30%) for "Up to 44,000 BDT"; four households (40%) for "45,000–54,000 BDT"; two households (20%) for "55,000–65,000 BDT"; and one household (10%) for "Above 65,000 BDT" (Figure 2). These results are shown in Figure 2.

Despite their high reliance on fishing for their livelihoods, the income of non-AIGA fishers has decreased over the years due to the involvement of more people from neighboring communities in fishing as a seasonal or part-time occupation.

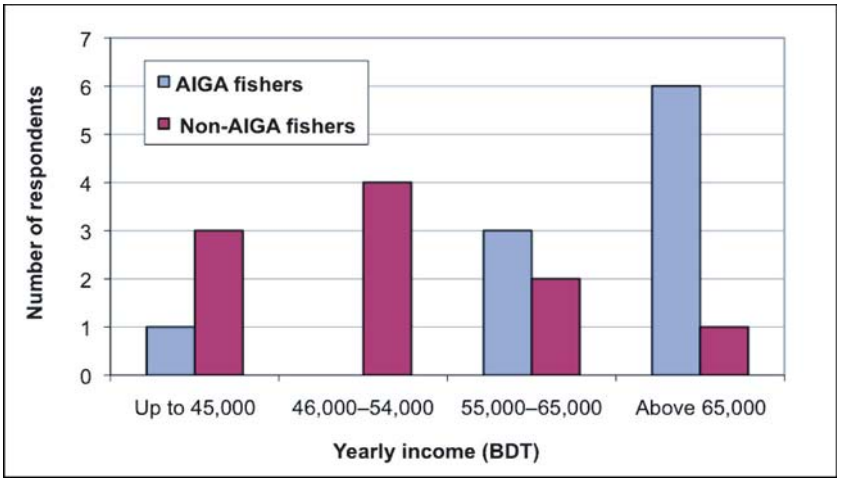


Figure 2: Yearly income of AIGA vs. non-AIGA fisher households (BDT)

The ownership of fishing and non-fishing assets among respondents is limited in general, but AIGA households have been able to develop their assets through technical and financial support from cooperatives and other organizational activities and projects. According to my analysis, the yearly savings of AIGA households varies from 5,000 BDT to 18,000 BDT. Out of 10 AIGA households, one household (10%)

was found to have no savings, two households (20%) had savings of up to 5,000 BDT, three households (30%) had savings of 5,000–10,000 BDT, and four households (40%) had savings above 10,000 BDT. In contrast, among the non-AIGA households, I found that nine households (90%) had no savings and the remaining one household (10%) had savings of above 10,000 BDT (Figure 3).

These findings suggest that AIGA households were able to save more money from fishing, as well as through other income generating activities. This has enabled them to invest their money in the trading of fish, agriculture, and others business ventures during the off-season. 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 occupation (Ruddle 1994).

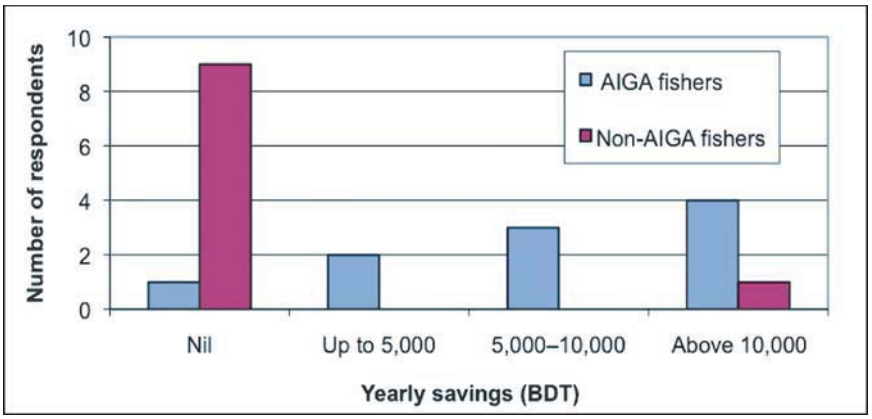


Figure 3: Yearly savings for AIGA vs. non-AIGA fisher households (BDT)

From the interviews, I learned that, among AIGA-receiving fishers, monthly fish consumption varied from 4.6 to 12.8 kilograms. According to my analysis, the average monthly fish consumption of AIGA households is as follows: "Up to 5 kilograms" for one respondent (10%); "5–10 kilograms" for three respondents (30%); and "Above 10 kilograms" for six respondents (60%). On the other hand, among non-AIGA fishers the lowest fish consumption was 3.6 kilograms and the highest was 11.2 kilograms. Two non-AIGA households reported their fish consumption was "Up to 5 kilograms," seven households (70%) said their consumption was "5–10 kilograms," and one household (10%) reported their consumption was "Above 10 kilograms." Thus, overall, it is evident that AIGA households have higher fish consumption than non-AIGA households (Figure 4).

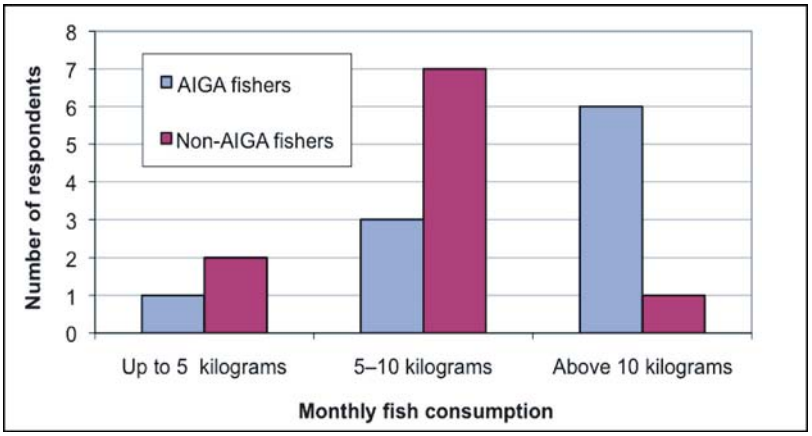


Figure 4: Monthly fish consumption of AIGA vs. non-AIGA fisher households

Through my survey, I identified the employment patterns and sources of income of AIGA fishers and non-AIGA fishers. My analysis revealed that, of the 10 AIGA households, 10 (100%) were engaged in fishing, one (10%) in agricultural labor, two (20%) in pulling rickshaw-vans, four (40%) in cattle/poultry rearing, two (20%) in handicraft/petty trade, and one (10%) in other activities. Among the non-AIGA households, 10 (100%) engaged in fishing, six (60%) in agricultural labor, one (10%) in pulling rickshaw-vans, and one (10%) in cattle/poultry rearing (see Table 1).

These results demonstrate that fishers who have participated in the MACH and IPAC projects are engaged in other occupations apart from fishing. AIGA fishers receive finanical and technical support from the MACH and IPAC projects, as well as from other organizations. However, non-AIGA fishers often lack assets, savings, training, and other financial inputs for income-producing activities unrelated to fishing.

Table 1: Income sources of AIGA vs. non-AIGA fisher households

Income Source	AIGA Fishers	Non-AIGA Fishers
	Number (and %) of respondents	Number (and %) of respondents
Fishing	10 (100)	10 (100)
Agricultural labor	1 (10)	6 (60)
Non-agricultural labor	--	--
Rickshaw-van	2 (20)	1 (10)
Handicraft/petty trade	4 (40)	1 (10)
Cattle/poultry rearing	4 (40)	1 (10)
Business	2 (20)	--
Other	1 (10)	--

NOTE: Due to multiple responses, percentages do not add up to 100 percent.

Assessment and Comparison of Social Aspects

Local fishers who received AIGAs in the MACH and IPAC projects have more financial and technical support to acquire knowledge, experience, and assets that could transform their socio-economic status. As demonstrated by the above results, they also have higher income and savings, and more diversified employment opportunities, which could also enhance their social status. Here, I compare the educational status of respondents' children, household food intake, housing construction materials, birthplace of respondents' children (e.g. home, hospital), and household sanitation facilities, to see if there is any significant difference between the status of AIGA and non-AIGA households.

Educational status differs between children of respondents receiving AIGAs and those not receiving AIGAs. Among the children of AIGA recipients, about 10 children (56%) had completed primary level education and six children (33%) had completed secondary level education, while only two children (11%) had dropped out of school before completing their primary education. Conversely, among the children of those households not receiving AIGA support, I found that about 11 (42%) had received a primary education, four (15%) had received a secondary education, eight (31%) had dropped out of school before completing their primary education, and the remaining three (12%) were below the age of five (Figure 5). At the time of the survey, none of the children had completed an education above the secondary level.

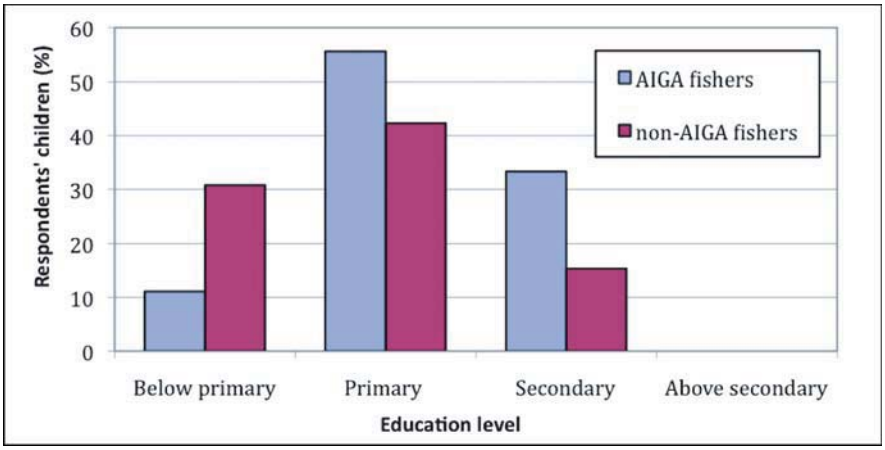


Figure 5: Educational status of respondents' children

The most striking difference between the educational status of children from AIGA households and non-AIGA households is that 31 percent of the children from the non-AIGA households dropped out of school before completing their primary education, compared to only 11 percent of children from AIGA households. Bishwajit (2011) found that, near Baikka Beel in Moulvibazar district, 30 percent of the children from non-MACH households and six percent of the children from MACH households dropped out of school before completing their primary education. This is consistent with my findings. This study reveals that most households receiving AIGAs, as well as a smaller proportion of non-AIGA households, want their children to receive an education so that they can obtain good employment and thus improve their social status. However, according to my survey responses, many non-AIGA households pull their children out of school, perhaps to fish or perform other work to help support the family. Overall, more children from AIGA households have gone to primary school and completed a secondary-level education, and fewer have dropped out of primary level. This may be related to increases in monthly income and savings that could be a result of involvement in AIGAs and co-management activities.

Food intake, in terms of the frequency of meals and consumption of various food items, also differed between households of fishers receiving and those not receiving AIGAs. Out of the 10 households receiving AIGAs, I found that one (10%) ate two meals per day and nine (90%) ate three meals per day. Furthermore, 10 (100%) of the AIGA households consume fish, seven (70%) consume lentils, and six (60%) consume vegetables on a daily basis, while three (30%) consumed meat on a weekly basis. On the other hand, among the 10 non-AIGA households, I found that four (40%) take meals twice a day and six (60%) take meals thrice a day. Furthermore, among non-AIGA households, seven (70%) consume fish, two (20%) consume lentils, and two (20%) consume vegetables on a daily basis, while no households consume meat on a weekly basis (Figure 6).

Based on a study of the socio-economic conditions of fishing communities in Bangladesh, Hannan (1994) states that fishers are a highly neglected class in society and many are living hand-to-mouth. My results support this assertion, and suggest that households receiving loans for AIGAs are better off, since significantly more of the non-AIGA households cannot afford three meals a day for their families, don't eat meat on a regular basis, and consume less protein in the form of fish and lentils.

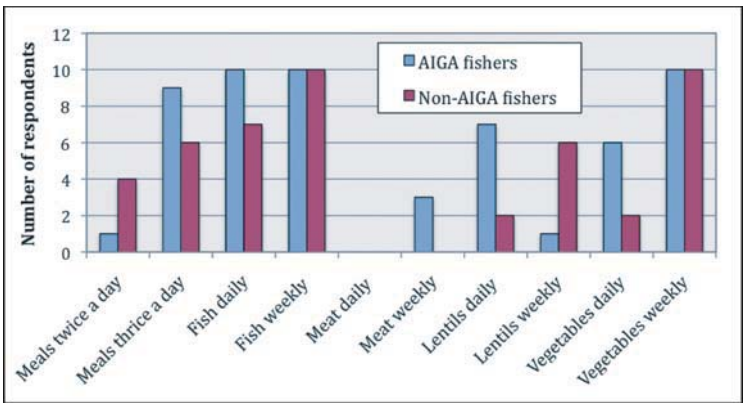


Figure 6: Type and frequency of foods consumed by AIGA vs. non-AIGA households

Since soil is an abundant and inexpensive resource, and concrete is rare, the majority of houses in the villages are not made of concrete. They are constructed adjacent to one another and are made of tin (steel sheet), bamboo, and/or earth, with soil floors. Both the roof and the walls are typically made of tin. According to my survey among the AIGA households, 10 of their houses (100%) have roofs and walls made of tin and 8 houses (80%) have floors made of soil, while the remaining two houses (20%) have floors made of concrete. In contrast, out of the 10 non-AIGA households, 10 houses (100%) have roofs made of tin; 9 houses (90%) have floors made of concrete and one has soil floors; and the walls are made of tin (five households, 50%), bamboo (four households, 40%), or soil (one household, 10%) (see Figure 7). In other words, AIGA households have more durable housing facilities. This could be due to the fact that they have earned more income and savings from AIGA activities implemented as part of co-management.

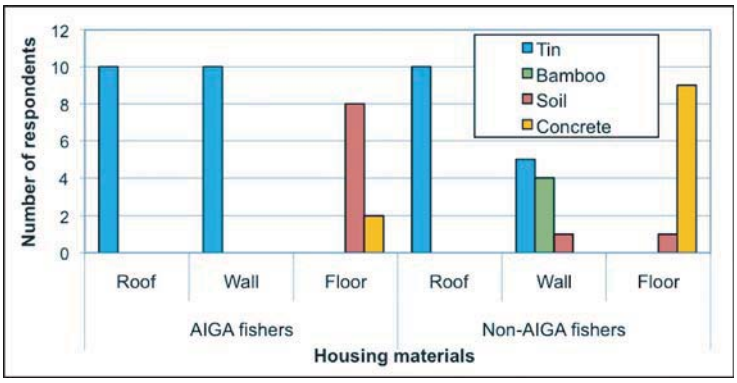


Figure 7: Housing conditions of AIGA vs. non-AIGA fisher households

Groundwater, which is obtained via tube wells, is the only source of drinking water in the village. But there has been an alarming fall in groundwater levels due to its excessive use for irrigation purposes. Most tube wells have no concrete platforms and their general cleanliness is not good. For both the AIGA and non-AIGA households, I found that 100 percent have access to tube wells.

In order to understand the health issues in the villages, it is important to see how the health system operates in the country and how it filters down to the community level. The discussion that follows considers the health-related issues in Sherpur District, Sherpur Sadar Upazila, and the study villages. In my study area, there is no health clinic and, as a result, villagers face severe health problems. The nearest health center is at Sherpur, about seven kilometers away, but there is no efficient means of transportation (i.e. the roads are poor) from the villages to Sherpur. As part of this study, I analyzed the birthplace of the households' children according to the following categories: (1) hospital, (2) clinic, (3) home, and (4) other. Among the AIGA households, three (30%) of their children were born in a hospital and seven (70%) were born at home. However, all (100%) of the children from non-AIGA households were born at home (Figure 8). Thus, according to my survey results, AIGA fishers are more conscious about reproductive health in terms of where they choose to have their children. This could be due to their enhanced income and savings as a result of participation in AIGAs in particular, and in co-management activities in general.

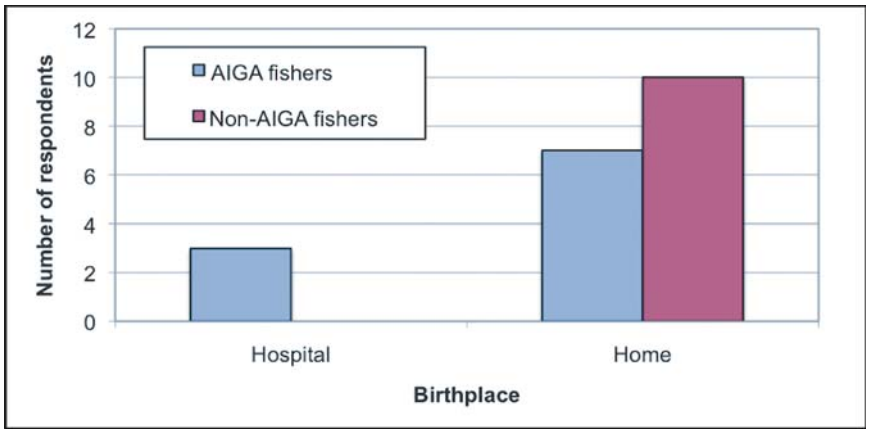
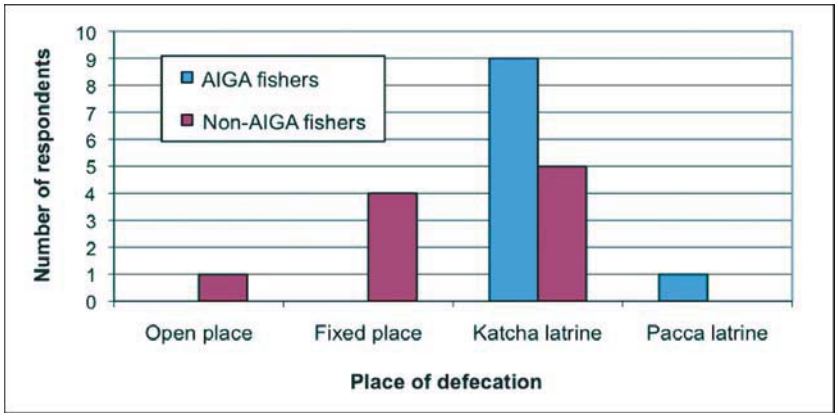


Figure 8: Birthplace of children for AIGA vs. non-AIGA fisher households

There is no suitable place for defecation among some of the households in the village. As part of this study, I analyzed the households' place of defecation according to the following categories: (1) open place (no fixed toilet); (2) fixed place; (3) *katcha* latrine (temporary toilet made of packed earth); and (4) *pacca* latrine (wet latrine made of bricks and concrete). Among the AIGA households, nine (90%) used katcha

latrines, while one (10%) used a pacca latrine and none used an open or fixed place. Among the non-AIGA households, one (10%) used an open place, four (40%) used a fixed place, and five (50%) used a katcha latrine, while none used a pacca latrine (Figure 9). According to my survey results, AIGA households had better sanitation facilities overall. Again, this could be because they have earned more income through their involvement in AIGAs and co-management.



Respondents' Views about Benefits from Co-management Activities

I gathered different types of data to identify the benefits experienced from co-management activities. Among the AIGA households, 10 (100%) mentioned an increase in fish production, participation in training programs, involvement in other economic activities besides fishing, and knowledge about the maintenance and guarding of the fish sanctuary as benefits; nine (90%) mentioned participation in decision-making meetings, knowledge about the Fish Act and laws, and knowledge about which gear is more/less destructive; and eight (80%) mentioned involvement in environmental protection activities and knowledge about the ban season for harvesting. On the other hand, of the 10 non-AIGA households, nine (90%) noticed increased fish production, four (40%) knew about maintenance and guarding of the fish sanctuary, two (20%) mentioned participation in decision-making meetings, involvement in environmental protection, involvement in activities other than fishing, knowledge about the ban season for fish harvesting, and knowledge about which gear is more/less destructive; and one respondent (10%) mentioned involvement in training programs and knowledge of the Fish Act and laws. Overall, I found that the AIGA fisher households reported more benefits, suggesting a stronger positive influence on their participation, knowledge, and awareness about co-management activities and involvement in AIGAs (See Table 2).

Table 2: Respondents' views about benefits received from co-management activities

Benefits	AIGA fishers (n = 10) Number of respondents (%)	Non-AIGA fishers (n = 10) Number of respondents (%)
Increased fish production	10 (100)	9 (90)
Receiving training	10 (100)	1 (10)
Participation in decision-making meetings	9 (90)	2 (20)
Involvement in environmental protection	8 (80)	2 (20)
Involvement in activities other than fishing	10 (100)	2 (20)
Knowledge about maintenance and guarding of the fish sanctuary	10 (100)	4 (40)
Knowledge about ban season for fish harvesting	8 (80)	2 (20)
Knowledge about the Fish Act and laws	9 (90)	1 (10)
Knowledge about which gear is more or less destructive	9 (90)	2 (20)

Impact of Activities on Fish Production in Keuta Beel

I found that due to the MACH and IPAC project activities, the average fish production is increasing and the number of fishers is decreasing. The analysis revealed that the AIGA households said their average fish production was 1.05 metric tons per hectare in 2008, 1.08 metric tons per hectare in 2009, and 1.22 metric tons per hectare in 2010. On the other hand, non-AIGA households reported that during these same years their average fish production was 1.08 metric tons per hectare, 1.17 metric tons per hectare, and 1.29 metric tons per hectare, respectively (Figure 10).

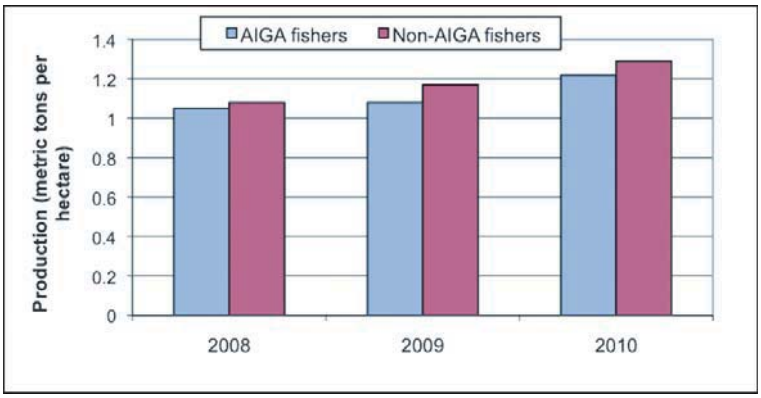


Figure 10: Average fish production (in metric tons per hectares) from 2008 to 2010

In terms of engagement in fishing, the average number of people involved in fishing in Keuta Beel in 2008, 2009, and 2010, as reported by the 10 households receiving AIGAs, was 283, 262, and 242, respectively. On the other hand, the average number of people engaged in fishing that was reported by the 10 non-AIGA households was 319, 306, and 297 during these same years (Figure 11).

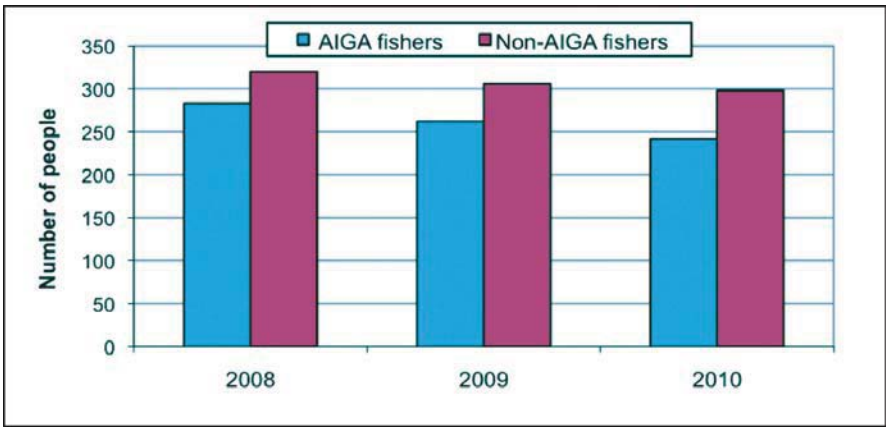


Figure 11: Number of people engaged in fishing in the last three years

While environmental degradation (caused by late rains, heavy siltation, and agricultural pollution) has occurred, the beel area is also shrinking and becoming crowded with aquatic weeds. At the same time, some fishers are facing unemployment and some have migrated to urban areas for work, either temporarily or permanently. Along with these trends, the overall fish production has increased and the total number of people engaged in fishing has decreased for both groups during implementation of the MACH and IPAC projects. This implies that fewer fishers (both AIGA and non-AIGA) are catching more fish and potentially earning more income from fishing, in addition to their non-fishing activities. The socio-economic results from this study provide some evidence for this.

During the project interventions, the quality of life of AIGA households has improved significantly. Thus, it could be concluded that participation in co-management at Keuta Beel through involvement in AIGAs may have improved certain socio-economic aspects of AIGA households such as food (diet), education, housing facilities, healthcare, income, fish consumption, and employment oppourtunities. However, the concurrent benefits to non-AIGA households suggest that co-management activities have also had indirect benefits for non-participating fishers

who are heavily dependent on Keuta Beel. Although not all fishers received AIGAs, many have been involved in fish sanctuary maintenance, including sanctuary excavation and re-excavation, and other types of co-management activities. They have supported these efforts because they receive indirect benefits from them. As a result, all of the fishers, including both AIGA and non-AIGA households, replied that active engagement of fishers in co-management activities has helped to reduce fishing pressure, resulting in an overall increase in fish production. The objectives of the AIGAs were to: (1) improve livelihoods, (2) reduced dependence on fishing, and (3) increase other economic opportunities. My findings reveal that current trends among AIGA households are consistent with these objectives.

Conclusions and Recommendations

Findings from this study suggest that the MACH and IPAC projects may have had a positive impact on both the socio-economic and environmental conditions of Keuta Beel and the surrounding area. These initiatives have actively engaged fishers in co-management activities and have made a contribution to reducing pressure on the fishery as a result of the overall increase in fish production (harvesting). Co-management helps to ensure more active participation of community group members and, therefore, more inclusive decision-making during meetings. Based on the findings of this study, I strongly believe that the active involvement of user groups in co-management activities can improve their socio-economic conditions.

Community members' responses concerning their involvement in and benefits from the MACH and IPAC project activities are encouraging, because they suggest that the livelihoods of fishers have improved as a result of initiatives jointly supported by the government of Bangladesh, NGOs, the upazila administration, local agencies, and the efforts of community members themselves. Based on the data I have presented in this paper, I conclude that the fisher households that have participated in MACH and IPAC are doing better than non-MACH and IPAC fishers in terms of basic economic indicators (overall income, savings, consumption, employment, and involvement in alternative income-generating activities during the off-season) and social indicators (education, food, housing, healthcare, and sanitation). Moreover, fishers can benefit from training and technical support provided by different government programs and non-governmental organizations.

IPAC is now working in Keuta Beel, but many fishers are not yet aware of this. Therefore, I suggest several additional measures to make the current and future

project interventions more effective:

- Establish community-managed water bodies where only local fishers are allowed to catch fish.
- Promote wider participation in FRUGs, since only a small percentage of households are currently involved in them.
- Increase the scope and amount of loans for AIGAs, since the financial benefits of AIGAs have been limited and insufficient.
- Provide capacity-building training for all fishers, including those not participating in AIGAs.
- Conduct an awareness-raising program so that all RUG members are informed of government policies and legislation.
- Increase the number of fish sanctuaries.
- Provide suggestions to fishers on how they can work together to fulfill their shared responsibilities and duties in order to enhance accountability and transparency in every aspect of co-management.
- Construct and maintain a community center in the beel area so that decision-making meetings will run properly, and as a repository for relevant documents and materials.

This study suggests that the government and NGOs can take further initiatives to enhance co-management for the betterment of fishers' livelihood security and financial means. In particular, the Land Ministry of Bangladesh should take immediate measures to designate and demarcate the beel area for protection; otherwise this resource could be captured by elites, which would create further obstacles to implementing the co-management approach. This research provides important lessons for wetland conservation and natural resources management and can help enhance planning and awareness among policymakers, government agencies, NGOs, and communities involved in co-management.

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Impacts of Alternative Income-generating Activities on Livelihoods and Forest Dependence at Madhupur National Park in Bangladesh

Ranadhir Kumar Das

Abstract

Globally, forest degradation is a severe problem. In Bangladesh, forests have been degraded due to over-exploitation, changes in land use, encroachment, fire, uncontrolled and wasteful commercial logging, illegal felling, grazing, and the collection of fuelwood for a large population. People who live near forests are usually involved in agriculture, and they regularly rely on forest products (timber, fuelwood, bush foods, medicinal plants, etc.) for both their own subsistence purposes and for income generation. Recognizing this problem, in 2008 the Forest Department (FD) of the Government of Bangladesh and the United States Agency for International Development (USAID) started the Integrated Protected Area Co-management (IPAC) project in 17 protected areas (PAs) and one eco-park in Bangladesh with the aim of improving local people's livelihoods through greater access to and control over local forest resources.

Since 2009, IPAC has promoted alternative income-generating activities (AIGAs) as one means of improving the livelihoods of villagers living around Madhupur National Park (MNP), while also decreasing their reliance on forest resources. This paper examines whether AIGAs have improved village livelihoods and decreased the use of forest resources, by documenting and comparing the livelihood patterns of villagers involved in AIGAs sponsored by IPAC with those of villagers in communities that did not receive such IPAC support. I rely on data gathered through household surveys, focus group discussions, key informant interviews, and secondary sources such as an IPAC database based on an earlier socio-economic survey. In the 16 village conservation forums (VCFs) at MNP, the IPAC database reveals that, between September 2010 and May 2011, 450 of the 4,450 households from 16 VCFs each received about BDT 1,944 for various AIGAs, including turmeric growing, fisheries development, homestead gardens, and bamboo production. By providing these AIGAs and conducting awareness-building activities, the IPAC project has created alternative livelihood opportunities for poor people who otherwise would depend heavily on natural resources from the protected area. Thus, IPAC project activities appear to be contributing to the conservation of natural resources in and around Madhupur National Park.

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Introduction

Globally, deforestation and forest degradation are a severe problem. In Bangladesh, forests have been degraded due to over-exploitation, changes in land use, encroachment, fire, uncontrolled and wasteful commercial logging, illegal felling, grazing, and the collection of fuelwood to support the energy needs of a large population. For example, Madhupur Forest was a compact, densely forested area until the 1960s (Bhuiyan 1994), but in the last few decades it has shrunk substantially. Government statistics show that 18,000 hectares of forest remained in 1997 (BFD 1999; MoEF 1999), but a land-cover classification based on 2003 Landsat ETM+ images shows only about 2,000 hectares of forest left, mainly in the Madhupur Thana area.

One quarter of the world's people depend directly or indirectly on forests for their livelihoods (Uprety 2004). This is one cause of forest degradation. People who live near forests are usually involved in agriculture outside the forest, and they regularly rely on forest products (timber, fuelwood, bush foods, medicinal plants, etc.) for both their own subsistence purposes and for income generation. This high dependence of households on forests coupled with other socio-economic attributes like low levels of education, poverty, and small landholdings is associated with forest degradation.

A livelihood comprises the capabilities, assets, and activities required to earn a living. A livelihood is "sustainable" when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets, both now and in the future, while not undermining the natural resource base (Carney 1998). In 2008, the Forest Department (FD) of the Government of Bangladesh and the United States Agency for International Development (USAID) started the Integrated Protected Area Co-management (IPAC) project in 17 protected areas (PAs) and one eco-park in Bangladesh with the aim of improving local people's livelihoods through greater access to and control over local forest resources. IPAC has promoted alternative income-generating activities (AIGAs) as one means of improving village livelihoods while decreasing their reliance on forest resources.

This study aims to test the hypothesis that AIGAs improve village livelihoods and decrease the use of forest resources, by documenting and comparing the livelihood patterns of those villagers living in communities and involved in AIGAs sponsored by IPAC with those living in communities that did not receive IPAC support. The specific objectives of the study are to:

- Describe the basic socio-economic and demographic characteristics of households that participate in IPAC sponsored co-management activities and of those that do not;
- Assess whether IPAC AIGA grants have improved the livelihood conditions of community members; and

- Assess whether co-management practices have reduced forest dependence among IPAC village conservation forum members.

Background

Madhupur forest is situated 125 kilometers northwest of Dhaka on the Tangail-Mymensingh Road in Tangail District. Some portions of this forest were gazetted as a national park as early as 1962. Today Madhupur National Park (MNP) covers three upazilas (sub-districts): Madhupur Upazila in Tangail District, and Muktagacha and Fulbaria Upazilas in Mymensingh District. Major parts of the park are under the administrative control of the Tangail Forest Division. MNP, which is also known as Madhupur Garh, comprises an area of 18,440 hectares (45,565 acres), of which 1,022 hectares (2,525 acres) have been declared reserved forest, through gazette notification, and the remaining 43,039 acres are in the process of being designated as reserved forests. MNP is comprised of numerous administrative divisions, including four ranges, ten beats, and one nursery center (IPAC 2009).

Madhupur forest is the largest surviving forest of the plains. It initially covered an area of approximately 647.5 square kilometers (250 square miles), but deforestation has reduced it to less than half of its original area. The Koch and Mandi (also known as Garo) tribes historically lived in the area and extracted forest resources. Over time, this extraction caused deforestation as they sought to meet their livelihood needs. The forest and its inhabitants came under the Zamindari of the Rajah of Natore who dedicated the area to the god Gobinda as a *debottor* (endowed property) as per the British Zamindari system. Throughout the British period, the Mandi people cultivated higher lands under lease from the government and could legally register lowlands in their own name (secure and permanent tenure). The Mandi recorded their lowlands under the Indian Tenancy Act of 1878.

The government of Pakistan established a 202-hectare (500-acre) farm in Kakraid, under Madhupur Thana, and resettled displaced Bengali farmers on lands prescribed for the Mandi people in Aronkhola in 1962. Eviction notices were sent to the Mandi of Chunia village by the Divisional Forest Officer of Mymensingh in 1968 and 1969. Consequently, a community-based organization was formed to ensure the rights of tribal people in Madhupur. Pressure from this organization prevented the Mandi from being fully evicted. The association produced a 15-point petition demanding land, security, education, and the power and authority to determine their own development. The concerned authorities never answered this petition.

In 1971, the great Freedom Fighters used the surrounding sal (*Shorea robusta*) forests as base areas during the Liberation War. The Dhokla Guest House is renowned as the site of the drafting of the Wildlife Act of 1973. In 1973, the Father of the Nation, then Prime Minister Bangabandhu Shiekh Mujibur Rahman, stayed in this guesthouse for

three days. To protect the sal forests, he declared the Madhupur Sal Forest as a heritage area with great ecological importance.

In 1978, the Divisional Forest Officer and District Commissioner of Tangail issued additional eviction notices to 200 homesteads consisting of about 800 families. In order to create the national park, the Government of Bangladesh offered people BDT 1,000 and one acre of land per homestead as compensation for resettlement.

In 1980, the government ordered the Rasulpur Range Office to occupy 108 acres of Mandi land in Joynagacha, Bonderiacholla, and Kedjai. In May 1981, the Forest Department hired local thugs to try to occupy the land by force. After the proclamation of martial law in 1982, a martial law order was sent to the Union Chairman and the village government head to evict those "forcibly occupying government forest." In 1984, over 16,997.4 hectares (42,000 acres) in the Madhupur forest were classified as forestland, meaning land belonging to the state Forest Department, without consulting with the Mandi community.

In the 1980s, rubber trees were planted on 6,070.5 hectares (15,000 acres) in Madhupur forest. Private entrepreneurs took this opportunity to take over Mandi land without providing compensation. In January 1990, the government announced that 10,117.5 hectares (25,000 acres) of Madhupur forest were planted with rubber trees, with another 16,188 hectares (40,000 acres) to be developed with funding from the Asian Development Bank (ADB). As a result, many sal forests were destroyed, teak trees uprooted, and other plants and wildlife disturbed or destroyed. ADB later withdrew its funding due to huge pressure from human rights groups.

Today MNP is a popular tourist spot from November to February. Many visitors from different parts of Bangladesh come to visit and picnic there. Various tourist companies employ many people to provide services to tourists. About 57,000 people still live inside MNP. Of these, about 15,000 are classified as ethnic (Garo and Koch) and 42,000 as non-ethnic. These inhabitants are dependent on the park for their livelihood activities. Approximately 113 villages surround MNP with a combined population of 28,513 households consisting of 124,575 inhabitants, of which 63,678 are male and 60,897 are female (IPAC 2009).

Local community members depend on the MNP for their subsistence and businesses. Forest stakeholders in Madhupur include *moholder* (auctioneers); illegal tree fellers; collectors of various non-timber forest products, including fuelwood, honey, bamboo, cane, sungrass, fruits, and medicinal plants; and farmers who grow pineapples, bananas, papayas, lemons, and other crops in the forest. Many poor people who live in adjacent villages are entirely dependent on the forest for fuelwood and building materials, the collection of which often involves illegal tree felling. There are several mosques, Hindu temples, and churches located in the park. Nearly 15 non-governmental organizations (NGOs) are actively working in the park, many of which

are implementing micro-credit and other development programs. These NGO micro-credit programs usually focus on supporting activities for women. A government bank also operates in the park and makes micro-loans for income-generating activities, such as agricultural production and handicrafts, to assist in poverty reduction. IPAC has been operating a program through the Center for Natural Resources Studies (CNRS), a national non-governmental organization implementing IPAC activities at the village level. A few other development organizations (e.g. Society for Social Services, Grameen Bank, Habitat for Humanity, Young Men's Christian Association, World Vision) have also been working for livelihood support.

Co-management is defined as a "situation in which two or more social actors negotiate, define and guarantee amongst themselves for a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources" (Borrini-Feyerabend *et al.* 2000). IPAC has been implementing co-management activities in MNP since 2009 and provided support for AIGAs between September 2010 and May 2011. As of December 2011, 89 village conservation forums (VCFs), two people's forums (PFs), and two co-management councils (CMCs) had been formed under the Madhupur National Park. IPAC's management information database states that 450 of 4,450 households from 16 different VCFs had each received around BDT 1,944 per household for AIGAs in Madhupur for activities such as growing turmeric, developing fisheries, planting homestead gardens, and producing bamboo (Fox *et al.* 2011). After a preliminary visit to these villages and a reconnaissance survey, I chose two villages that received AIGAs from IPAC for my study-Gachabari and South Bhutia. These two villages are ideal for my study, because both IPAC and non-IPAC target households are available for interviewing.

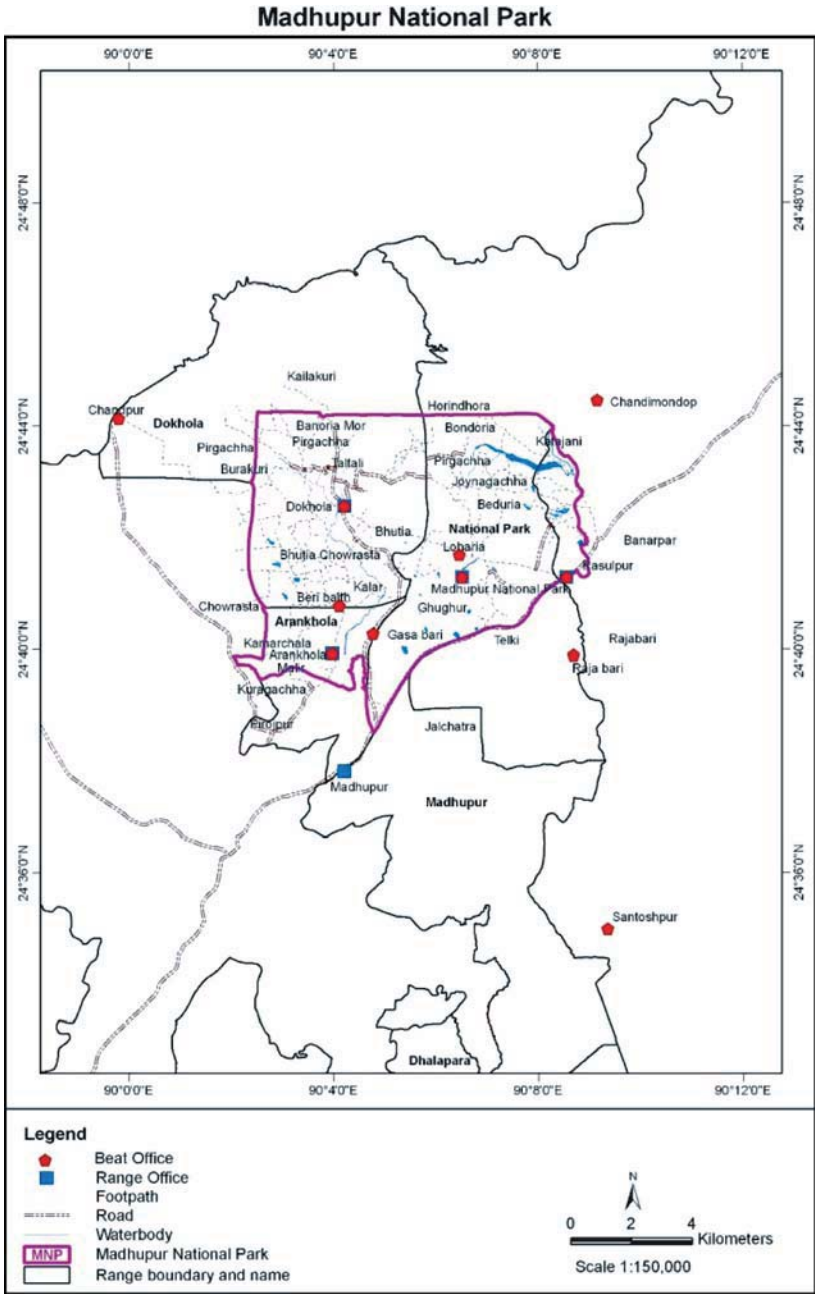

Figure 1: Location of the study area (Source Forest Department)

Methodology

This study was conducted using both primary and secondary data. I collected secondary data from various sources including IPAC, the Forest Department, the Center for Environmental and Geographical Information Services (CEGIS 2008), journals, and government and NGO reports and publications. Some demographic data were also collected from the Bangladesh Bureau of Statistics Handbook 2010 (BBS 2010).

I began fieldwork by visiting Madhupur Upazila and consulting with the IPAC and CNRS staff members, community leaders, members of the local government, and other key informants. Next, I conducted a reconnaissance visit to gain a better understanding of the local livelihoods, socio-economic conditions, and IPAC project activities. IPAC began working here in June 2009 to advance co-management through various methods. Among other initiatives, the project has supported alternative income-generating activities with the goals of reducing peoples' dependence on Madhupur National Park and the surrounding forest, improving livelihoods, and changing attitudes towards resource management.

Prior to choosing the study sites, I made preliminary visits to villages in Madhupur Upazila and identified two suitable villages that were representative of the area (Gachabari and South Bhutia under Rasulpur Forest Range), both with a mix of ethnic/non-ethnic, IPAC/non-IPAC, and AIGA/non-AIGA inhabitants. For primary data collection, I drafted a questionnaire for gathering the necessary information from households that participated in IPAC-sponsored activities and from those that did not. I pre-tested this questionnaire by interviewing several community members and then modifying it and adding questions about the respondents' family size, age, sex, occupation, educational levels, livelihood options, income, expenditures, and housing conditions (Appendix).

Primary data were collected through field visits, direct observations, consultations with community leaders and residents, focus group discussions (FGDs), and informational discussions (e.g. at the tea stall, school field, celebrations). I conducted a detailed sample survey in the two selected villages, Gachabari and South Bhutia under Rasulpur Forest Range, located in Madhupur Upazila, Tangail District, and adjacent to Madhupur National Park (Figure 1). For the survey, I took a stratified random sample of 40 households: 20 households that participated in IPAC-sponsored activities and 20 households that did not. About half of the respondents were male and half were female, in both the IPAC and non-IPAC groups. I conducted semi-structured interviews among the households using a prepared questionnaire. I also conducted two FGD sessions, one in each of the target communities. I used both qualitative and quantitative methods to analyze the collected data, focusing on livelihoods, income, and other factors. See Table 1 for a list of the interviews and discussions.

I conducted the study from August 2011 to January 2012, with most of the primary data collection completed in January 2012. I visited IPAC, WorldFish, and CNRS for data collection and to set up appointments for interviews. I also interviewed three project staff from CNRS as key informants (one staff member from each village and one CNRS coordinator who also lived in the area). The key informants were chosen for their broad and in-depth knowledge about their area, as well as for their knowledge of the livelihoods of villagers. Discussions with key informants focused on past conditions in Madhupur National Park, and on the villagers' livelihood practices. Key informants also spoke about forest dependence and collaborative activities supported by the IPAC project.

In order to crosscheck interview data and gain an overall impression of each village, I used participatory research assessment tools like FGDs. I conducted two FGDs, one in each of the survey villages. In addition to the selected respondents, family members also participated in the FGDs. Using a checklist of topics, I asked participants about the situation at Madhupur National Park prior to the implementation of IPAC. With regard to AIGAs, I asked what types of AIGAs local people had engaged in, and whether or not they were sufficient to improve local livelihoods. I used a checklist of structured questions for the FGD (see Appendix), which corresponds to the topics covered in the individual interviews.

Table 1: Data collection methods matrix: household (HH) interviews, focus group discussions (FGDs), and key informant interviews (KIIs)

Data collection event	Gachabari		South Bhutia		Total
	IPAC members	Non-IPAC members	IPAC members	Non-IPAC members	
HH interviews	10	10	10	10	40
FGDs		1	1		2
KIIs with villagers	1	1	1	1	4
KIIs with CNRS field staff		1	1		2
KII with CNRS site coordinator			1		1
KII with DFO Tangail			1		1

At each stage of the survey the data were checked, edited, coded, and transferred to computers at the field site. Some data were collected in local units of measurement familiar to respondents, so these units were converted into standard international units during the data entry process. Data were processed and analyzed using Microsoft Excel. Preliminary data sheets were compared with the original coding sheets to verify the accuracy of data entry.

Results

Socio-economic and Demographic Characteristics of IPAC and Non-IPAC Households

I collected socio-economic information from the 40 household survey respondents, including both IPAC and non-IPAC beneficiaries, and I also observed infrastructure, such as roads, market facilities, and health facilities in these communities. Among the 40 respondents, the largest age class was 20–35 years old (*n* = 18, 45%), followed by 35–45 (*n* = 15, 37.5%,) 45–55 (*n* = 3, 7.5%), and 55 years and older (*n* = 4, 10%). Respondents included Christians (*n* = 18, 45%), Muslims (*n* = 20, 50%) and Hindus (*n* = 2, 5%). I found their housing and sanitation conditions to be relatively good, and to be supported by other donor-funded projects. The FD and some donor-funded NGOs have provided the majority of participants with improved cook stoves under the Nishorgo Support Project (NSP) effort to increase fuel efficiency and conserve forests. Good roads connect Madhupur with Dhaka, and the community has good market access, within a distance of four kilometers on a good road. A Christian missionary hospital also provides good health services in the area.

In terms of the educational level, my data suggest that the largest group of respondents has no formal education, followed by those who completed primary school. The educational levels of respondents are shown in Table 2.

Table 2: Educational level of household survey respondents

Educational level	Number and percentage of respondents	
	IPAC households (*n* = 20)	Non-IPAC households (*n* = 20)
No studies	8 (40%)	7 (35%)
Completed primary school	6 (30%)	7 (35%)
Completed secondary school (SSC)	4 (20%)	3 (15%)
Education above SSC	2 (10%)	3 (15%)

In terms of occupations, the largest group of respondents are day laborers and people dependent on collecting forest products, followed by farmers. Table 3 shows the occupations of different respondents. A 2010 survey showed that 55 percent of households in this area were dependent on forest resources (Rokeya 2011). However, I found forest dependence to be approximately 30 percent in households that received AIGAs. My findings also show that non-IPAC participants are more involved in day labor and forestry work than IPAC participants. These data suggest that more IPAC participants may be involved in non-forestry related activities such as farming and small businesses.

Table 3: Current occupations of respondents

Major Occupation	Number and percentage of respondents	
	IPAC households	Non-IPAC households
Services (i.e. formal job in NGO, private firm, government)	2 (10%)	3 (15%)
Agriculture	5 (25%)	3 (15%)
Daily labor and forest resources	6 (30%)	9 (45%)
Van/Rickshaw puller	4 (20%)	3 (15%)
Small business	3 (15%)	2 (10%)

Average monthly incomes for both IPAC and non-IPAC households were normally distributed and the income levels of both groups were similar (Table 4). Major sources of income for both IPAC and non-IPAC households are presented in Table 5, along with the average contribution from each. The data show that non-IPAC participants depend more on day labor and forest income than IPAC households.

Table 4: Average current monthly income of respondents

Income ranges in BDT (and USD)*	Number and percent of respondents	
	IPAC households	Non-IPAC households
< 3,5000 (USD 41)	4 (20%)	3 (15%)
3,500–6,500 (USD 41–76)	9 (45%)	10 (50%)
6,500–9,500 (USD 76–112)	5 (25%)	6 (30%)
> 9,500 (USD 112)	2 (10%)	1 (5%)

*Note: 1 USD = BDT 85 (ONDA online currency conversion, February 10, 2012)

Table 5: Sources of household income and monthly averages for each

Major sources of income	Mean monthly income in BDT	
	IPAC participants	Non-IPAC participants
Services (i.e. formal job in NGO, private firm, government)	8,970	8,590
Agriculture	6,158	5,650
Daily labor and forest resources	4,050	5,460
Van/Rickshaw puller	7,490	7,250
Small business	10,345	9,567
Mean income in BDT	6,701	6,603

Eight NGOs work in the project area: World Vision Association for Social Advancement (ASA), Grameen Bank, Buro Tangil, Bangladesh Rural Advancement Committee (BRAC), CARITAS, PROSHIKA, and the Society for Social Services. These NGOs provide loans (usually for 6–12 months with weekly repayments at 10–15 percent interest) to beneficiaries to use for income-generating activities such as small businesses, fish cultivation, and poultry and livestock rearing. These NGOs

target mainly women participants. People also borrow money from their neighbors and relatives. The AIGA grants provided by IPAC are small in comparison with the amount of money available to villagers to borrow from other NGOs and informal sources.

Impact of IPAC AIGA Grants on the Livelihood Conditions of Community Members

IPAC has been implementing co-management activities in 10 villages in MNP since 2009 and has provided AIGA support between September 2010 and May 2011. In my study villages, 60 of the 450 village conservation forum member households received AIGA support for vegetable gardening (see Table 6). IPAC provided a one-day training on vegetable cultivation (see Figures 2 and 3) and gave participating households one-time input packages valued at BDT 1,944 per household. These included seeds and starts for different kinds of vegetables, such as turmeric and ginger. Beneficiaries cultivated these and other varieties of vegetables. Many participants invested their own resources in their gardens, in addition to their labor. These investments ranged up to BDT 42,455 with an average of BDT 10,624 per household.

Figure 2: Turmeric cultivation in Gachabari

Figure 3: A woman in her ginger garden, South Bhutia

Table 6: IPAC's AIGA support in different village conservation forums

Name of VCF	Number of HHs	Name of product	Number of beneficiaries	Land area (decimals) for AIGA cultivation	IPAC support (BDT)	Personal investment of beneficiaries (BDT)	Total investment (BDT)
South Bhutia	250	Turmeric	30	570	58,334	272,266	330,600
		Ginger	0	0	0	0	0
Gachabari	142	Turmeric	26	520	50,556	251,044	301,600
		Ginger	4	102	7,778	67,702	75,480
Total	392	2	60	1,192	116,668	330,668	447,336

Participants had good production, although some farmers' yields were hampered by heavy rainfall in September 2011. All of the IPAC participants benefited financially from their investments. Recently, in February 2012, participants began harvesting their turmeric and stockpiling it for further value-added processing in their homes (see Figure 4). Some farmers store their products for sale at a later date when prices are higher. Some participants sold some of their products to meet their emergency family expenses, as they have no other options to get money immediately. The minimum and maximum cash income received from selling these products ranged from BDT 300 to 5,000 (see Table 7), with an average of BDT 1,270. Almost 50 percent of the beneficiaries received less than BDT 1,000. In 2012, the market price of turmeric fell drastically. One of the AIGA beneficiaries told me on February 4, 2012 that fresh turmeric was then being sold at BDT 300 to 350 per one *maund* (40 kilograms) compared to BDT 1,200 to 1,500 the previous year, while boiled and dried turmeric was being sold at BDT 1,200 to BDT 1,500 compared to BDT 10,000 to 12,000 per 40 kilograms the previous year. He stated that, if the market price of turmeric had remained at last year's levels, then incomes would have been eight to ten times greater. Table 6 shows the mean cash income that households have earned from their AIGA-supported home gardens to date.

Figure 4: Freshly harvested turmeric, Gachabari

Table 7: Cash income received from AIGA vegetable gardens as of January 2012

Income range (BDT)	Number and percentage of respondents
< 1,000	3 (30%)
1,000–2,000	5 (50%)
2,000–5,000	2 (20%)

IPAC maintains a database of the 450 participants it supports in Madhupur forest. In Table 8, I compare land holdings and investments for turmeric for my 10 sample households with the IPAC database for 348 households. The IPAC database shows that a total area of 5,812 decimals (23.52 hectares) is utilized for turmeric by the 348 beneficiaries who cultivated this crop. In the IPAC database, the minimum and maximum land holdings were four decimals (161.9 m^2) and 120 decimals (4,856 m^2), respectively, with an average of 16.7 decimals (675.8 m^2) per beneficiary. My survey results found minimum and maximum land sizes of four and 60 decimals (161.9 m^2 and 2,428.5 m^2, respectively) with an average size of 24.5 decimals (991.5 m^2). In both databases, 50 percent or more of beneficiaries had less than 10 decimals (404.7 m^2) of land. Furthermore, the IPAC database shows that a total of BDT 3,370,960 was invested in turmeric cultivation in Madhupur in 2011. This figure includes both IPAC's AIGA support (BDT 1,944 per person) and the beneficiaries' own contributions. IPAC's contribution was BDT 676,669, or 20 percent of the total investment. This investment produced an estimated 232.5 metric tons of turmeric. In 2010 and 2011, Bangladesh faced a serious turmeric shortage. During 2011, the retail prices of fresh turmeric ranged from between BDT 330 to BDT 350 per kilogram, and powdered turmeric prices varied from between BDT 450 to BDT 460 per kilogram (Haroon 2011).

Table 8: Land area and self-investment for turmeric cultivation under AIGA grants

Land cultivated under IPAC grant (decimals)	Land size distribution used for turmeric cultivation				Investment range in BDT	
	# of responses	% of IPAC members	# HH from IPAC data-base	% HH from IPAC data-base	My survey data	IPAC database
< 10	5	50%	195	56%	< 3,855	< 3,855
10–20	2	20%	58	17%	3,855–6,755	3,855–9,655
20–30	1	10%	49	14%	6,755–11,395	9,655–14,455
30–40	1	10%	19	5%	11,395–13,340	14,455–20,095
40–50	0	0%	11	3%	-	20,095–27,055
> 50	1	10%	16	5%	32,855–44,440	27,855–67,655
Total	10	100%	348	100%		

IPAC members receive various types of training and earn extra money from AIGA activities, which in turn helps them to improve their livelihoods. One of the six components of IPAC is to create AIGA opportunities for local people who are dependent on forest resources. By bettering socio-economic conditions and improving people's ability to practice sustainable forest management, AIGA opportunities seek to facilitate the conservation of forests. My data suggest that, while IPAC activities

have been gradually improving the livelihoods of IPAC members, the AIGA grants given by IPAC, in equal amounts for all AIGA options (turmeric, ginger, fish, vegetable) (BDT 1,944 = USD 23), were not sufficient for the target beneficiaries. In fact, in total they invested four to five times the amount of money they received from IPAC to cultivate their land.

Impact of Co-management Practices on Forest Dependence among IPAC VCF Members

I learned from the FGDs that households who participated in IPAC activities claim to collect fewer forest resources than non-IPAC households. Previously, community people used to extract various foods such as *bon kachu* (wild taro), *bon alu* (wild potato), and *bon misticumra* (wild pumpkin) from the forest. Today, most people grow these vegetables in their gardens or buy them in the market. Other people used to collect forest products for sale, including fuelwood, bamboo, cane, and honey. Although previously many of the IPAC households that I surveyed were heavily dependent on forest-based resources, they have been compelled to convert their livelihoods to non-forest-based income-generation activities.

The focus group discussions also revealed that IPAC households have become more concerned about conservation issues and the protection of the national park due to participation in different types of awareness-raising programs, trainings, and meetings. The changing attitudes about the importance of forest conversation among IPAC households could have had some influence on their choice of professions, although other factors like the availability of credit and grants for AIGAs are likely as influential, if not more so.

Conclusions

In term of the benefits received from AIGAs, half of the participants I interviewed received grants to cultivate turmeric and ginger on their land. I found that these AIGA grants improved local livelihoods and increased household incomes to a limited extent. However, these AIGAs also resulted in other benefits. For instance, they provided a means of mobilizing people's participation and increasing agricultural production. A number of the participants who received AIGA grants for vegetable farming also invested in small businesses such as bicycle vans (rickshaw-vans). Based on these results, I conclude that the livelihoods of VCF members can be improved through the provision of appropriate AIGAs. Overall, however, only a small portion of VCF members received AIGA grants and training, and non-recipients continued to pursue less sustainable livelihoods. The majority of the people I interviewed that did not participate in any IPAC activities showed a higher dependence of forest resources than the people who did participate (see Table 3).

Community people who did not receive AIGA grants are eager to participate in IPAC co-management activities, especially the training that accompanies AIGA grants, because of the benefits others have received. These people have observed the monetary benefits that participants receive from selling the products of their improved vegetable cultivation practices. My results suggest that IPAC's AIGA grants have successfully improved the livelihoods of participants. The study's findings also provide some support for the hypothesis that recipients of AIGA grants have become less economically dependent on forest resources than non-recipients, as evidenced by their higher involvement in non-forest-based livelihoods in general, and by their higher participation in and income from sustainable agriculture, turmeric cultivation in particular.

I also learned from the FGDs that AIGA recipients found the training in vegetable cultivation to be useful; they met with and developed links to the upazila sub-assistant agriculture officer and private suppliers. Beneficiaries acknowledged that many of them would cultivate vegetables without IPAC assistance, but IPAC support allowed them to cultivate larger plots. Many beneficiaries invested their own resources on top of the AIGA grant for cultivating turmeric, ginger, and taro.

Discussions with beneficiaries (mainly the poor) also revealed that they consumed the vegetables they produced and distributed them to neighbors and relatives as well. This distribution helped them to strengthen social ties and relationships. Furthermore, if they did not grow vegetables they would have to buy them from the market. Although they would not purchase as great a quantity as they grow, they would have to earn money for these purchases. According to them, they would collect forest resources from Madhupur Forest for the money. Hence, these AIGA grants have implications for forest resource dependence.

Overall, people living in the area seem to lack the skills for successfully undertaking alternative income-generating activities. Skill development training provided by the NGOs is limited and confined to traditional areas of income generation. Local people, particularly tribal people, have skills in handicrafts like making bamboo baskets and weaving mats. However, I fully agree with community members that training in other areas such as food processing and marketing; medicinal plant production and marketing; cattle, poultry, and dairy farming; and pineapple and banana cultivation would be useful. With sufficient training and capital support (grants or loans), these activities could play a vital role in income generation for some local people and also help to lessen their dependence on forests. In the interviews, community people requested hands-on vocational training, including tailoring, beauty parlor training for women, and motor mechanics and carpentry for men.

By providing AIGAs and conducting awareness-building activities, the IPAC project has created alternative livelihood opportunities for poor people who otherwise would depend heavily on natural resources from the protected area. As a result, IPAC project

activities appear to be contributing to the conservation of natural resources in and around Madhupur National Park. The small AIGA grants that IPAC provides for vegetable cultivation have also contributed to increased recognition and acceptance of IPAC and its activities in these communities. This additional benefit may play an important role in enhancing conservation of this important protected ecosystem.

Recommendations

Based on my research findings, I would suggest the following measures to reduce forest dependence, improve local livelihoods, and promote positive forest conditions in Madhupur National Park:

- IPAC should continue to support vegetable cultivation in the project area where feasible and as resources permit.
- Poor households and forest users (resource collectors) should get priority as AIGA beneficiaries.
- Areas that are not currently used for vegetable cultivation, but have the potential to be, should be given priority for growing high-value vegetables like ginger and turmeric.
- Only a small percentage of households in each VCF receive AIGA grants or loans; there needs to be more investment to support additional VCF members.
- AIGA funds should be changed to a revolving fund, as in a micro-credit program, to promote the long-term financial viability of the program.

In summary, this study reveals that alternative income-generating activities can have an effect on livelihoods and forest dependence at Madhupur National Park in Bangladesh. The benefits of co-management of natural resources can be enhanced through support for sustainable livelihoods by providing AIGAs to resource user groups. In-depth, long-term studies are urgently needed to explore area-specific AIGA options for sustaining livelihood. The study results may contribute to project and policy formulation by decision makers.

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Appendix

Checklist of questions for focus group discussions

Demographic profile

1. What are major occupations of the people of the locality? Please rank them.
2. Are there many illiterate people in the locality? Do many people go to High school, college, and universities? Please rank them and indicate on the form.
3. Do you think that the occupations of people in the locality have changed over the past 30-50 years?

Socio-economic activities / livelihood strategies

1. What are the major income-generating activities of the local people? Please rank them according to their importance.
2. Are there many people who have no land?
3. Are there many people in the locality who have no work/job?
4. Please indicate how the availability of work changes with seasons.
5. What do the local people do when there is less or no work for them to do?
6. Do many people in the locality take loan from a bank, NGO or other organization? Please mention the reasons for taking loans.
7. Do the local people get income-generation training from any organizations?

Resource exploitation

1. What are the various resources that are collected from the forest and who collects what? Please indicate on the form.
2. For which resources is their collection likely to pose a threat to their availability in the future?
3. Please indicate how the exploitation of different resources varies with different seasons.
4. Which animals and plants are collected more and which are collected less?
5. When is there a scarcity of fuelwood in the locality? Please indicate how it varies with season (seasonal calendar).
6. Do the local people collect medicinal plants from the forest? Are they available nowadays?

Others

1. What are the major NGOs operating in the locality? Please indicate their activities on the form.
2. What are the major challenges for the conservation of forest resources?

Checklist of questions for key informant interviews

Stakeholders Assessment

1. What are the organizations/institutions that carry out any type of work in the forest?

2. From which villages do people come to the forest to collect resources?
3. Which villages are more involved and which are less involved?
4. What are the different categories/groups of people who go to collect various resources from the forest?
5. Are there any people who do not use the forest resources directly, but have linkages with resource exploitation and development of the forest?
6. Are there any other people who could be important for the conservation of the forest and its resources?

Resources and resource status

1. Which plants and animals have disappeared from the forest in the recent past?
2. Which plants and animals in the forest have been declining very rapidly?
3. What are the causes for the decline of various animals and plants?

Resource exploitation and dependency on forest

1. What are the various resources that are collected from the forest? Which are collected more and which are collected less?
2. What are the reasons for the collection of these resources?
3. Which category/group of resource users are dependent on the collection of these resources?
4. What proportion of local HHs benefit from the forest?
5. For which resources is their collection likely to pose a threat to their availability in the future?
6. Do people collect and use medicinal plants from the forest?

Demographic profile

1. How many households are living in this community/*thana*? How many adults?
2. What are the major occupations of the local people?
3. What proportion of local people are illiterate and what proportion of people have studied up to school, colleges and above?
4. How have the occupations of people in the locality changed over the past 30-50 years?

Socio-economic activities/livelihood strategies

1. What are the major income-generating activities of the local people?
2. What proportions of local people are very poor (have food shortage), poor, middle class and rich?
3. Are there many unemployed in the locality? What proportion of the local population?
4. In which season(s) is there a scarcity of work in the locality?
5. From which sources do local people take credit?
6. What are the different organizations that offer credit in the locality?

7. Do many people in the locality take loans from a bank, NGOs or other organizations?
8. Do the local people have skills that can be utilized for undertaking alternative income-generating activities?
9. Is there any work/economic opportunity that requires special skills that the local people don't have?

Others

1. What are the major threats to the forest habitat and its resources
2. What are the major challenges for the conservation of biodiversity and the restoration of habitat?

Benefits and Weaknesses of Collaborative Management: A Case Study in the Rema-Kalenga Wildlife Sanctuary

Hoq Mahbub Morshed

Abstract

Examining existing co-management practices can lead to an understanding of the suitability and potential for implementing this strategy in other protected areas (PAs). Specifically, an analysis of the benefits, linkages among actors, perceptions of local people, and their future implications for the sustainability of co-management committees (CMC) can assist in the development of better national policies and institutional mechanisms for implementing co-management in the protected areas of Bangladesh. This paper presents a case study of Rema-Kalenga Wildlife Sanctuary (RKWS), a 1,795-hectare site located in northeast Bangladesh on the Indian border. I collected primary information through informal group discussions, focus group discussions, key informant interviews, and household surveys. Some findings were unanimous-each respondent felt that natural resource depletion had been reduced and that local communities had benefited, mainly through alternative income-generating activities (AIGAs) provided through the support of NGOs and foreign governments. Moreover, all respondents confirmed that AIGAs are insufficient in terms of both the amount dispersed and the number of beneficiaries. This study suggests that the institutional sustainability of CMCs is tenuous due to insufficient AIGAs, a lack of interaction by CMC leaders and Integrated Protected Area Co-management (IPAC) project team members with grassroots people and organizations, inadequate road connectivity and infrastructure development to promote eco-tourism, a dearth of programs to promote awareness and motivation, insufficient small loans, a lack of a fixed income source for the CMCs' budget, insufficient policy and legal instruments, and weak incentives for community patrol groups to perform their services.

Introduction

Collaborative management or "co-management" of protected areas is a participatory approach to natural resource conservation that also can lead to improvements in local livelihoods. Protected areas (PAs) are specifically devoted to the protection and conservation of biological diversity and are also focused on cultural heritage. They are managed through legislation and other effective policy and institutional mechanisms, including co-management initiatives. PAs are declared and are then

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regulated or managed to achieve specific conservation objectives (IUCN 1994; Mukul *et al.* 2008; Mulongoy and Chape 2004).

Conventional forest management has been unsuccessful in arresting or slowing deforestation, degradation, and encroachment of forests in Bangladesh. The experience of communities worldwide, as shared in the First, Second, and Third World Parks Congresses, has confirmed that the sustainable management of forested PAs requires minimizing the dependence of local people on forest resources, while also bringing them into the mainstream of forest management as direct beneficiaries of these protected habitats and resources. This experience has demonstrated to forest managers in Bangladesh that, without the active participation of local people in the management and benefits of PAs, there is limited scope for the success of forest ecosystem conservation. The experience of the global community, combined with the continuing degradation of PAs in Bangladesh, has led the Forest Department to implement collaborative management strategies. In 2004, they initiated co-management in five PAs through the Nishorgo Support Project (NSP), implemented by the Government of Bangladesh and funded by the United States Agency for International Development (MoEF 2010).

During the implementation of co-management activities at different sites under the NSP, there were many challenges, including a lack of coordination among key stakeholders at the PA level; a lack of understanding about co-management among key implementing actors; a lack of effective policy and legal instruments to implement co-management activities; and a lack of efforts for sustaining the co-management committees (CMCs). After completion of the NSP in 2009, no clear evaluation was conducted. Despite this, many government officials considered the project a success and, under the subsequent Integrated Protected Area Co-management (IPAC) project, the Forest Department (FD) introduced co-management practices in more PAs. However, deriving maximum benefits from natural resource conservation and sustaining co-management organizations in the process has proven to be a significant challenge for the FD.

Examining existing co-management practices and their outcomes in a specific PA can lead to an understanding of the suitability of co-management in other areas, and can thus direct national forest policies towards improving co-management practices in the PAs of Bangladesh in general. This study investigates the perceptions of local people towards co-management and its impacts, examines the extent and nature of relations among major actors participating in co-management, and proposes strategies for sustaining co-management organizations after the completion of the project period, in order to promote increased understanding and provide evidence for policymakers and the stakeholders surrounding PAs for the future planning and implementation of co-management initiatives.

Background

Healthy forest ecosystems can lead to socioeconomic development and thereby contribute to the livelihoods and well being of local communities that depend on their resources. Forests also serve as carbon sinks, helping to stabilize the global climate, regulate hydrological cycles, and provide habitat for biodiversity, while hosting a wide variety of genetic resources. They can also contribute substantially to poverty reduction, livelihood development, the creation of employment opportunities, and many more ecological and economic activities and services (USAID 2011). However, the increasing utilization of forests for agriculture, settlements, fisheries, industrialization, urbanization, and the collection of fuelwood, construction materials, and other resources puts tremendous pressure on their natural resources and ecosystems. The consequences of these activities include the fragmentation of forestland, and the loss of biological diversity and wildlife habitat, which have led to broader ecosystem changes. Climate change impacts have further aggravated the situation (USAID 2011).

In Bangladesh the area of legally defined forestland is about 2.52 million hectares, or 17 percent of the total geographical area of the country (Shamsuddin *et al.* 2007). The Forest Department directly controls 1.52 million hectares of this forest, and the District Land Administration controls an additional 0.73 million hectares of forestland known as "unclassified state forest." The remaining 0.27 million hectares is comprised of privately owned homestead forests (Shamsuddin *et al.* 2007).

Forest protected areas include wildlife sanctuaries, national parks, and game reserves. As of February 13, 2012, the government had declared 17 wildlife sanctuaries and 17 national parks in forested areas through notification in the official gazette, as well as numerous eco-parks, safari parks, and botanical gardens, which are also managed for biodiversity conservation (Dey 2012). These were declared via Article 23 of the Bangladesh Wildlife (Preservation) Order of 1973, which aims to conserve wildlife, nature, and biodiversity (Dey 2012). Forest PAs cover about 265,403 hectares, which amounts to just 1.8 percent of the total geographical area of the country and only 10.5 percent of the total forestland; and most of these protected areas are comprised of the reserved forests (Dey 2012).

In addition, there are about 85,000 hectares of wetlands in Bangladesh, of which 44,000 hectares have been declared as Ecologically Critical Areas (ECAs) by the Ministry of Environment and Forests under the Bangladesh Environmental Act of 1995 (USAID 2011). The overall objectives of the ECAs are to ensure the sustainable use and conservation of wetland biodiversity, and to achieve significant and positive impacts for the long-term viability of the country's biodiversity resources, which also have importance from a global biodiversity perspective (Kahangire 2006).

The natural high-forest system of Rema-Kalenga Wildlife Sanctuary (RKWS) was

first officially declared in 1981, with an area of 1,095 hectares, and was expanded in 1996 to include a total area of 1,795 hectares. RKWS is part of the Tarap Hill Reserve Forest in Chanurughat Upazila, Habiganj District. It is bordered along most of its northern and western boundaries by reserve forests, along its southwestern boundary by the Rema Tea Estate, along its southern and eastern boundaries by India (Tripura State), and along a small portion of its northern boundary by *khas* lands (owned by the national government and managed by the district land administration) (Sharma 2006).

RKWS is located approximately 130 kilometers northeast of Dhaka and 80 kilometers southwest of Sylhet, between 24°06' to 24°14' north latitude and 91°34' to 91°41' east longitude. It falls under the ecological zone of the Sylhet Hills (Mollah and Kundu 2004). The average temperature in the area varies from a minimum of 27° Celsius in February to 37° Celsius in June, with the monthly average humidity varying from 74 percent in March to 89 percent in July, and an average annual rainfall of approximately 4,000 millimeters (Sharma 2006). RKWS incorporates both evergreen and semi-evergreen tropical forest. The landscape is comprised of rolling hills with small valleys. The highest hill is about 67 meters above sea level. A series of ridges form micro-watersheds with a mix of small streams. The area has rich plant, animal, and bird life. In fact, it provides some of the best bird watching in the country. The capped langur (*Trachypithecus pileatus*) has been identified as a flagship species of the sanctuary (Sharma 2006).

There are Bengali and ethnic minority Tripura settlements located both inside and outside of RKWS. Registered forest villagers living within the sanctuary get some privileges, including permission to live on FD land and to cultivate low-lying land. In return, they provide assistance with plantation management and forest protection. Their livelihoods, however, are mostly at the subsistence level and they also encroach on FD lands that they do not have permission to use, exploiting fuelwood, bamboo, wild potato, seasonal fruits, and other resources on a subsistence basis. There are a total of 36 villages that are primarily dependent on the resources of Tarap Hill Reserved Forest, which encompasses the reserve. One of these villages is located within RKWS, nine are situated on the boundary of the sanctuary, and 23 are located further away from it (Mollah and Kundu 2004). Other settlements that have a stake in RKWS and are located outside the sanctuary, but in its immediate vicinity, have also been identified (FSP 2000).

People living in the 36 villages inside and adjacent to the sanctuary depend heavily on forest resources for their livelihoods. Of these villages, 10 are forest villages (i.e. residents are permitted to live inside the forest in return for assisting the Forest Officers with their work) and eight are tribal villages. Among the outside villages, six villages have medium dependence, 15 have minor-medium dependence, and five have minor dependence on the sanctuary for their livelihoods; and there are two tea estates, Rema and Hoogli, which have minor-medium dependence on the sanctuary (Mollah

and Kundu 2004). Some tea laborers and unemployed people are also involved in illegal resource extraction from the sanctuary. Inhabitants of forest villages exploit the most resources from the sanctuary, followed by local poor people, other local users, and tea garden laborers (*ibid.*).

The NSP assisted local communities with protecting the natural resources of the country. By the end of the project in 2009, eight co-management councils and eight co-management committees had been established in five PAs, including the Rema-Kalenga Wildlife Sanctuary. The Nishorgo Support Project formed co-management committees, people's forums (PFs), nature clubs, youth clubs, forest user groups (FUGs), and community patrolling groups (CPGs). In addition, some alternative income-generating activities (AIGAs) were introduced, including plant nurseries, dairy farming, eco-guide services, and eco-tourism facilities, such as lodges and dormitories.

The Integrated Protected Area Co-management (IPAC) program, active from 2010 to 2013, continues the objectives of the Nishorgo Support Project (administered by the Forest Department) and the Management of Aquatic Ecosystems through Community Husbandry (MACH) project (administered by the Department of Fisheries). IPAC project activities have been expanded to 19 sites. The Department of Environment is also included as a partner in the IPAC program.

Methodology

This study was carried out from July to December 2011 in four villages, Debrabari, Kalengabari, Krishnachara, and Mongliabari, in and around Rema-Kalenga Wildlife Sanctuary. It was conducted in four stages: (1) collection of secondary information, (2) collection of primary data, (3) personal observation, and (4) data interpretation and analysis. The research was designed by using the knowledge and information gained from secondary data, which were collected from various related books, reports, journals, publications, FD officials, local IPAC offices, other government sources (FD, local government executives), and non-governmental organizations (Rangpur Dinajpur Rural Service). Various methods were applied to collect primary data, including household surveys, key informant interviews, informal group discussions, and more structured focus group discussions. Each of these methods is described below and summarized in Table 1.

I worked at RKWS in charge of Sub-divisional Forest Officers from October 2004 to February 2007. Based on this work experience, and on the reports of the participatory and rapid rural appraisals (PRA and RRA) conducted in the study area (Mollah and Kundu 2004), I identified four representative villages in which to focus my research. I chose these villages because of their location, their ethnic composition, and their heavy dependence on the PA. They include Debrabari (a Tripura village located inside the sanctuary), Kalengabari (a Bengali village located at the boundary of the

sanctuary and the reserved forest, and inside a forest plantation area), and two villages adjacent to the sanctuary, but inside the forest plantation area (Krishnachara, inhabited by Bengali tea garden laborers; and Mongliabari, inhabited by Tripura people).

Using an open-ended questionnaire (see Appendix II), I conducted surveys with a random sample of 20 households, five from each of the four villages, in order to collect relevant demographic and occupational information. I selected these 20 households because they were beneficiaries of NSP/IPAC project activities, or because of their involvement in groups and activities such as Nishorgo Shahayaks, community patrolling groups, eco-guiding, people's forums, forest user groups, village conservation forums (VCFs), and ethnic-based groups.

I also conducted semi-structured key informant interviews in each village using a checklist (see Appendix I). Prior to selecting the key informants, I met with local FD staff members to get some basic information about the villages. All four of the key informants were men-three were headmen of their villages (in Mongliabari, Krishnachara, and Debrabari) and one was a member of the local government (in Kalengabari). I selected these key informants based on their broad or in-depth knowledge about the village, including its households, resources, and involvement in co-management activities.

In addition, I carried out four informal group discussions (GDs). I initiated these group discussions randomly, when I found a gathering of people while strolling in the villages. One justification for using such a method is that it is very hard to gather villagers and community members, as households are dispersed and villagers remain busy in various livelihood activities during the daytime. The objective of the GDs was to develop community profiles to identify the benefits gained through co-management activities and the functionality of local institutions, linkages within and between organizations, the scope of additional benefits, and perceptions about co-management organizations and institutions.

Additional qualitative data were collected through focus group discussions (FGDs) with different co-management institutions. In order to collect information on the specific effects of co-management, I conducted a total of 10 FGDs in the four study villages: four discussions with members of forest user groups and village conservation forums with three to four participants in each; one discussion with the co-management committee members; two discussions with FD personnel (one with two Assistant Conservators of Forests, and one with a Forest Ranger, a Deputy Ranger, and a Forester); one with a group of NSP/IPAC team members (IPAC Site Facilitator and Field Organizer); and two discussions with community patrol groups (20–25 in each group). I created one checklist for the FGDs with community members, and another checklist for the FGDs with the FD officials and IPAC team members.

Table 1: Summary of methods used during field research

Methods	Research activity	Respondents (Individuals/ Organizations)	Distribution of interviews/ discussions	Number of interviews / discussions	Total number of participants
Open-ended questionnaire	Household survey	Villagers	5 in each of the 4 villages	20	20
Semi-structured interview	Key informant interviews	3 headmen, 1 community member	1 from each village	4	4
	Group Discussions	Villagers	4 groups from 4 villages	4	15–20
	Focus Group Discussions	FUGs/ VCFs	1 from each village	4	12–15
		CPGs	CMC Office	2	40–45
		FD staff	Forest Office	2	4
		IPAC staff	CMC Office	1	2
		CMC members	CMC Office	1	3

Results and Discussion

In investigating the effects of co-management in the study area, one finding was unanimous: all the respondents felt that natural resource depletion was reduced by 70 to 80 percent according to all 20 household surveys, the four key informant interviews, the four GDs, and the 10 FGDs. My own personal observations from working at RKWS confirm this finding, since I also observed reduced human impacts in the sanctuary now compared to when I worked there in 2004–2007. The undergrowth of the natural forest area was less disturbed, biodiversity seemed to be improving, and the stumps of illegally felled trees were less frequent. This recovery of the ecosystem and simultaneous reduction of human impacts has corresponded with the implementation of co-management at the sanctuary, beginning in 2004 with a pilot project. While there may be other factors that have contributed to these conservation outcomes, co-management seems to have played a significant role in habitat restoration.

The FD continues to have the sole legal responsibility for protecting RKWS, but it is not equipped with sufficient funds, training, or staff to perform its resource protection function effectively-this has not changed. What has changed with the implementation of co-management is that additional efforts are being made by stakeholders who were not engaged in protecting the resource in the past, and thus the PA resources are more protected than before. The views of local people combined with my own observations suggest that involving local communities in forest protected area management can be an effective solution for the protection of forest resources.

In terms of livelihood benefits from co-management, of the 20 households I surveyed, only seven families (35%) had received AIGA support. These seven families were involved in AIGAs such as livestock rearing (cows, goats, pigs), production of vegetable seeds, improved cook stove manufacturing, sewing, fish fry production, horticulture, sewing, and eco-guiding. My research suggests that few families received AIGA support and that, among those who did, the amounts were insufficient to significantly affect their livelihoods. Furthermore, my household survey data revealed that the seven members who received AIGA support or benefited in other ways from co-management are still dependent on forest resources. This indicates that participation in AIGAs did not prevent them from collecting resources from the forest. On the other hand, those who have not received AIGAs were unhappy that they were not selected to receive this support. The participants of the key informant interviews, the GDs, and the FGDs all confirmed that AIGAs are insufficient in terms of both the amount of support provided and the total number of beneficiaries.

When I asked how AIGA support could be improved in order to have a greater impact, all of the respondents agreed that there should be AIGA activities for all forest dependent people. In answering the free-response question "What types of AIGAs do community people need?" three of the four key informants, and respondents in all four of the GDs, all 10 of the FGDs, and all 20 of the household surveys agreed that there should be more road and infrastructure development. While such development does not constitute AIGAs explicitly, it can help to facilitate some AIGAs. For instance, respondents reported that additional investments in eco-tourism would not be productive; a better road would promote eco-tourism and provide greater opportunities for the people to improve their livelihoods. Other responses noted the need for no-interest loans, grants, and the provision of various other facilities and productive inputs, including domestic animals and poultry, rickshaws or rickshaw-vans, improved stoves, cotton for weaving, pond excavation, fish stocking, deep tube wells, power pumps for irrigation, sanitation and medical facilities, and a school for children. Respondents also emphasized that support should benefit all members of the community and that the amount should be sufficient to enhance their livelihoods and to prevent people from engaging in the extraction of different products from the forest. The above findings suggest that AIGA support should be guided by an assessment of the specific needs of each community, and that this could help to reduce resource dependence and enhance the livelihoods of local people.

Furthermore, my household survey results show that the perceptions of local people towards co-management are generally very positive. However, most respondents felt that CMC leaders and IPAC team members have a poor relationship with community members, and that their efforts for awareness-raising and motivational programs were not sufficient to engage the whole community in effective co-management practices in RKWS. While key informants and the GD and FGD participants were generally aware of co-management, many local people were not, as revealed by the household survey data, which showed that only seven of the 20 respondents had any clear

knowledge about co-management. Of these seven, three had a good understanding of co-management because they are members of the CMC. Despite the fact that co-management is not well understood by the remaining 13 of the household interview respondents, when I explained the concept to them their attitude towards co-management was positive.

Among the 20 participants of the key informant interviews, GDs, and FGDs, all acknowledged that there is a strong relationship between the FD, the IPAC project team, and the CMC leaders. Most of the key informants and the GD and FGD participants confessed that the CMC leaders and the IPAC team have poor relations with the community people and with local grassroots organizations. On the other hand, all of the household survey respondents admitted that they have good relations with the FD since they are "forest villagers," they feel they have to give support to the FD for patrolling and plantation work. This difference between the views expressed by the villagers and the other respondents could be due to the fact that the villagers have a more direct (legally binding) relationship with the FD and IPAC staff, which has a direct bearing on their livelihoods.

Based on the above findings, my recommendation is that, in order to build more interest in co-management and to improve co-management practices and relations, there should be more interaction between the IPAC team and the CMC leaders on the one hand, and the grassroots-level organizations and community people on the other hand.

My results from the key informant interviews, GDs, and FGDs show that all respondents felt that the institutional sustainability of the CMC is tenuous. They attribute this to insufficient AIGA support for local residents, limited interaction with community members and grassroots organizations by the CMC leaders and/or the IPAC project team members, and a lack of road connectivity and other infrastructure to promote eco-tourism. Earnings from eco-tourism activities provide 50 percent of the CMC's total revenue, so the more income obtained from eco-tourism, the more resources the CMC will have to invest in improving PA management and enhancing the welfare of the local community. In this regard, an increase in the benefit-sharing ratio from eco-tourism from 50 percent to 75 percent could also have a significant impact on the sustainability of the CMC.

The survey also revealed that, out of the 18 combined individuals and groups consulted, 16 mentioned that a lack of awareness and motivation programs, and an insufficient amount of small, low-interest loans could lead to the unsustainability of the CMC. If people benefit from co-management activities, they will engage more actively with the CMC, thereby promoting its institutional sustainability. Results also showed that, of these individual/group respondents, 13 to 15 mentioned a lack of a fixed income source like an endowment fund (money deposited in the bank as a fixed deposit for earning interest regularly) for PA development and conservation measures,

or enrollment funds (no-interest fixed-term loans provided by donors or the government) for livelihood development; insufficient policy and legal instruments; and a lack of monetary support to CPGs for their services. All of these also have implications for the sustainability of the CMC. Finally, of the 18 individual/group respondents, only two (FGDs) mentioned the lack of a monitoring policy of the CMCs for CPGs, VCFs, and PFs as a significant factor affecting their sustainability. The various issues that participants cited as threats to the sustainability of the CMC are provided in Table 2.

Table 2: Issues cited as threats to the institutional viability of the CMC

Reason	Respondents		
	KI (n = 4)	GD (n = 4)	FGD (n = 10)
Insufficient policy and legal instruments for CMC empowerment	2	3	8
Insufficient AIGA support	4	4	10
Lack of fixed income sources for livelihood development, PA development, and daily expenditures of those working for conservation	4	2	8
Lack of awareness-raising and motivation programs	4	4	8
Insufficient small/low-interest loans and endowment/enrollment funds	4	4	8
Lack of a monitoring policy of CMC for CPG, VCF, PF activities	0	0	2
Lack of monetary support to the CPG for their services	4	4	7
Lack of interaction with community members and grassroots organizations	4	4	10
Lack of road connectivity and infrastructure development to promote eco-tourism	4	4	10
Benefit-sharing ratio from eco-tourism must be increased (e.g. from 50% to 75%)	0	0	2

NOTES: KI = key informant interview; GD = group discussion; FGD = focus group discussion

Conclusion

Over the past two decades, co-management strategies have been implemented throughout the world as a natural resource conservation tool. Their main impetus has been to engage local people as partners in resource protection. However, co-management is very site specific, and each country must develop its own implementation strategy. In some South Asian countries such as Nepal, India, and Sri Lanka, a number of co-management initiatives, such as buffer-zone management committees, joint forest management, community forest management, and others, have proven to be effective tools for the sustainable management and conservation of forests and protected areas.

In Bangladesh, which piloted co-management strategies under the Nishorgo Support Project from 2004–2009, many relevant lessons have been learned. The long-term success of co-management of PAs in Bangladesh will depend on effectively internalizing the lessons from such pilot projects. However, sustaining co-management organizations and deriving maximum benefits from natural resource

conservation has proven to be a huge ongoing challenge for the Forest Department after completion of their project interventions. Some additional measures are needed to ensure the long-term sustainability and effectiveness of co-management at RKWS and other protected sites. Based on the findings of this study, I recommend the following actions and strategies be pursued to ensure the viability of key co-management institutions and outcomes at RKWS, and their replication in other forest protected areas of the country:

1. Ensure the involvement of local communities in the management of forest protected areas as a solution for protecting natural resources;
2. Provide more AIGA activities according to community needs and an assessment of their dependence on the PA;
3. Create an endowment fund to provide regular income for the administrative costs of the CMC, and to promote sustainable PA management and community development;
4. Ensure good road communication and eco-tourism facilities to encourage tourists;
5. Facilitate greater interaction among co-management decision-makers, grassroots-level organizations, and community people;
6. Develop a clear monitoring policy of CMCs for CPGs, VCFs, and PFs; and
7. Establish a clear legal basis for co-management.

The outcomes and shortcomings of co-management practices in existing pilot sites can lead policymakers and other stakeholders and proponents of co-management to a fuller understanding of the suitability and applicability of specific co-management strategies in other PAs. Ultimately, the long-term viability of co-management organizations and the effective replication of co-management strategies in other protected areas depends upon the implementation of these lessons learned from past experiences, as well as on garnering political and legal support and sufficient financial flows.

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Appendix I: Checklist of questions for key informant interviews

1. What benefits did the community receive due to co-management?
2. What are the perceptions of local people about co-management?
3. What benefits did/do community members receive from Nishorgo/IPAC activities?
4. What types of AIGAs do community people need?
5. Do you think resource degradation in the PA is decreasing?
6. Do you think IPAC team members, co-management councils, and FD staff members have very good relations?
7. Do you think they (IPAC team members, co-management councils, and FD staff) have enough communication with the CPGs, PFs, VCFs, youth clubs, etc.?
8. What are your perceptions about the Nishorgo Network?
9. What are your suggestions for sustaining CMC?

Appendix II: Open-ended questionnaire for household surveys

1. Did you get any benefits from the NSP/IPAC projects?
2. Do you have any idea about co-management? Are you interested in co-management?
3. What additional benefits - AIGA or others - did you receive from co-management?
4. How can local people benefit more from co-management?
5. Are there any (communication) linkages among the members of the CMC and the members of the VCFs, PFs, youth clubs, and CPGs?
6. What are the roles and interests of the major actors in PA management (FD, IPAC team, CMC)?
7. Have you had any involvement in PA management? To what extent?
8. Do you think the degradation of resources from PAs is decreasing?
9. Is there any conflict among the FD, the IPAC team, and CMC members?

Impacts of Co-management and Related Institutions on Fish Biodiversity and Livelihoods of Fishers of Baikka Beel

Fozlul Kabeer

Abstract

Co-management has been a focus of attention in fisheries and natural resource management in the last two decades. 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, a 100-hectare water body in 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 paper, I investigate the role of co-management institutions, including federations of resource user groups (FRUGs) and resource management organizations (RMOs), as well as alternative income-generating activities (AIGAs), on sustainable wetland resource management, and I examine the resulting benefits for fish production and biodiversity. The study results suggest that the knowledge and attitudes of MACH fishers towards sustainable resource management are more positive and optimistic than those of non-MACH fishers; the income level of MACH fishers is higher than that of non-MACH fishers; MACH fishers are involved with AIGAs, non-MACH fishers are not; fishing rights of both MACH and non-MACH fishers are not well established due to current leasing systems; and fish production and biodiversity have 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 12.5 million people are directly or indirectly involved with the fisheries sector for their livelihood. Fishing plays a major role in meeting the country's animal protein demands, earning foreign exchange, and in the socio-economic development of the rural poor, by alleviating poverty through employment generation (DoF 2009). At the same time, natural resources in Bangladesh have been gradually declining due to habitat degradation for instance, in the case of wetlands, through siltation and loss of natural breeding grounds and man-made problems like overfishing, use of destructive fishing gear, huge use of

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agrochemicals, conversion of wetlands to agricultural lands, and catching of parent, young, and undersized fish. 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 under threat of irreversible decline (DoF 2005).

In Bangladesh, wetlands are highly productive environments that support the livelihoods of millions of poor people. Despite the possession of a highly productive inland water area, the continuing decrease in fish catch increasingly threatens the livelihoods of 1.28 million fishers nationwide (DoF 2011). The demands on inland aquatic areas by different stakeholders have also rapidly accelerated the destruction of aquatic resources. Barriers to the access of fishers in the management of inland fisheries resources and over-exploitation by the relatively wealthier contract fishers population are reducing the options for sustaining the livelihoods of fishery-dependent communities. Under the current leasing system, in which revenue collection is the main target and biological impacts are not considered, poor fishers have failed to gain fishing rights, mainly because of high leasing value, and are less able to defend their fishing rights than more socially and economically powerful leasers who can conduct unauthorized fishing through threats and social pressure.

Community-based management of natural resources has, in the past two decades, become a common strategy for improving resources management and empowering local communities using concepts such as local knowledge, recognition of local institutions, and establishment of common property regimes (Sultana and Thompson 2007). Community-based fisheries management (CBFM) is a new tool for the sustainable management of inland fisheries resources, and the success of such management depends on the motivation and active participation of the community members (Thompson and Colavito 2007).

The Management of Aquatic Ecosystems through Community Husbandry (MACH) project was an innovative pilot program with the aim of developing community-based fisheries management and demonstrating sustainable, integrated management of wetland resources including fish, plants, agriculture, livestock, forestry, and wildlife over entire ecosystems.

In this study, I investigate the role of co-management institutions, including federations of resource user groups (FRUGs) and resource management organizations (RMOs), as well as alternative income-generating activities (AIGAs), in sustainable wetland resources management, and examine the resulting benefits for fish production and biodiversity. The specific objectives of the study are: (1) to understand the role of co-management institutions in wetland resources management; (2) to learnmore about the income level of members of resource user groups (RUGs) and their rights to the fishery; (3) to understand the role of AIGAs and their benefits for wetland resources

management; and (4) to determine the status of production and biodiversity as perceived by the fishers.

Considering the potential, possibilities, and limitations related to the management of wetland resources, the present research was conducted to determine the socio-economic and ecological impacts of co-management as implemented in my study area. This may serve as a guideline for policy formulation and be useful for the government, NGO officials, fishers, and members of RUGs, FRUGs, and RMOs.

Background

Hail Hoar is an extensive wetland area situated in Moulvibazar District that reaches a maximum flooded size of 14,000 hectares, but which, in the dry season, recedes to less than 4,000 hectares and is restricted to about 130 beels and narrow canals. More than 172,000 people in 30,000 households live in 60 villages surrounding the haor. Over 80 percent of these households engage in fishing in the haor, many as a full-time profession (Chakraborty *et al.* 2005).

Baikka Beel is situated in Hail Haor, and this beel includes three other sub-beels Chapra, Maguara, and Jaduria and retains water year round. Together with the surrounding marshy areas, these beels form the fish sanctuary known as Baikka Beel Sanctuary, covering about 100 hectares. Baikka Beel was once famous for its rich fisheries and as a spawning and nursery ground in Hail Haor. The Bangladesh Government declared Baikka Beel a permanent fish sanctuary on July 1, 2003. Baikka Beel came under the management of the MACH project, funded by USAID and implemented by the Department of Fisheries, from 1998 to 2008. This sanctuary was created to improve the wetland habitat, protect sensitive avian areas, and support the diversity of aquatic plants and animals of Hail Haor.

First the MACH project and now the Integrated Protected Area Co-management (IPAC) Project have promoted a co-management approach in Baikka Beel to reduce the overuse of wetland resources and to preserve them from degradation within the project sites. Specific activities have included the development of fish sanctuaries, the implementation of alternative income-generating activities to reduce fishing pressure, reconnecting water bodies through the excavation of canals, and establishment of swamp plantations to facilitate fish migration and spawning and to preserve wetland productivity.

In Bangladesh, most wetlands are government property and are administered by the Ministry of Land (MoL). On behalf of the MoL, officials at the district and upazila levels look after these water bodies. The Department of Fisheries, the Department of Environment, and the Forest Department also share some responsibility for the management of the water bodies, including administration of Ecologically Critical Areas (ECAs).

Baikka Beel was established as a co-management site by MACH. Around this location, both resource management organizations (RMOs) and federations of resource user groups (FRUGs) have been operating with the support of the DoF. The deputy commissioner at Moulvibazar manages Baikka Beel, with technical support from the DoF and active participation of local community RMOs, specifically the Barogangina RMO.

Study Area

Based on supplementary information from DoF officials, IPAC staff, local communities, and a review of previous reports, I selected two villages as my 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 and twenty kilometers southwest of Moulvibazar District town (Figure 1). Due to their close proximity to the beel, the 40 households in these two villages engage in fishing as their main occupation and also to meet their household food demands. In Hazipur, MACH provided AIGA funds to members of the RUGs, who chose 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, I look at changes in income levels of fishers due to AIGAs in Hazipur village, as well as the difference between the MACH (Hazipur) and non-MACH (Uttar Uttarsur) villages.

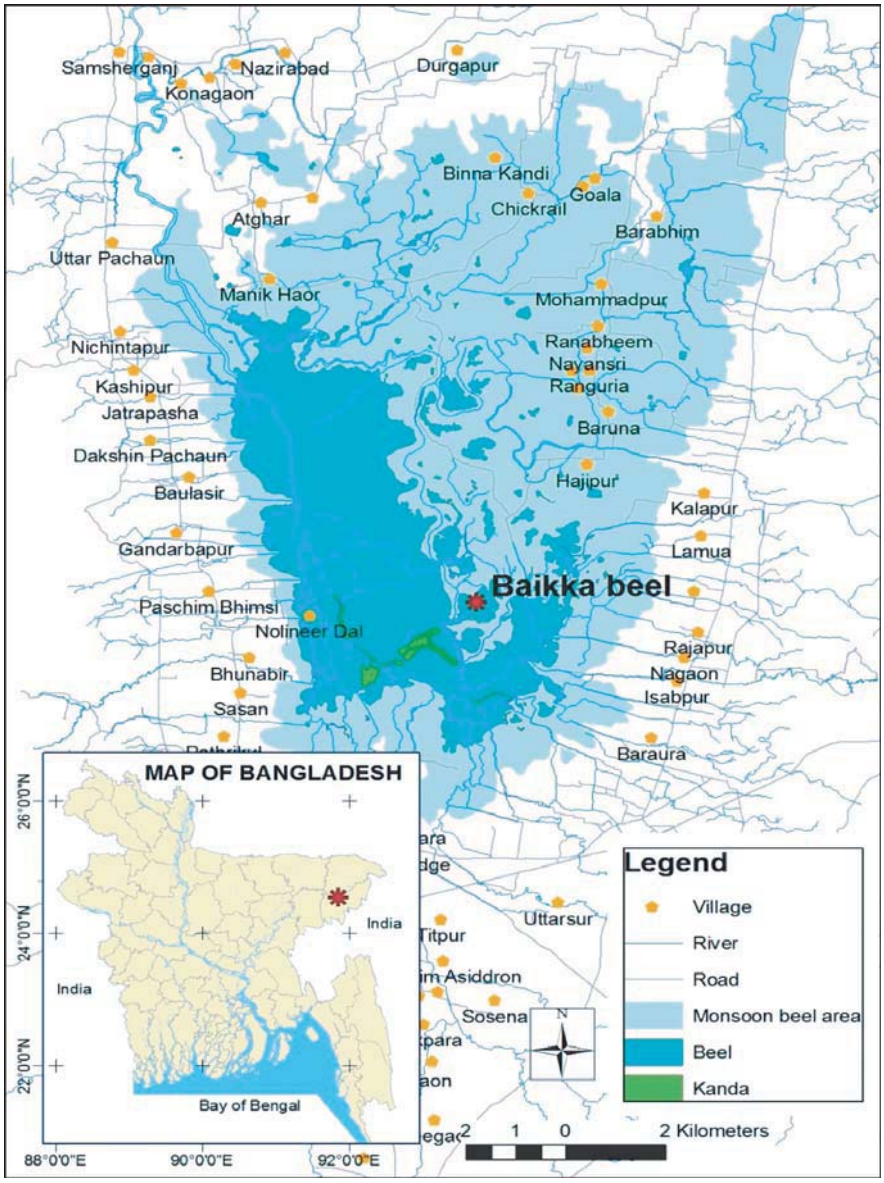

Figure 1: Map of the study area (Source: IPAC)

Methodology

For this study, I collected both primary and secondary data. I collected primary data through field visits and observations, semi-structured interviews, 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, I visited the area and selected two villages for data collection. I gathered information about local livelihoods, socio-economic conditions, and the fishing activities of the community members, as well as their management activities in Baikka Beel. Based on this information, I designed my questionnaire to collect qualitative and quantitative data. I visited the study area for data collection once a month from August 2011 to December 2011 (five times). I gathered secondary data on Baikka Beel, MACH activities, IPAC activities, previous and present fish catch, and AIGA trainings and funds from the reports of the Department of Fisheries, the Upazila Fisheries Office, and the local IPAC office.

Using a semi-structured questionnaire, I conducted a comparative household survey in Hazipur and Uttar Uttarsur villages; Hazipur has a RMO (and AIGAs) and Uttar Uttarsur does not. From each village, I chose 20 respondents who had been engaged in fishing for several years at that site because they could provide me with information about fish catch and biodiversity over time. In Hazipur village, all 20 respondents fish around the beel for their livelihoods and all are members of the RUG who received AIGA training and funds for alternative professions other than fishing. In Uttar Uttarsur village, all 20 respondents also fish around the beel, but they are not members of a RUG.

For qualitative data collection, I conducted two focus group discussions in these two villages, with participants not included in the semi-structured interviews,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. I also collected data through semi-structured interviewswith community leaders and key informants.

To determine the biodiversity statusof the beel, I visited three nearby fish markets, Baruna Ghater Bazar, Hazipur Ghater Bazar, and Bhairabganj Bazar, one time each month. I also analyzed secondary data using various types of sources to identify and better understand the impacts of fish sanctuaries on fish biodiversity. I asked the respondents from both villages, participants in the FGDs, and key informants 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 amounts of previous and current catches and fish consumption; the types of fishing gear used; implementation of Fish Acts and Rules;

fish sanctuaries; excavation; swamp plantation; AIGA funds and activities provided; and management strategies of RUGs, FRUGs, and RMOs; and I 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.

After completing data collection, I conducted an analysis to estimate impacts of AIGAs on fisheries production, biodiversity, and income generation, as well as their implications for fisheries management.

Results and Discussion

In this section I first describe the role of co-management institutions (RUGs/ FRUGs/ RMOs) in wetland resources management. Next I look at the income level of members of resource user groups (RUGs) and their rights to the fishery. I also examine the role of AIGAs and their benefits for wetland resources management. In addition, I discuss the status of production and biodiversity as perceived by the fishers.

Role of Co-management Institutions in Wetland Resources Management

I gathered data from the respondents of both MACH and non-MACH villages in order to understand the role of co-management institutions and the respondents' attitudes and perceptions concerning co-management. I asked respondents about the objectives of the MACH project and sought out additional information from focus group discussions. In the FGDs, I asked about 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 shown in Table 1. In the MACH village, all 20 respondents (100%) said that fish production had increased, while in the non-MACH village,16 respondents (80%) said that fish production had increased. Nineteen respondents (95%) in the MACH village and none in the non-MACH village had received AIGA training and funds. Fourteen respondents (70%) in the MACH village are involved with AIGAs and only two (10%) respondents from the non-MACH village are involved with AIGAs. Nineteen respondents (95%) are aware of the Fish Act in the MACH village, while only four (20%) of the respondents from the non-MACH village are aware of it. The respondents from the MACH village are also more aware than respondents from the non-MACH village of 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 (see Table 1). Most of the respondents in the MACH village are well informed about co-

management and have a positive attitude about sustainable wetland resources management. On the other hand, the non-MACH village fishers reported having received little information about these issues and they responded less frequently to questions on the importance of conserving wetlands. My analysis suggests that MACH village fishers are more aware of co-management, sustainable wetlands resources management and conservation,and biodiversity, and I found them optimistic compared to the non-MACH village fishers. Based on this analysis, it may be argued that the positive attitude of the respondents in the MACH village towards sustainable wetlands resources management is due to the appropriate role of co-management institutions, community-based organizations, and the provision of funds for AIGAs.

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)
Report that fish production has increased	20 (100%)	15 (75%)
Have received AIGA-related training	20 (95%)	3 (15%)
Received AIGA funds individually	19 (95%)	0 (0%)
Engage in AIG activities (plant nursery, fish nursery, cow 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%)
Support stocking/releasing of new fish species	16 (80%)	2 (10%)
Have 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%)
Engage in resource sustainability activities (RMO meetings, organized trainings, etc.)	18 (90%)	2 (10%)
Support environmental protection (e.g. swamp plantation)	18 (90%)	5 (25%)
Have savings individually	12 (60%)	2 (10%)

There are 22 RUGs (with 15–30 members in each RUG) active in Baikka Beel management activities. These 22 RUGs are formed of fishers/villagers from three villages, Hazipur, Baruna, and Nayanshri. Four FRUGs (federations of resource user groups) have also been formed by members of these RUGs three FRUGs in Sreemangol Upazila and one in Moulvibazar Sadar Upazila. The main function of the FRUGs is to maintain and manage a revolving fund provided by the MACH project. The fund has been provided to the FRUG authorities' accounts to provide loans to individual RUG members for AIGAs. Fund disbursements are supervised and controlled by the FRUGs.The RMOs are responsible for coordination with the upazila

committee and overall management of the beel. The president and member secretary of the RMO are members of the upazila fisheries committee (UFC). The RUGs, FRUGs, and RMOs are linked with each other, and these local, community-based organizations have a linkage with the upazila administration, which helps in sustainable Baikka Beel management.

Resource User Group Members: Income Level and Rights to the Fishery

In Hazipur village, the average monthly income per respondent from fishing is 3,210 BDT and from AIGAs or other sources is 4,895 BDT. In Uttar Uttarsur village, the average monthly income per respondent from fishing is 4,645 BDT, and from AIGAs or other sources is 1,635 BDT. The analysis of income level of the respondents of these two villages shows that the average monthly income per respondent from fishing in Hazipur village is lower than it is in Uttar Uttarsur village, but the average monthly income per respondent from AIGAs or other sources is higher in Hazipur village than in Uttar Uttarsur village (Figure 2). The combined average monthly income from both fishing and AIGAs or others sources was higher in Hazipur village than in Uttar Uttarsur village.

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 environmentally friendly fishing gear. But in the dry season, when the embankment of each beel is visible, then contract leaseholders prevent the local fishers from fishing. Thus, during the dry season, many fishers of the non-MACH village work as day laborers for the contract leaseholders to guard and also to catch fish. Therefore, due to the current leasing system, the fishing rights of the fishers of my study area are at risk.

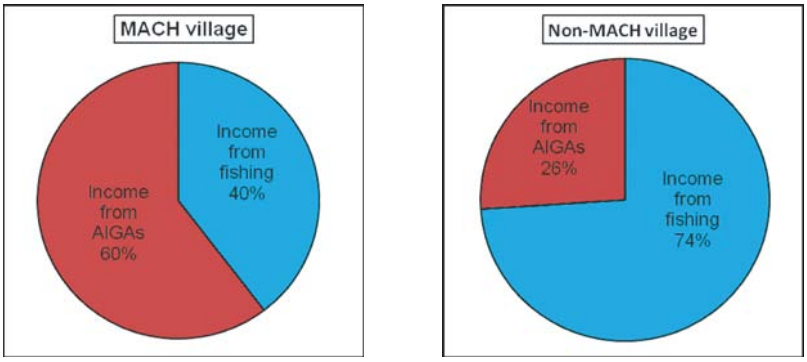

Figure 2: Percentage of average monthly income from fishing and non-fishing in MACH and non-MACH village

AIGA-related trainings for different income-generating activities have been provided to the members of RUGs, FRUG, and RMOs of the MACH village. These include (a) plant nursery, (b) fish nursery, (c) fish cultivation, (d) cow fattening, (e) goat rearing, (f) vegetable culture, (g) driving (h) weaving, and (i) handicrafts production.

Funds for alternative income-generatingactivities (AIGAs). Before the end of 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 is 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 of Baikka Beel and the Sreemangol Upazila Water Resource Management Committee, while the remaining 10 percent is added to the main endowment fund. In this way, the endowment fund is being increased gradually. The amount of the revolving fund is 8,700,000 BDT, which is also deposited into a bank account controlled jointly by the president, member secretary, and treasurer of the FRUG. The fund is used to provide loansat a 12 percent interest rate to RUG members for AIGAs, and is controlled by the FRUG's executive committee and reviewed during the FRUG's general assembly. Fund disbursement is supervised and controlled by the FRUG. The first loan amount for individual RUG members is 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 are receiving such loans and investing their funds in AIGAs.

The analysis of monthly average income levels of respondents in the two villages shows that in the non-MACH village,74 percent of their monthly income comes from fishing and 26 percent of their monthly income comes from other sources. On the other hand, in the MACH village, 40 percent of their monthly income comes from fishing and 60 percent of their monthly income comes from AIGAs or other sources. The previous main occupation of most of the respondents of Hazipur village was fishing, and at present they are involved with different types of AIGAs such as plant nursery, cow fattening, goat rearing, fish nursery and culture, driving, and others (Figure 3). On the other hand, 15 respondents (75%) in Uttar Uttarsur village were engaged in fishing as their main occupation, and they are still engaged in fishing at present (Figure 4). 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 has been no AIGA-related training, no AIGA funds, and no motivational work done in Uttar Uttarsur village. Therefore, there are no community-based co-management organizations (RMOs, RUGs, or FRUGs) functioning in this village. The fishermen of this village are engaged in

traditional fishing around Baikka Beel. They are not very aware of or motivated about co-management, the Fish Conservation Act and Rules, biodiversity, or sustainable wetland resources management. Thus, it might be said that AIGAs help to reduce dependence on fishing and to promote sustainable wetland resources management.

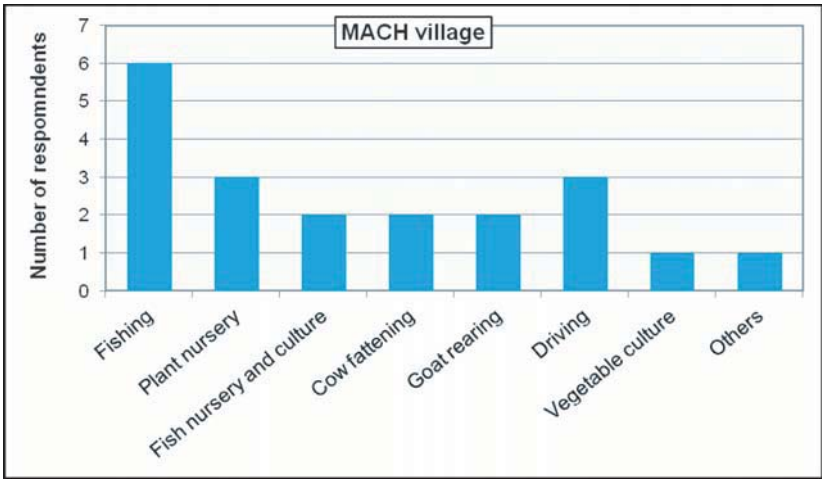

Figure 3: Present occupational status in the MACH village

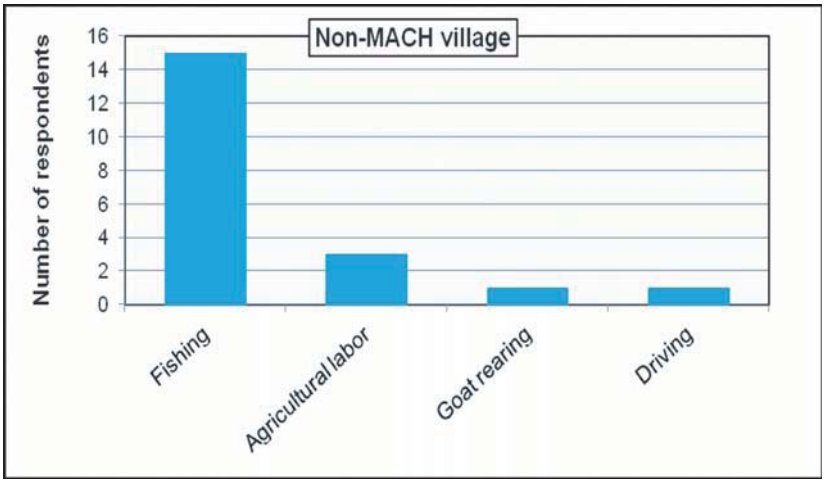

Figure 4: Present occupational status in the non-MACH village

Fish production status and biodiversity as perceived by the fishers. The fish production was figured by asking about the daily individual catch of the 40 respondents and then calculating the average to compare their daily catch with the IPAC fish catch monitoring report of 2011. According to the report (IPAC 2011), the daily fish catch by individual fishers was, on average, 2.83 kilograms per fisher per day. I found similar levels: the present fish catch in the study villages is, on average,

2.70 kilograms per fisher per day. Twenty MACH respondents (100%) and 16 non-MACH respondents (80%) expressed their opinion that the trend of fish production is increasing in comparison to previous years (Table 3). The catch per fisher per day has increased when compared with the catch reported in the 2003 MACH report. To determine the fish biodiversity status, I made a list of major fish species from the daily catch results of the 40 respondents, and from my observations of the three nearby fish markets, shown in Table 2.

Table 2: Major fish species in Baikka Beel

Sl. No.	Local Name	Scientific Name	Previous Status	Present Status
1	Ghonia	*Labeo gonius*	Endangered	Common
2	Rui	*Labeo rohita*	Common	Common
3	Catla	*Catla catla*	Common	Common
4	Mrigal	*Cirrhinus mrigala*	Common	Common
5	Calibaus	*Labeo calbasu*	Endangered	Common
6	Carpio	*Cyprinus carpio*	Common	Common
7	Koi	*Anabas testudineus*	Common	Common
8	Titputi	*Puntius ticto*	Vulnerable	Common
9	Sarpunti	*Puntius sarana*	Critically Endangered	Common
10	Shing	*Heteropneustes fossilis*	Common	Common
11	Magur	*Clarias batrachus*	Decline	Common
12	Tengra	*Mystus tengara*	Common	Common
13	Gulsha	*Mystus vittatus*	Data deficient	Common
14	Chital	*Notopterus chitala*	Not shown	Common
15	Boal	*Wallago attu*	Common	Common
16	Ayre	*Mystus aor*	Common	Common
17	Gutum	*Lepidocephalus guntea*	Common	Common
18	Tara baim	*Mastacembelus armatus*	Vulnerable	Common
19	Taki	*Channa punctatus*	Common	Common
20	Gojar	*Channa marulius*	Endangered	Common
21	Rani	*Botia dario*	Not shown	Common
22	Madhupabda	*Ompok pabda*	Endangered	Common
23	Ketchki	*Corica suborna*	Not shown	Common
24	Kanipabda	*Ompok bimaculatus*	Endangered	Common
25	Foli	*Notopterus notopterus*	Vulnerable	Common
26	Bheda	*Nandus nandus*	Vulnerable	Common
27	Kholisa	*Colisa fasciatus*	Common	Common
28	Lombachanda	*Chanda nama*	Vulnerable	Common
29	Lalkholisa	*Colisa lalia*	Common	Common
30	Kakila	*Xenentodon cancila*	Common	Common
31	Dhela	*Rohtee cotio*	Common	Common
30	Bacha	*Eutropiichthys vacha*	Critically endangered	Common
31	Bighead	*Aristichthys nobilis*	Common	Common
32	Baila	*Glossogobius giuris*	Common	Common
33	Darkina	*Esomus danricus*	Data deficient	Common
34	Shoal	*Channa striatus*	Common	Common
35	Mola	*Amblypharyngodon mola*	Common	Common

Among these species, sarpunti, ghonia, madhupabda, chital, and bheda were endangered and shoal, koi, shing, magur, ayre, and gulsha were declining before the activities of the MACH project. Now all these fish are commonly found in and around Baikka Beel. A number of activities begun by the MACH project are being done to increase fish production and biodiversity. These include: (a) habitat improvement activities such as excavation of canals to ensure fish migration and spawning; (b) establishment of fish sanctuaries; (c) restriction of illegal fishing gear by the Fish Conservation Act and promotion of use of environmentally friendly gear; (d) maintenance of closed areas (fish sanctuary zones); (e) planting of swamp trees (hijal, koroch); (f) fish fry stocking; (g) restocking of two new fish species; and (h) restoration of breeding grounds for chital fish. According to a study by the International Union for Conservation of Nature (IUCN 2000), in this area some 54 fish species are endangered, of which 12 are either critically endangered or extinct. Most of the respondents of the two villages thought that both fish production and biodiversity have increased (Table 3). According to respondents and key informants, five endangered fish species have been revived sarpunti (*Puntius sarana*), madhu pabda (*Ompok pabda*), chital (*Notopterus chitala*), bheda (*Nandus nandus*), and ghonia (*Labeo gonius*). The revival of endangered and declining fish species around Baikka Beel is due to completion of a number of habitat improvement activities, establishment of the fish sanctuary, restocking of two fish species, the use of environmentally friendly gear, and ongoing effective operation of co-management institutions. These findings support those of Azher *et al.* (2007), who investigated the impacts of sanctuary zones on fish production and fish biodiversity in Dopi Beel in Joanshahi Haor and found that the total production obtained from Dopi Beel was much higher than before the sanctuary zones were established. Fish species previously deemed as threatened were found to have reappeared in Dopi Beel.

Table 3: 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 effectively increased fish catch and improved fish biodiversity.	32 (80%)
Not effective	0 (0%)

Note: Due to multiple responses, percentages do not add up to 100%.

Conclusion

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 supporting strategies for better fisheries management. Based on the findings of this study, I believe 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, and providing funds for AIGAs are the key factors for sustainable management of Baikka Beel.

The major aim of this study was to investigate the role of co-management institutions, such as the federations of resource user groups (FRUGs) and resource management organizations (RMOs), as well as alternative income-generating activities (AIGAs) in sustainable wetland resource management, and to examine the resulting benefits for fish production and biodiversity. In my assessment of the role of co-management and the perceptions of respondents towards co-management, I found that most of the respondents of the MACH village are well informed about co-management and have a positive attitude towards sustainable wetland resources management. On the other hand, non-MACH fishers have little information on these issues and they responded less frequently about the importance of conserving wetlands. Overall, MACH village fishers were more aware and optimistic about co-management and measures for sustainable wetland resources management and biodiversity conservation than non-MACH village fishers.

In terms of the income and fishing rights of fishers, I found that the average monthly income per respondent from fishing in the MACH village is lower than in the non-MACH village, but the average monthly income per respondent from AIGA or other sources is significantly higher in the MACH village than in the non-MACH village. Furthermore, the combined average monthly income from both fishing and AIGAs or other sources is higher in the MACH village than in the non-MACH village.

Twenty respondents (100%) in the MACH village and 15 respondents (75%) in the non-MACH village said that in the rainy season, when all the beels situated around Baikka Beel are connected with each other, fishing remains open to all fishers using environmentally friendly fishing gear. However, in the dry season, when the embankment of each beel is visible, contract leaseholders occupy the leased-out beels and the fishers are usually not entitled to fish in those beels due to the terms and conditions of leasing system. During this time, fishers from the non-MACH village work as day laborers for contract leaseholders to guard and catch fish. Under this current leasing system, the fishing rights of the fishers in the study area are not well established and remain at risk. The fishing rights both of MACH and non-MACH fishers could be strengthened by changing the present leasing system and by expanding community-based management of the wetlands for sustainability.

In terms of AIGAs, I found thatin the non-MACH village 74 percent of respondents' monthly income came from fishing and 26 percent came from other sources. On the other hand, in the MACH village, 40 percent of their monthly income came from fishing and 60 percent from AIGAs or other sources. The previous main occupation of most respondents in the MACH village was fishing and at present many are involved with AIGAs. On the other hand, 20 respondents (100%) in the non-MACH village previously were and still are engaged in fishing as their main occupation.

These responses suggest that the additional income from AIGAs and others sources for respondents in the MACH village has increased their monthly income level and thereby reduced their dependence on fishing.

In terms of fish production and biodiversity, the IPAC (2011) report shows that the daily fish catch by individual fishers was, on average, 2.83 kilograms per fisher per day. My study found similar amounts, at 2.70 kilograms per fisher per day, in the area around Baikka Beel. Most respondents of the MACH and non-MACH villages expressed their perception that the trend of present fish production is increasing in comparison to previous years. Catch per fisher per day has increased when compared with the MACH (2003) report. Among the major fish species, sarpunti, ghonia, madhu pabda, chital, and bheda were endangered before the activities of the MACH project. Now these fish are available. It was found that these fish species have been revived, which could be due to the activities conducted by the MACH project to increase fish production and biodiversity.

There are differences between MACH and non-MACH fishers regarding resource use, access to AIGAs, occupational status, and attitudes towards sustainable wetland management. AIGAs appear to have considerable impact on the quality of people's livelihood and fishing practices. Based on the data I have presented in this paper, I conclude that the role of co-management institutions, including the federations of resource user groups (FRUGs) and the resource management organizations (RMOs), as well as alternative income-generating activities (AIGAs), have had a great impact on sustainable wetland resource management and fish production and biodiversity in Baikka Beel.

The results of this study suggest that, for the co-management of Baikka Beel to be further enhanced, fishers of all surrounding villages must actively participate in co-management institutions and activities. The MACH project operated in only three villages around Baikka Beel. It would be better if IPAC would begin motivational trainings and other activities like AIGAs for sustainable Baikka Beel management in all villages, because most of the fishers outside of the three MACH project villages are not very aware about co-management and sustainable wetland resource management.

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Reducing Dependence on Fisheries in the Ecologically Critical Area Bordering the Sundarbans Reserved Forest

A.S.M. Jahir Uddin Akon

Abstract

The Sundarbans is the largest single tract of mangrove forest in the world and supports diversified natural resources, including huge fishery resources.Thousands of people depend on the Sundarbans Reserved Forest (SRF) for their livelihoods, but there is a need to reduce the dependence of local communities on the forest resources. Providing alternative means of earning income could help to support the livelihoods of people currently dependent on fishing in the area, while also preserving threatened fish resources in and around protected areas.This study was conducted among fishers living in two villages located in a 10-kilometer wide Ecologically Critical Area that borders the SRF. Its goals are to (1) assess the dependence of fishers on fishing and fishing loans before and after they receive loans/grants for alternative income-generating activities (AIGAs), and (2) identify the impacts of AIGAs on fishing dependence and damaging fishing practices. I found that AIGAs have had a small but definite impact in this area, slightly reducing the surveyed households' dependence on fishing and on local moneylenders. However, the AIGAs provided thus far are insufficient; individual AIGA loans/grants should be larger and more households should have access to AIGAs.There is also a need forprograms supporting greater awareness of sustainable practices, and it is crucial that more effort be put into halting fishing with poison.

Introduction

The Sundarbans has been recognized globally for its importance as a reservoir of biodiversity. Sundarbans Reserved Forest (SRF), the largest single tract of mangrove forest in the world, supports diversified natural resources, including huge fishery resources. In 1997, for their outstanding natural value and importance as reservoirs of biodiversity, three wildlife sanctuaries in SRF known as Sundarbans West, East, and South were recognized as a world heritage site by the UNESCO World Heritage Committee (UNESCO n.d.).

The mangrove forests of the Sundarbans, and particularly these three wildlife sanctuaries, act as good nurseries and potential breeding grounds for shrimps, prawns,

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and many edible fishes.Thousands of people depend on the Sundarbans for their livelihoods. People living around the Sundarbans suffer from poverty, vulnerability to natural calamities, illiteracy, insufficient medical services, scarcity of drinking water, and limited income-generating opportunities. At the same time, they are highly dependent on fishing for their livelihoods, which contributes to high biotic pressure on the fishery resources. The local community also faces significant risks while fishing, including tigers, robbers, and natural calamities. In addition, there are financial barriers to fishing for a livelihood, as many fishers are unable to afford the necessary equipment and provisions for fishing, and thus resort to taking loans in order to fish. For all of these reasons, there is a need to reduce the dependence of local communities on fishing. Providing alternative means of earning income to members of these communities could help to support the livelihoods of people currently dependent on fishing, while also preserving threatened fish resources in and around protected areas.

Besides fishing, there is a lack of alternative economic opportunities for local communities to support their livelihoods. Other products are collected from the SRF as well, for example, by *mouwali*, who are honey collectors, and *bauwali*, who are collectors of golpata (*Nypa fruticans* palm leavesused for thatching). These activities entail many of the same problems as fishing for a livelihood. Some collecting is done legally, but there is also illegal harvesting of forest products (Zohara 2011). To address the lack of alternative income-generating activities and the high levels of dependence on the forest and the fisheries among local residents, the Bangladesh Forest Department (FD), with assistance from the United States Agency for International Development (USAID), initiated activities for co-management of natural resources in SRF through the Integrated Protected Area Co-management (IPAC) program. IPAC aims to expand local economic options by providing communities with the means for alternative income-generating activities (AIGAs), including some training and inputs such as stock for fish culture, supplies for vegetable gardening, sewing machines, and rickshaw-vans. The experience of co-management in SRF reveals that AIGAs are an effective means to reduce people's dependence on fishery resources and to enhance their livelihoods by diversifying their economic opportunities.

The present study seeks to (1) assess the dependence of fishers on fishing and fishing loans before and after they receive loans/grants for AIGAs; and (2) identify the impacts of AIGAs on fishing dependence and damaging fishing practices (especially poison fishing). This study should be useful for policy makers in government agencies and NGOs. Its goal is to provide information that will lead to policies that benefit fishermen and forest-dependent communities while promoting the sustainable management of there sources.

Background

Study Area

In accordance with the Bangladesh Environment Conservation Act (BECA) of 1995, the Department of Environment (DoE) declared nearly 40,000 hectares of Bangladesh as Ecologically Critical Areas (ECAs), where the ecosystem is considered to be threatened and in a critical state (DoE 1995). A separate 10-kilometer wide area surrounding the northern and eastern boundary of the SRF was declared an ECA with the main objective of providing protection to the SRF and conservation of its biodiversity (DoE 1995). This ECA fully covers 26 unions and partly covers 21 unions of five districts (FD 2010). This study was conducted in Chandpai Union of Bagerhat District, which is located entirely within the ECA (Figure 1).

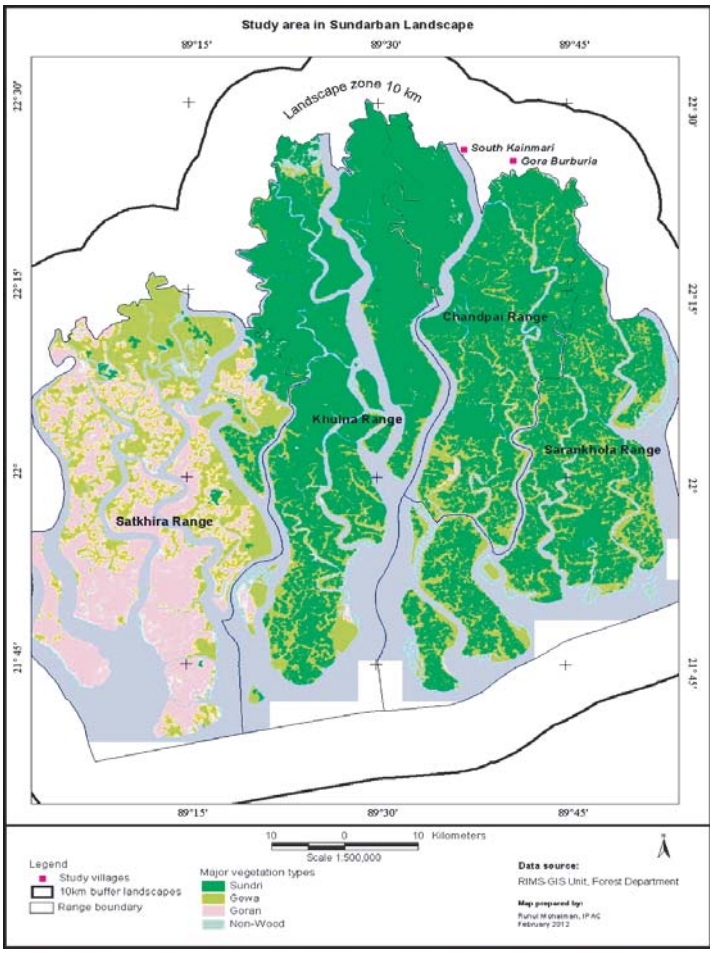


Figure 1: Map of the study area (Source: IPAC)

In the Sundarbans ECA, there are four co-management committees (CMCs), which focus on capacity building within the Sundarbans. There are about 209 village conservation forums (VCFs), which concentrate on reducing illegal activities in SRF with the help of the Forest Department, as well as on identifying the poorer members who are in need of AIGAs within these CMCs' areas. These CMCs and VCFs were formed to facilitate the participation of local people in the management of the resources. These groups provide linkages between people and government agencies and departments. There are 34 VCFs in the Chandpai CMC area, incorporating 437 households (IPAC 2011).

Farmers in the Sundarbans have converted agricultural lands into *gher* (blocks of agricultural land used for shrimp cultivation) because of the high economic returns from shrimp production. Shrimp cultivation requires farmers to use saline water, and hence these lands have now become unproductive for agricultural purposes. This alternation in the ecosystem has also reduced fish nursing areas and the movement of spawn and hatchlings. As a result, fisheries production is decreasing in the ECA.

Wetlands in the ECA include canals and river branches that are connected with the main rivers flowing through the Sundarbans. Many of the smaller canals have few connections with the larger rivers, and some have lost connectivity with larger rivers after becoming full of silt. This has caused their flow to become seasonal, with low water retention in the dry season. Upstream rivers and canals have also become full of silt, blocked, and extinct. Salinity is increasing in the area due to the reduction of freshwater flows. These changes in the wetlands have had socio-economic consequences, because with the reduction in fishing opportunities, unemployment rates have risen (FD 2010). As a result, larger numbers of local people now depend on the SRF for their livelihoods.

To reduce the dependence of the local people on the ECA of SRF for their livelihood needs, the IPAC project started to distribute AIGAs. IPAC has offered four basic types of AIGAs to encourage income-generating activities based on (1) fish culture; (2) vegetable gardening, (3) sewing machines, and (4) rickshaw-vans. However, as of June 2011, only eight percent of VCF members had received AIGA support.

Description of Fishery Resources

The Sundarbans provides a unique spawning and nursery ground for many species of marine fish and shrimp. This ecosystem supports 27 families and 53 species of pelagic fishes, 49 families and 124 species of demersal fishes, five families and 24 species of shrimps, three families and seven species of crabs, two species of gastropods, six species of pelecypods, eight species of locust lobster, and one family and three species of turtles (IUCN 1994). Despite this diversity, there has been an overall decrease in the number of fish species, and fisheries production has been reduced by 23 percent in the last 12 years (Shah *et al.* 2010).

To introduce rational harvesting of wetland resources and to improve fisheries resource conservation, the Bangladesh FD has implemented a number of fisheries management measures. These include fishing bans (implemented year round in wildlife sanctuaries, from July to August in canals, and from February to May in beels); species bans for selected fish and shellfish; limits on the size of fish that can be caught; regulation of the types of gear that can be used, with bans on some types; limits on the seasons that certain types of gear can be used; boat licenses; fishing permits; and time limits on fishing periods.

In the Sundarbans, inshore fishing is carried out using non-mechanized boats, while offshore fishing generally involves mechanized boats. Most fishers do not have enough of their own financial resources to equip themselves with fishing gear and other equipment, and thus they are heavily dependent on credit from *dadondar* (local moneylenders who charge extremely high interest rates).

Methods

I conducted this study in two villages of Chandpai Union of Bagerhat District, which is located entirely within the ECA. After holding a group discussion with CMC members, I selected the two villages, Dokkhin Kainmari and Goraburburia, for the study because most of the people living in these villages are fishers and have already received AIGAs from IPAC. IPAC provided AIGAs to these villagers based on their dependence on SRF, number of family members, and income levels. The AIGA opportunities provided included fish culture, vegetable gardening, sewing machines, and rickshaw vans. I selected 27 households to interview about their livelihoods before and after they received AIGAs (Table 1).

IPAC provided AIGA grants to support fish culture (valued at BDT 2,200 per participant) consisting of fish feed and 10 kilograms of calcium carbonate for refreshing the ponds. Among my respondents, 12 households in Goraburburia and 10 in Dokkhin Kainmari were provided with AIGAs for fish culture. IPAC provided grants/loans for vegetable gardening (valued at BDT 500 per participant) consisting of vegetable seeds, fertilizer, and protecting nets to cover the crops. As these grants were made in May 2009, I was only able to interview one of these households.

Table 1: Categories of AIGAs

Category	Goraburburia			Dokkhin Kainmari		
	Total AIGAs	Surveyed AIGAs	% of surveyed AIGAs	Total AIGAs	Surveyed AIGAs	% of surveyed AIGAs
Fish culture	23	12	52%	82	10	12%
Vegetable	13	1	8%	8	0	0
gardening						
Rickshaw-van	1	1	100%	2	1	50%
Sewing machine	0	0	0	3	2	67%
Total	37	14	38%	95	13	14%

I randomly chose participants from different age groups. The number and percentage of respondents per age group was 21–30 (2, 5%), 31–40 (13, 32%), 41–50 (8, 28%), 51–60 (12, 20%) and 61–70 (6, 15%). Interviews were conducted using a prepared questionnaire.

I began my work by collecting secondary data from various literature, reports, and records. I then collected primary data using a structured household survey to estimate how dependent people are on fishing. The survey included questions on various demographic and socio-economic parameters such as occupation, credit availability, and others opportunities. I compared statistics between the AIGA and non-AIGA households. The numbers and percentages of surveyed households are shown in Table 2.

Table 2: Households surveyed within the study villages

Name of Village	No. of VCFs	Received AIGA	
		Total Households	Surveyed Households
DokkhinKainmari	1	82	17 (21%)
Goraburburia	1	23	10 (43%)

I also conducted two focus group discussions. The first was with four representatives of the co-management committee (CMC) and the second was with five local officers from the FD (a range officer, a deputy ranger, a forester, a forest guard, and a boat man). I asked the focus group discussion participants about the present status of fishing and any changes in peoples' livelihoods or the environment since the implementation of AIGA activities in the study area.

Results and Discussion

Many of the households in the study area are dependent on fishing activities in the ECA of SRF. These households have already turned their paddy lands into gher for shrimp farming by keeping them continuously inundated with salt water. As a result, crop production has been reduced. Because shrimp culture is less labor intensive than agriculture, employment opportunities have also decreased. With the gradual extension of shrimp fields and their expansion into homestead areas, grazing grounds for cattle are fast diminishing and fresh water for stock feeding and domestic consumption is becoming scarce. As they have no legal alternative sources of food and income, people go into the SRF for subsistence and small-scale commercial fishing.

To address the high dependence on fishing in the SRF, IPAC began distributing AIGAs to the VCF participants in May 26, 2009. The study period was in the summer of 2011. Hence, it is too early to definitively assess how these benefits affect people's fishing dependence. Nevertheless, although it is a slow process, I found that people who received AIGAs were doing better in both of the two study villages. I observed that fish cultivation is one of the most successful AIGAs. Most participants derive a good income from this type of AIGA. Before the introduction of this activity, most of their ponds were fallow and they did not use them for fish cultivation.

Vegetable gardening is another AIGA supported by IPAC. The individuals involved in this activity have developed and improved their livelihoods by a small amount. They attempt to grow different types of vegetables year round. They have earned some returns from their AIGAs, but they do not have much capital for continuing their vegetable gardening. They generally spend everything they earn from vegetables to meet their daily needs. A member of one AIGA household in Goraburburia earned BDT 8,000 last year from selling vegetables raised on his land. He is continuing his efforts this year and expects to earn a good income from selling his products. Because most cultivable land has been converted into gher for shrimp cultivation, little land is available for cultivating gardens. Consequently, people living in this area are bound to import vegetables from nearby districts.

Rickshaw-vans and sewing machines are the other two types of AIGAs. These two options were started in the middle of 2011. One of the participants I interviewed now drives a rickshaw-van in Dokkhin Kainmari. Previously, he fished all year round but now he has decided not to fish. He earns approximately BDT 300 daily from driving his rickshaw. This has changed his livelihood. Many VCF families are interested in these kinds of activities. The IPAC program included three months of training for these activities. If IPAC could give more support to sewing machine and rickshaw-van owners by providing them proper training, these VCF members would be greatly benefitted.

Considering that 207 VCF members are completely dependent on the Sundarbans for fishing, the amount of AIGAs is insufficient. As of August 2011, 145 of the 207 VCF members (70%) in Chandpai ECA had received AIGAs. About two thirds of the VCF members have received AIGA grants worth BDT 3,000 to 4,000 per member.

Impacts of AIGAs on Fishers' Socio-economic Status in SRF

According to the socio-economic data that I collected, in terms of age groups, the largest group of fishers who took part in the study are between 31 and 40 years of age (32%). About 80 percent of the fishers have received some education (ranging from the first year to completion of secondary school), but about 27 percent of fishers can only sign their names. Rabbani and Sarker (1997) reported that 22 percent of the fishers in SRF can write their names and only 16 percent can read and write. The present study also asked the fishers' households about their family sizeduring and after the AIGA period, and found no significant change, with only a minor increase after AIGAs were introduced. In terms of the quality of the fishers' homes, the study found that only 7 percent of the households had electricity before the AIGAs, and 11 percent had electricity after AIGAs were introduced. Forty-four percent of the houses had tin roofs and 56 percent had golpata roofs. Forty-two percentof the houses were made of wood, and 93 percent of them had earthen floors.

Impacts of AIGAs on Fishers' Dependence on Fishing and Fishing Loans

The first goal of this study was to assess the dependence of fishers on fishing and fishing loans before and after the AIGAs. My study reveals that about 48 percent of the fishers were fully dependent on fishing-related activities for their livelihood, meaning that they spent 10 to 12 months per year fishing, before they received AIGAs. This was reduced to 44 percent after the AIGAs. About 37 percent of the fishers surveyed were partially dependent (spending four to six months per year) on fishing before they received AIGAs, and this was reduced to 26 percent after the AIGAs. Table 3 presents the surveyed households' level of dependence, in terms of months per year, on fishing-related activities before and after the AIGAs.

Table 3: Fishing dependence before and after AIGAs

Dependence (months per year)	Dependence before AIGAs	Dependence after AIGAs
1–3	4% (*n*=1)	15% (*n*=4)
4–6	37% (*n*=10)	26% (*n*=7)
7–9	11% (*n*=3)	15% (*n*=4)
10–12	48% (*n*=13)	44% (*n*=12)

The results of the surveys presented in Table 4 suggest that AIGAs had a minor impact on fishing activities in the wetlands. Fishers collected slightly less post larvae fish (5 to 25 days after hatching), crabs, hilsa (*Hilsa ilisha*), and other fish after they received AIGAs than they did before. The AIGAs, however, did increase fishers' dependence on non-fishing activities. The information shown in Table 4 suggests that hilsa fishing decreased and fishers invested more time in activities like growing fish in private ponds. Because hilsa fishing is offshore fishing, changing this type of activity will reduce the dependence of fishers on SRF.

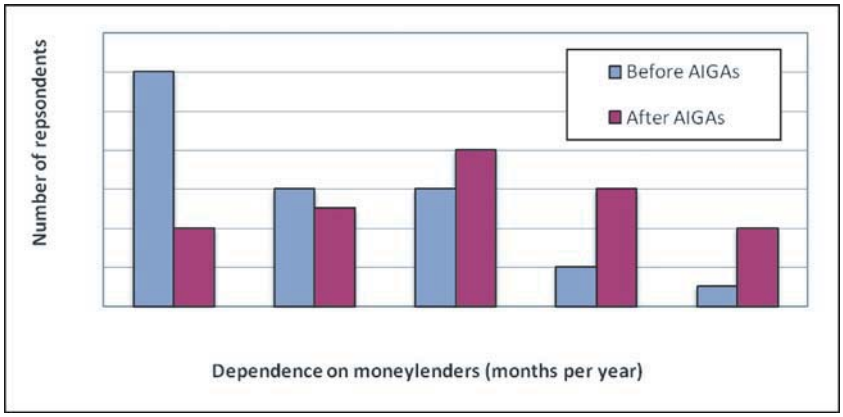
Table 4: Proportion of income from fishing vs. non-fishing activities (before/after)

Types of activity	Activities	Before AIGAs (no. of HH)	After AIGAs (no. of HH)	Percentage change
Fishing types	Post larvaefish collection	22	21	-4.5%
	Crab collection	11	12	9.1%
	Hilsa fishing	12	10	-16.7%
	Other fishing	21	20	-4.8%
Non-fishing types	Livestock	1	1	0.0%
	Poultry	7	5	-28.6%
	Fish culture	2	6	200.0%
	Van pulling	0	1	0.0%
	Daily labor	5	3	-40.0%
	Small trade	1	2	100.0%
	Others	10	7	-30.0%

Although there are policies and programs for making credit support to poor and marginal fishers available from formal financial institutions, most fishers do not benefit from these programs. Most fishers borrow money from local moneylenders instead of using formal loan facilities from scheduled banks. An absence of collateral, too-small loans, poor communication networks, a fixed monthly repayment system, and poor repayment rates are the major constraints for the provision of credit by scheduled banks. So the fishers have to take loans from local moneylenders to equip themselves with the gear that they needin order to fish. These loans come with high interest rates.

In the two study villages, Goraburburia and Kainmari of Bagerhat District, I found that 96 percent of the fishers had taken loans from local moneylenders before receiving AIGAs, while 85 percent had taken such loans after. The study found that AIGA households reduced their dependence on loans from informal moneylenders after they received AIGA support (Figure 2). The study also showed that fishers do not get fair prices for their fish.

Figure 2: Fishers' dependence on moneylenders before and after AIGAs



Impacts of AIGAs on Fishing Dependence and Damaging Fishing Practices

The second goal of this study was to identify the impacts of AIGAs on fishing dependence and damaging fishing practices in particular, using poison to catch fish.

My study revealed that in Chandpai ECA there are full-time fishers who depend on fishing for their livelihoods for more than 10 months per year. The other fishers depend on fishing for nine or fewer months per year and are engaged in other activities for the rest of the year. In terms of the impacts of AIGAs on fishing, my key informants told me that, nowadays, due to the reduction of fishes in the SRF, some dishonest fishers try to catch fish by pouring poison into the water, which is aquick way to kill a lot of fish at one time. By using poison in the water, however, they also kill the hatchlings of many fish species and the zooplankton, which is the most important food of fish and other marine creatures. My key informants also informed me that the size of the AIGA grants is insufficient to change their livelihoods; they are not large enough for them to develop alternative income-generating activities that would meet the needs of their families. For example, while the fish culture AIGA grants help them to increase their incomes, they still need to fish. Nevertheless, my study suggests that people are fishing less today than in the past. The other AIGAs implemented by IPAC in this area vegetable gardening, rickshaw-van pulling, and using sewing machines may have a greater impact on fishing in that they have the potential to change the professions of households so that they would stop catching fish in the SRF.

In terms of damaging fishing practices, my key informant interviews suggest that CMC meetings are increasing fishers' awareness of the damage caused by poisoning fish. The study also reveals that while legal instruments exist to stop fish poisoning,

the Forest Department and other agencies lack the capacity to stop fishers from using poison. However, building fishers' awareness through CMC meetings and better enforcing bans on using poison to kill fishshould lead to a gradual decrease in this damaging practice.

Factors Influencing Fishing

From the interviews with key informants, I learned that in the study area people fish because they have no alternative sources of income to meet the requirements of their families. Because fishing requires less labor and investment, because fishers have easy access to SRF for fishing, and because demand exists in the markets for fish, most people do not think of trying other income-generating activities. Furthermore, fishing is their traditional profession, which they inherited from their grandfathers, and they are habituated to this profession. The additional fact that these fishers are very poor means that they must take loans to meet their daily needs; they incur a great obligation to repay the loans, and then they must fish to repay the loans, going deeper into debt with the moneylenders in order to have the funds necessary to fish. All of these reasons combine to trap people in the fishing profession.

Conclusion

In conclusion, I would like to make three suggestions. First, the AIGAs that are provided by government organizations or NGOs with the goal of changing fishers' livelihoods must be larger and distributed more widely if they are to be sufficient for supporting such change. Second, there must be a greater emphasis on awareness programs in the ECA of the SRF, to increase the local residents' knowledge and understanding of sustainable practices. Third, it is crucial that more effort be put into halting fish poisoning; the Forest Department must receive more support so that it is able to enforce the ban on using poison to catch fish. These suggestions, if followed, will help fishers living in the SRF ECA to reducetheir dependence on fishing, as well as preserving threatened fish resources in and around the protected areas.

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Impact of Community-based Natural Resources Management and Co-management on the Livelihoods of People in the Hakaluki Haor Area

Mohammed Solaiman Haider

Abstract

Hakaluki Haor is one of the most important wetlands in Bangladesh in terms of the goods and services it provides, not only to local communities living in the surrounding areas and to the broader region, but also as a precious ecosystem with global significance for biodiversity conservation, since various migratory birds visit the wetland each year. Past management initiatives to conserve the wetland natural resources undertaken by the Government of Bangladesh in collaboration with national and international NGOs and other partners have had some positive impacts for both the community and the ecosystem. Nevertheless, there is much yet to do to ensure the integrated and comprehensive management of the dwindling wetlands. This case study intends to assess the major problems or vulnerabilities of the ecosystem posed by man-made interventions, as well as the impacts of community-based natural resources management and co-management on the livelihoods of people depending on these wetlands. A survey was conducted among 20 households to assess current problems and potential solutions. A focus group discussion and a consultation with the representatives of various stakeholders, including local NGO workers and government officials, were also undertaken. The survey responses were analyzed to assess perceptions of community-based natural resources management and co-management among the households, prevailing problems, and the impacts of the projects on the livelihoods of the households. It is evident that initiatives like alternative income-generating activities have had positive impacts on the livelihoods of the community. These findings suggest that an integrated development approach under co-management should be continued to help ensure the long-term sustainability of the wetland ecosystem and to harness benefits for the local community.

Introduction

Co-management requires two or more social actors to negotiate, define, and guarantee among themselves a fair sharing of the management functions, entitlements, and responsibilities for a given territory, area, or set of natural resources (Borrini-Feyerabend *et al.* 2007). Strengthening community-based natural resource

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management or co-management is considered to be one of the best options to conserve wetland ecosystems and their associated goods and services. Several biologically significant wetlands have been designated as Ramsar Sites and/or declared Ecologically Critical Areas (ECAs) by the Government of Bangladesh. The Government of Bangladesh in collaboration with NGOs and local communities has introduced various management initiatives in the Hakaluki Haor ECA under various development projects. Although these projects have all endeavored to implement and uphold community-based natural resources management or co-management, some issues and concerns remain, including gaps between the stated objectives and the reality of co-management.

Village conservation groups (VCGs) constituted through one of the already implemented projects and who are dependent on wetland resources often cannot play an effective role in managing these resources, because the wetlands are leased to influential or elite individuals, or because VCG members possess inadequate knowledge and know-how. For example, some VCGs have insufficient capacity to manage fish sanctuaries and swamp forests, or lack of incentives for conservation. Those who are not members of the conservation groups are not engaged in alternative income generation activities. Furthermore, a lack of coordination among ministries and field-level officials, as well as communication problems between NGOs and government field-level officials, hampers the implementation of co-management programs. In terms of interventions led by government and NGOs to engage communities in natural resource management, there is a need to re-examine the lessons that have been learnt on a case-by-case basis to ensure the long-term sustainability of the ecosystem and its ability to provide optimum goods and services for the community surrounding Hakaluki Haor.

This research aims to identify the major issues faced by people living in the Hakaluki Haor area, and the solutions those residents have suggested for resolving these issues. This inventory of problems and possible solutions may help to improve the decision-making process and the implementation of ongoing or upcoming project activities. The specific objectives of the study are threefold:

- To assess the impacts of community-based natural resources management initiatives and co-management programs on the livelihoods of people living in the study villages of Hakaluki;
- To identify major problems faced by people living in the Hakaluki Haor area; and
- To identify solutions suggested by the local people for resolving these problems.

The findings of this study could be useful to project managers, diverse users, and other stakeholders of wetland resources, including fisherfolk, farmers, NGOs, and concerned government bodies like the Ministries of Land and of Environment and Forests, the Department of Environment, the Department of Fisheries, and the local district and upazila administrations.

Background

The wetlands of Bangladesh are rich reservoirs of biodiversity and natural resources upon which local communities depend for their livelihoods. They are comprised of both *haors* (seasonal water bodies formed during the monsoon) and *beels* (low-lying depressions of the haor system retaining water even during dry months).

Fish from wetlands provide about 80 percent of the country's dietary protein, and food, fuel, fiber, fodder, and building materials are also harvested from wetlands (SEMP 2005). Wetlands provide water for irrigation and domestic use, and act as winter habitat for a rich variety of resident and migratory waterfowl. The economic uses of the wetlands include growing flood-tolerant rice varieties, collecting mollusks, planting vegetable gardens, and rearing fish, ducks, and livestock. Fodder for cattle and dried weeds for fuel are also collected from these wetlands. Furthermore, healthy wetland ecosystems act as a buffer for floods and help to reduce the vulnerability of local communities to droughts.

The wetlands of Bangladesh are being degraded rapidly due to pressures from the population for irrigation, fish, fuelwood, and large-scale habitat conversion for farming. In some places, wetland degradation has arisen from the neglect of waterways that eventually become impassable due to sedimentation. Such sedimentation also fragments water bodies and disrupts the local ecology through disconnecting the fish migration routes, preventing the completion of breeding cycles and resulting in declining fish populations. Historical systems of wetland utilization encouraged maximum exploitation of fisheries and other aquatic resources, as well as the marginalization of local communities. Both community-based natural resource management and the co-management of these resources have strong potential to promote their sustainable use through the active engagement of all stakeholders.

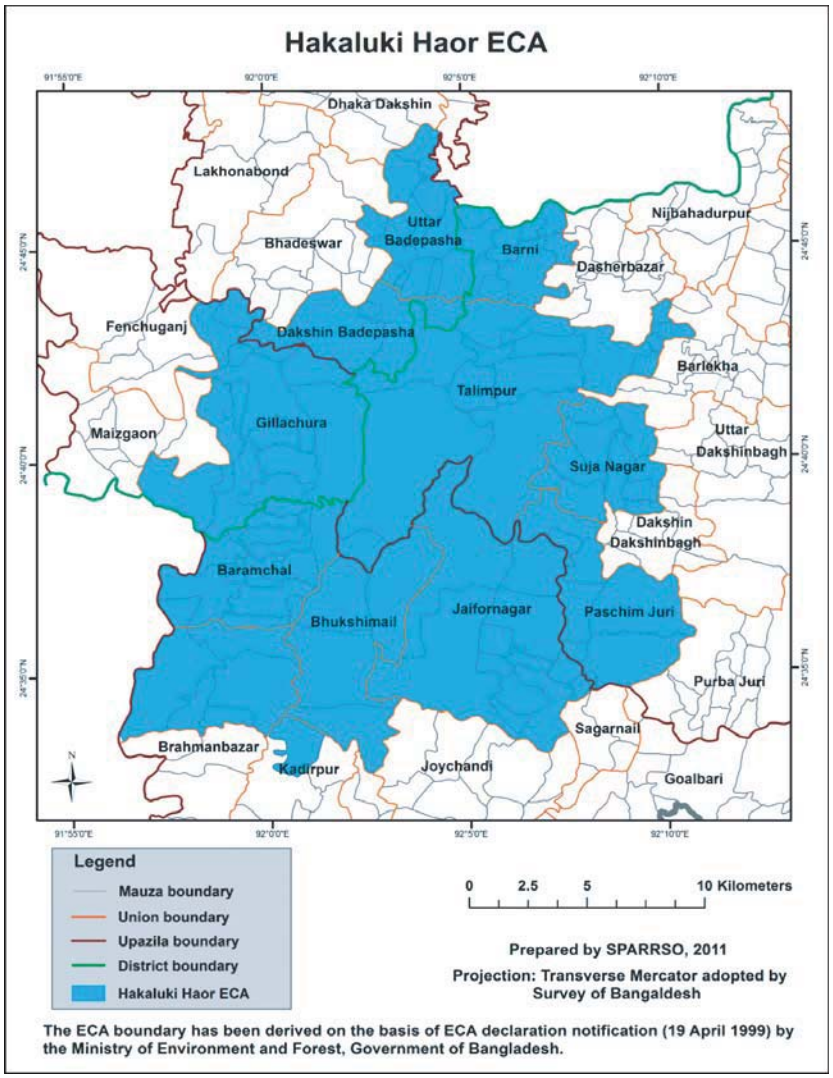

Figure 1: Hakaluki Haor in Sylhet and Moulvibazar Districts (unpublished map produced for the Department of Environment by the Space Research and Remote Sensing Organization of Bangladesh)

Hakaluki Haor, located in the greater Sylhet division of Bangladesh, represents a complex wetland system having beels in a shallow basin formed between the Patharia and Madhab Hills to the east and the Bhatera Hills to the west (Figure 1). The area was once known as the "fish mine" of the country and the haor was declared an Ecologically Critical Area by the Government of Bangladesh in 1999. Hakaluki Haor supports a rich biodiversity of fish, animals, and plants that provide direct and indirect

benefits to local communities. Beels in Hakaluki Haor provide shelter for fish during the dry winter months, and in the early monsoon these fish produce millions of spawn for the entire downstream fishing community. The main fish species of the haor include kalibaus, boal, rui, ghagot, pabda, and chapila.

Hakaluki Haor contains 276 interconnecting beels (CWBMP 2005) (Table 1). The most important beels are Chatla, Pinlarkona, Dulla, Sakua, Barajalla, Pioula, Balijhuri, Lamba, Tekonia, Haor-Khal, Tural, Baghalkuri, Bala Gojua, Polovanga, and Chinaura (MoEF 2006).

Table 1: Hakaluki Haor at a glance

Division	Sylhet
Districts	Sylhet, Moulvibazar
Upazilas	Fenchuganj, Golapganj, Kulaura, Juri, and Barolekha
Boundary of Upazila	Golapganj (north), Kulaura (south), Juri and Barolekha (east), Fenchuganj (west), and some parts of Kulaura
Unions	11 in number
Area in wet season	Over 18,000 hectares
Beels	276 in total, covering 4,925 hectares in area
Rivers	1760.3 hectares (average) (Juri, Sonai Bardhal, and Kushiyara rivers)
Total fish species (historical)	107 (of this total, there are 32 species threatened nationally, 12 vulnerable, 16 endangered, 4 critically endangered)

(Source: CWBMP 2006)

Some 200,000 people live in the area surrounding Hakaluki Haor (Rana *et al.* 2009). The two main sources of livelihood support for these people are fishing and agriculture. Depending on how water levels are controlled, tensions arise over the areas available for fishing versus those available for agricultural production. An important task facing wetland managers is thus to find equitable ways to achieve balance between these often competing forms of production.

Wetland forested areas have become rare due to clearing, cutting, and burning. Reed beds have been severely reduced due to exploitation for fuel and thatch, and the conversion of marginal wetlands for agriculture. Certain species of aquatic plants have become very rare or disappeared altogether due to a combination of the over-utilization of useful species and changes in water quality. Furthermore, many species of fish, amphibians, reptiles, and mammals have become rare or disappeared due to overfishing and habitat destruction. Human activities that affect the fauna, such as collecting and hunting them for food (e.g. frogs and turtles), persecuting them as pests (e.g. wild boars, otters), and incidental poisoning from use of pesticides (e.g. frogs and fishes) also add to the decline of wetland species and the disruption of the local ecology.

The banks of the beels (*kanda*) are habitat for various animals and birds but used for multiple purposes by the local people. During the dry season, these are the grasslands used for grazing cattle, whereas during the monsoon season the reeds provide shelter and food to young fish, thus increasing fisheries output. Kandas are used to produce goods and services other than fish and rice in the haor area. They are usually utilized by farmers if irrigation facilities are made available and if embankments can be erected for expanding *boro* (dry season rice) cultivation. Kandas are also used for cattle grazing, duck rearing, collection of fuelwood, food, and medicinal plants, and other goods and services. The kandas are losing ecological integrity due to overgrazing or over-utilization by ranching of cattle.

The main occupations of the people of this area are fishing and agriculture. A total of about 14,000 hectares of land in Hakaluki Haor is under boro cultivation, which depends on irrigation facilities, labor supply, and soil quality, and is vulnerable to flash floods during early monsoon months. The poorer sections of the community, who do not have land, subsist largely on fishing in the haor. Women take part in repairing nets and drying fish during the monsoon and post-monsoon seasons.

Various governmental and non-governmental initiatives have been undertaken during the last two decades to promote sustainable management, community-based natural resources management, and co-management in the haor. Some of the major initiatives include:

- Community Based Haor and Floodplain Resource Management project: Undertaken by the International Union for Conservation of Nature (IUCN) Bangladesh Country Office as a component of the Sustainable Environmental Management Program (SEMP) of the Government of Bangladesh, and implemented by the Ministry of Environment and Forests (MoEF).

- Coastal and Wetland Biodiversity Management Project (CWBMP): Initiated by the Department of Environment (DoE) in 2002, with technical and financial support from the Global Environment Facility (GEF). CWBMP, completed in June 2011, implemented a number of activities for the conservation of natural resources of Hakaluki Haor by local communities.

- Integrated Protected Area Co-management (IPAC) project: Implemented by the Government of Bangladesh with financial and technical assistance from the United States Agency for International Development (USAID). The project seeks to ensure the continuation of CWBMP and community engagement with conservation and the sustainable use of globally significant wetland biodiversity.

- Biodiversity Conservation and Social Protection (CBAECA) project: Developed by the Department of Environment under the Ministry of Environment and Forests. The project aimed to foster community-based adaptation in ECAs though the participation of local communities.

- Vulnerability and Impact Assessment and Ecosystem-based Adaptation (VIA and EbA) case study in the Hakaluki Haor undertaken as part of the development of the study report on Bangladesh Environment and Climate Change Outlook (ECCO): Implemented by the Department of Environment with the technical assistance of the United Nations Environment Programme (UNEP).

These projects were implemented little by little, and have not considered how to involve the whole wetlands ecosystem or whole community in conservation activities. Therefore, there are still gaps to be filled in order to ensure the sustainability of the efforts as well as the ecosystem goods and services.

Methods

This study seeks to identify both the problems faced by the people living in Hakaluki Haor and possible solutions for enhancing community-based natural resources management and co-management initiatives undertaken by the government. I began my study by conducting a literature review on Hakaluki Haor, with special reference to documents on community-based natural resource management projects, activities, and co-management policies programs being implemented by the government and NGOs. I looked primarily at the accomplishments of the projects so far in terms of livelihood improvements and the establishment of sanctuaries and swamp forests. I also referred to socio-economic baseline information from the SEMP, CWBMP, IPAC, and CBAECA projects. I collected data from the Bangladesh Bureau of Statistics including information on economic activities, main sources of income, impacts of co-management initiatives on livelihoods, threats or vulnerabilities to livelihoods and ecosystem goods and services, and suggestions for enhancing the co-management of natural resources and the conservation of biodiversity.

I developed a structured questionnaire to utilize in interviews with households and key informants. I led focus group discussions with VCGs and attended a consultation workshop with staff members from government and non-government organizations, and with representatives of the VCGs (Figure 2). I collected information on the perceived benefits and outcomes of community-based natural resource management and co-management programs by asking whether respondents felt these newer management interventions had changed household income levels, provided alternative income-generating activities, affected the involvement of village conservation groups in resources management, resulted in success stories and/or management bottlenecks, and whether they had any suggestions for improving co-management practices.

I conducted a survey of 20 households from a total of seven villages bordering Hakaluki Haor: Shadipur (five households), Barogaon (four households), Mirshonkor (one household), and Bhrommateka (one household) in Kulaura Upazila of Moulvibazar District; and Judisthipur (three households), Badedeuli (two households) and Ashighor (four households) in Fenchuganj Upazila of Sylhet District. All of these villages have village conservation groups. Moreover, the IPAC project introduced co-management activities in Baia Gojua Beel through the involvement of Judisthipur-Badedeuli and Ekota Bahumukhi Somobay Samity in Kalimpur Union of Barolekha Upazila of Moulvibazar District. The government has declared these beels fish sanctuaries. The IPAC project has started implementing co-management activities in these areas of Hakaluki Haor.

I also conducted qualitative analysis of FGD perceptions on income levels, AIG activities, suggestions to improve co-management, and adaptive activities to address or cope with climate change impacts, success stories, and bottlenecks to achieving project initiatives.

Results and Discussion

Household Interviews

I interviewed 20 respondents in seven villages of Kulaura and Fenchuganj Upazilas of Moulvibazar and Sylhet Districts. In terms of involvement in co-management activities, 10 respondents (50%) were members of a village conservation group (VCG), while the other 10 were not VCG members. Five (50%) of the 10 respondents who did not belong to a VCG had heard of co-management initiatives, but the other five (50%) were not familiar with these projects. In terms of livelihoods, nine of the 20 respondents (45%) were engaged in agriculture or related activities; seven (35%) were involved in fishing or related activities; three (15%) operated small businesses (grocer, carpenter, day laborer); and one (5%) was an electrician. Thirteen respondents (65%) reported that smaller amounts of fish are being caught because of seasonal aberrations or the late arrival of the monsoon; and eight respondents (40%) reported lower crop yields because of erratic rainfall and unpredictable seasonal weather patterns.

The respondents described differences in their income-generating activities and the amount of their incomes before and after the AIGA was initiated. AIGA activities are small business, duck rearing, cow rearing, agriculture-equipment rent fish trading etc. Among the 10 respondents who were VCG members, eight (80%) reported their income levels had increased under co-management AIGA grants, and the other two respondents (20%), who did not receive AIGA grants, reported no change in their income levels. This suggests that VCG members' incomes increased due to their participation in co-management initiatives. In addition, I concluded from the household surveys and the key informant interviews that respondents who were not VCG members were less informed and/or less encouraged about the benefits of co-management. Respondents also offered suggestions for strengthening development through co-management activities. Twelve respondents (60%) emphasized the need for developing fish sanctuaries and restoring fish habitats through excavation or re-excavation of important beels, canals, and rivers to enhance fish production, drainage, water retention, and in-situ conservation; 10 respondents (50%) recommended changing cultivation practices to include varieties more tolerant of floods and other climatic stresses like drought; three respondents (15%) said that streams should be excavated for draining flash floods; establishment of a swamp tree plantation, adoption of flood and drought tolerant crops, and non-agricultural AIGAs like pulling rickshaw-vans and operating sewing machines were each suggested by two respondents (10%); and several other activities were suggested by one respondent each. These findings are presented in Table 2.

Table 2: Activities suggested by the household respondents for strengthening co-management initiatives

Suggested activities	Number of respondents
Fish sanctuary development	12
Crop variety change	10
Excavation of streams for draining flash floods	3
Swamp tree plantations	2
Improvement of indigenous agricultural crops for flood and drought tolerance	2
Non-agricultural income-generating activities	2
Bird sanctuary development	2
Management of haor resources under VCG	1
Release of fish fingerlings in water bodies	1
Embankment construction	1
Improvement of irrigation systems	1
Fishing restrictions during breeding period	1
Swamp forest protection and restrictions	1
Adopting short-duration varieties for boro (dry season rice cultivation)	1
Agricultural income-generating activities	1
Construction of deep tube well to expedite irrigation	1
Restoration of fish habitat	1
Deployment of full time conservation guard for the protection of haor resources	1

Focus Group Discussions and Interviews with Key Informants and Stakeholders

I conducted a focus group discussion (FGD) on October 3, 2012, with 20 VCG representatives, along with local NGO workers, in Ashighor village. I also held a consultation at Kulaura Thana on February 2, 2012, with 25 representatives, including the VCG chair and government and NGO representatives working in the area. Based on these discussions, I concluded that the wetlands of Hakaluki Haor are under tremendous pressure from various natural and man-made causes that need immediate and urgent attention; in some cases long-term action is required. Focus group discussants outlined a number of problems, which I discuss below.

Major Problems Identified

Sedimentation or silting up of the beels. Erosion in upstream areas is increasing due to destruction of vegetation and stone extraction on the river banks. The destruction of forests and the excavation of hills for various development purposes, such as mining, quarrying, and construction is accelerating the sedimentation process.

sand and silt flowing into the beels through some of the rivers and canals during the monsoon season reduce the productivity of the beels. Paddy land is also threatened by sand deposits coming through the rivers. Water flow has been reduced in the streams as their beds have risen, and this has led to degraded fish habitat and reduced fisheries production.

Reduction in fish catch and diversity. All of the lease owners with rights to catch fish from specified areas are, in most cases, violating the terms and conditions of their leases and causing loss of fish species and abundance due to over-exploitation. Informants reported that reduction in fish catch and diversity are caused by lease owners using destructive gear (small mesh-size), draining beels to maximize fish catch, fishing during the breeding season, and poisoning fish using an herbal extract (bishlata), as well as by the run-off of herbicides and pesticides from nearby tea gardens or agricultural lands and by the release of pollutants from urea-fertilizer factories upstream. Beel lease owners using improper fishing techniques thus destroy present as well as future stocks of fish, fry, and eggs. Respondents felt that not enough area has been set aside under fish sanctuaries for conserving brood fisheries, a step that is essential to increase production and conserve fish diversity.

Limited availability of fishing grounds and increased cost of catching fish. Population pressure, unemployment, and lack of alternative livelihood choices put tremendous pressure on fisheries resources. The government's practice of leasing beels to investors restricts access to common fishing grounds for poor and marginal fishermen and grants access to these resources to richer members of society. The destruction of beel vegetation destroys food sources and habitats for fish species. During the breeding season, fishing is restricted in sanctuaries, but marginal fishermen have no capital for pursuing other work or alternative choices for their livelihoods. Consequently some fishers engage in illegal fishing.

Environmental factors affecting the ecosystem. Respondents have reported climatic changes, including a later monsoon season, which affect the mating and spawning of fish and thus result in reduced fish abundance; more frequent flash floods, which place boro crops at risk; and a trend of higher temperatures.

Destruction of important habitats (swamp forests and kanda). Residents also noted that swamp forests that had once been abundant in Hakaluki Haor are now reduced to remnants due to the *bathan* grazing of domestic animals (ranching of cattle, mainly cows and buffalos, during the dry season) and the use of swamp plants as fuelwood (Figure 3). The main species found in these remnants include hijol (*Barringtonia acutangula*), koroch (*Pongamia pinnata*), and barun (*Crataeva nurvala*). These remnants are under pressure and are becoming sparse due to conversion to agricultural land, grazing, and felling. Therefore, respondents identified swamp forest restoration as one of the most important activities for sustainable development and management of the wetland ecosystem.

Further, the kandas, which provide habitat for wildlife and birds, are also threatened by degradation because of overgrazing by cattle and buffalo.

Figure 3: Hakaluki Haor with swamp forest (picture taken October 3, 2011)

Agriculture-related problems. Respondents reported that the lack of available land for cultivation is a problem for crop production to maintain a growing population, and there is frequent partitioning of land into small pieces and an excessive use of fertilizer and chemicals to produce higher yields. They reported that the water-retention capacity of soil has decreased while the invasion of insect pests has increased. Other problems include the lack of water and insufficient technological support for irrigation.

Possible Solutions

While the FGD participants, interviewees, key informants, and stakeholders identified an extensive number of problems facing Hakaluki Hoar and its inhabitants, they also suggested some possible activities to solve or mitigate these problems. I discuss these below.

The FGD participants and interviewees suggested that sediment control is a major issue, both for fishers and for rice producers. As a result, any effort to improve people's livelihoods in Hakaluki Haor will require a well-designed policy for controlling silt deposits in beels and paddies. In general, people suggested the periodic excavation of the beels and streams and the construction of embankments in suitable places to increase water retention capacity in the beels.

Boro crops are often threatened by early monsoon flash floods. Focus group discussants and key informants reported that the probability of crop damage is very

high in the haor basin. Consequently, it was suggested that embankments be constructed so that rice could be salvaged from the onslaught of early monsoon floods. Although popular, this proposition runs counter to environmental interests for two reasons. First, such embankments would lead to the expansion of boro (irrigated paddy) land and thus to a reduction of dryland habitat for wildlife. Second, it might prevent fish migration during crucial periods of fish movement and could reduce fish stocks.

Fishing is the life-blood of the people living in haor areas. The FGDs and stakeholder consultations suggest that fisherfolk are quite aware of the consequences of overfishing, but due to the leasing of major beels, there is growing pressure on the stock of fish in the remaining unleased wetlands. In recent years, pressure on the fisheries has grown more intense because some leaseholders drain their beels in order to catch fish. As a result, the entire fish stock is being depleted. It was also clear from the interviews and focus group discussions that there is popular support for the establishment of sanctuaries in various parts of the haor.

The swamp forests in the haor basin are unique forests that survive deep flooding during the monsoon months. However, due to human pressure these forests are virtually non-existent today. As a result, poor people suffer the most. The ecology also suffers as fish stocks decline and erosion occurs. Focus group discussants and stakeholders also requested assistance with reforestation programs. This is also a pro-poor issue because much of the benefits from such programs would, if designed properly, accrue to poor people in the haor area who would collect fuelwood, construction materials, and medicinal herbs from these new plantations. Some of the various respondents' specific suggestions for improving management of the wetland resources in the Hakaluki Haor region are included in Box 1.

Box 1: Suggestions for improving resource management in Hakaluki Haor

- Stop upstream excavation of hills, deforestation, dam construction, and unsustainable stone quarrying.
- Construct embankments or raise the level of the banks of large beels to retain water in the dry season and protect some areas from flash floods. This kind of development should be undertaken with prior hydrological surveys and environmental impact assessment.
- Dredge or excavate silted-up beels, to ensure restoration of fish habitat.
- Carry out afforestation or reforestation activities on the banks of beels to restore the habitat of avi-fauna.
- Declare and manage beels that have high potential for fish reproduction or migratory waterfowl habitat as sanctuaries.
- Deploy guards to protect sanctuaries and migratory waterfowl.
- Protect coppices of swamp vegetation through the active participation of communities.

Box 1: Suggestions for improving resource management in Hakaluki Haor

- Designate grazing areas to protect swamp vegetation from overgrazing by livestock.
- Stop leasing of the beels to promote the long-term sustainability of the ecosystem and broader benefits for the local community.
- Designate some beels for fish harvesting to provide a source of income for the local community for the conservation and maintenance of the sanctuary, which implies commercial fish culture.
- Prohibit use of small-mesh fishing gear.
- Restock threatened or rare fish species to increase their density in the sanctuary.
- Introduce short-duration, flood-tolerant rice species that are well suited for wetlands.
- Introduce and cultivate suitable new varieties of rice to reduce pest infestations.
- Develop an agro-weather forecasting system capable of warning of flash floods to help ensure minimal loss of standing mature crops.
- Introduce new irrigation technology to reduce stress from seasonal variation in the monsoon.
- Farmers, owners of tea gardens, and owners of rubber plantations should apply integrated pest management (IPM) techniques to reduce use of chemical pesticides.
- The government should undertake successive programs or projects in collaboration with local communities or VCGs to develop and manage sanctuaries and swamp forests.
- Promote alternative income-generating activities under government programs and projects.
- Hold regular meetings between VCGs and Upazila ECA committees to ensure proper monitoring and enforcement of laws, and to understand and resolve management problems.
- Develop an integrated master plan to conserve and manage the Hakaluki Haor wetland ecosystem, in order to ensure its capacity to provide goods and services for future generations.

FGD participants and other stakeholders also suggested that several major beels should be managed as fish sanctuaries (see Table 3). Participants mentioned that two beels in particular Baia Gojua and Polovanga in Barolekha Upazila of Moulvibazar District have already been declared as sanctuaries by the Fisheries Department. IPAC started its co-management activities in Baia Gojua Beel involving existing VCGs to conserve and manage beel biodiversity. Baia Gojua Beel is under good management because of the well-organized VCG. In the case of Polovanga Beel, poor management has been reported due to the absence of a VCG; instead there is a committee administered by the Union Council.

Table 3: The beels identified for conservation as fish sanctuaries

Beel Name	Upazila/Thana	Approximate area (hectares)
Chatla	Juri	210
Futo-Borna	Kulaura	32
Nagua	Juri and Barolekha	53
Kangli	Kulaura	10
Nerai	Barolekha	53
Haor-Khal	Barolekha	223

Conclusions

The importance of Hakaluki Haor for the livelihoods of the community living in the immediate area, and in that part of Bangladesh in general, is immeasurable. This case study examined the pitfalls in the existing wetlands management systems, and the obstacles hindering good management and development of the wetlands in the form of policy and governance challenges, natural and human-initiated environmental problems, and socio-economic challenges.

The total ecological and economic value of the ecosystem outweighs the relatively negligible earnings from the leasing of the beels. Therefore, leasing of the beels should be stopped for long-term sustainability and to ensure benefits for the community as a whole. Fish sanctuary conservation through co-management of the wetlands, habitat restoration and conservation, and a regular program of controlling silt deposits are some immediate and urgent steps to be undertaken in Hakaluki Haor.

There are complex interlinkages between wetland ecology and livelihoods of the community. This study showed that alternative income-generating activities have had a positive impact on the livelihoods of the local community. Therefore, the study's findings strongly support the value of institutionalizing AIGA initiatives for the betterment of both the surrounding community and the ecosystem.

This study revealed that there are burning issues to be resolved in order to maximize the co-management benefits for both the community and the wetland ecosystem. Government officials at the top policy-making levels should take into account the prospects, and the goods and services of the ecosystem, towards the goal of securing the long-term sustainability of the wetlands in Bangladesh. Co-management with an integrated development approach is vital for ensuring the long-term sustainability and benefits of these crucial wetland ecosystems.

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Elephant Habitat and Human-Elephant Conflict: A Case Study in Chunati Wildlife Sanctuary, Bangladesh

Md. Jahidul Kabir

Abstract

Elephant habitat conservation and human-elephant conflict management are major issues for Chunati Wildlife Sanctuary (CWS). Asian elephants (Elephas maximus), critically endangered mammals in Bangladesh, require large undisturbed mosaic habitats and need abundant foraging materials and water for survival. The Chunati forests were originally mixed evergreen and semi-evergreen forests, supporting the type of habitat required for elephants. However, fragmentation of elephant habitat, scarcity of fodder species, and increased human activities within the sanctuary pose serious challenges for habitat conservation and human-elephant conflict management. In my study, I have tried to assess the present condition of elephant habitat and human-elephant conflict in CWS after the adoption of co-management in 2004. I have found that co-management brings some positive changes among participating members in terms of increasing awareness about elephant habitat conservation and the Wildlife Act, and also may help to reduce forest dependence to some extent. The Chunati forests seem to be in a better condition recently, and the number of elephants appears to be increasing. I also found that human-elephant conflict has increased during the last two to three cropping periods, and that the increase in the number of elephants is contributing to increased human-elephant conflict. My study suggests that strengthening co-management organizations through sustainable alternative income-generating activities (AIGAs) and appropriate training programs can promote elephant habitat conservation and human-elephant conflict mitigation. Furthermore, additional management measures, such as participatory elephant monitoring, participatory crop protection measures, and conservation response units can help alleviate human-elephant conflict.

Introduction

Habitat preservation is the main challenge for elephant conservation and for human-elephant conflict mitigation. Asian elephants (*Elephas maximus*) are forest-dwelling animals that have been described as keystone or flagship species. They are often called the "engineers" of the forest as they play a significant role in maintaining the ecosystems they inhabit. Asian elephants are found in 13 different countries in Asia

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and there are currently fewer than 50,000 animals living in the wild. The status of Asian elephants in Bangladesh is threatened. In 2000, the species was listed by the International Union for Conservation of Nature as "critically endangered" (IUCN 2011).

The Chunati Wildlife Sanctuary (CWS) supports a population of about 20 elephants. They constitute an important part of the forest ecosystem and are an indicator of good forest health (FD 2006). As a large herbivorous mammal, elephants require abundant foraging material and water for drinking and bathing. They prefer a mosaic of habitat types with patches of forest, scrub forest, banana groves, forest clearings, intermittent open spaces, succulent grasslands, and savanna. Forests in CWS currently support these types of habitats, but to ensure the long-term sustainability of this habitat, further management and conservation measures are needed (FD 2006).

The fragmentation of forestland in and around the sanctuary, the associated scarcity of elephant fodder species, and the increase in human activities within the elephant habitat together pose significant challenges for elephant habitat conservation and for reducing human-elephant conflict (HEC) in CWS. Controlling activities such as illegal harvesting, forestland encroachment, forest fires, and grazing is not possible without the active involvement of local people. Therefore, it was deemed necessary to involve local people in biodiversity conservation through co-management initiatives and institutions, including sustaining their motivation and engagement through alternative income-generation activities (AIGAs) (FD 2006). In collaboration with the United States Agency for International Development (USAID), the Bangladesh Forest Department (FD) initiated co-management activities in CWS in 2004, through the Nishorgo Support Project (Roy 2009). The general aim of the Nishorgo Support Project (NSP) was to promote community protection efforts for wildlife and their habitats and, more specifically, to provide diversified food and adequate shelter for elephants by restoring forests (FD 2006). The experience of NSP has shown that co-management has helped to improve elephant habitat conservation (GIZ 2011).

This study investigates the impact of co-management initiatives for improving elephant habitat conservation and reducing human-elephant conflict in Chunati Wildlife Sanctuary. The main goals of this paper are threefold: (1) to assess the current conditions of elephant habitat and human-elephant conflict, and the effect that co-management has had on these conditions; (2) to identify the expected and actual roles and responsibilities of community people, co-management workers, and FD officials for elephant habitat conservation and HEC mitigation; and (3) to identify deficiencies in ongoing management practices and suggest some means for improving elephant habitat conservation and reducing HEC in CWS. On a practical level, this study aims to help field-level FD officials, co-management organizations, community members, and policymakers to take appropriate conservation measures that are compatible with local needs and will benefit elephant populations in the sanctuary.

Background

Chunati Wildlife Sanctuary, located in southeastern Bangladesh, was created in 1986 and encompasses a total of 7,764 hectares of reserved forest. The sanctuary is administered under the Wildlife and Nature Conservation Division office in Chittagong. It is divided into two forest ranges and seven forest beats: the Chunati Wildlife Sanctuary Range, consisting of Chunati, Aziznagar, and Harbang Beats; and the Jaldi Wildlife Sanctuary Range, including Jaldi, Chambol, Napora, and Puichari Beats. The estimated population of this area is 50,000 people living in 9,400 households. They reside in 60 settlements or *para* (hamlet) in and around the sanctuary (IPAC 2011). Major occupations among the local population include day laborers in both the agricultural and non-agricultural sectors (42%) and non-wage agricultural workers (21%). There is also significant unemployment (17%) (Hoque 2009).

I conducted my study in four paras; Bonpukur (Hasnakata) and Goyalmara (Vandarir Depa) in the Chunati Range; and Jaldi Villager Para and Jungle Chambol in the Jaldi Range. All of the paras are situated inside CWS and are frequently affected by elephants. There are 68 households in Bonpukur (Hasnakata), and 88 households in Goyalmara (Vandarir Depa). The residents of Bonpukur (Hasnakata) and Goyalmara (Vandarir Depa) are very poor. Around 50 percent of the households receive loans from different micro-credit organizations, and about 30 percent of the residents usually lease croplands from local elites and cultivate paddy for their own consumption as well as for sale in the market (GIZ 2011). Nearly all of the damage caused by elephants falls upon the shoulders of the villagers.

Jaldi Villager Para is in Banshkhali *Pourashava* (municipality), and people there have several livelihood opportunities. Some depend on the forest mainly for fuelwood, while others also collect housing materials. The Jungle Chambol is situated in Chambol Union under Banshkhali Upazila (Thana), where people largely depend on the forest for fuelwood and housing materials. They also use forest areas for vegetable gardening, cropland, and pastureland. The communities at both sites migrated there from nearby areas and established settlements during the mid-nineteenth century.

The Chunati area originally supported a mixed evergreen and semi-evergreen forest, but the forest has been substantially degraded by heavy human interference. There are hardly any stands of natural forest left. Currently, CWS has five designated habitat types: (1) small patches of secondary forest, (2) plantations, (3) grasslands and bamboo forest, (4) wetlands and water bodies, and (5) cultivated fields (FD 2006). German Development Co-operation (with Deutsche Gesellschaft für Internationale Zusammenarbeit; GIZ) with technical support from the Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU), conducted a baseline survey in CWS during 2011. The survey shows that CWS has an average density of 239 trees per hectare; 60 percent of this tree stock is composed of planted exotic

species (GIZ 2011). A total of 143 plant species, including 17 fodder species suitable for elephants, have been recorded by the IUCN (2004). Fodder species found in CWS forests include bamboo (*Bambusa* spp.), muli bansh (*Melocanna baccifera*), blackberry (*Syzygium* spp.), chapalish (*Artocarpus chaplasha*), jackfruit (*Artocarpus heterophyllus*), mango (*Mangifera indica*), teak (*Tectona grandis*), coconut (*Cocos nucifera*), banana (*Musa* spp.), sungrass (*Imperata cylindrica*), dumur (*Ficus* spp.), house-broom grass (*Thysanolaena maxima*), hill potato (*Dioscorea alata*), sweet potato (*Dioscorea* sp.), chupri potato (*Dioscorea* sp.) jambura (*Citrus grandis*), and deua (*Artocarpus lokoocha*). Among these 17 fodder species, bamboo and banana are the most preferred by elephants, but bamboo is also the most degraded, due to both a recent flowering followed by severe natural death of bamboo culms and to overharvesting. Local people eat banana flowers and the tender core of banana stems as a vegetable, and the local Hindu community collects banana leaves to use as food containers in funeral ceremonies. A 2011 regeneration study indicated that the average density of seedlings in CWS is more than 77,000 per hectare (GIZ 2011). Although many of the naturally regenerated seedlings might die during the summer season, if they could be protected, then the CWS forests could restore their diversity naturally (GIZ 2011).

People living in and around the CWS cannot imagine their existence without the forest. It provides them with food, fuelwood, fodder, medicine, shelter, housing materials, and various other products (Uddin and Foisal 2006). About 50 percent of the population in the study area extracts forest products from CWS (GIZ 2011). Fuelwood, sungrass, bamboo, dead leaves, and house-broom grass are commonly harvested and used for domestic purposes, such as house construction and agriculture. The extraction of dry and fallen fuelwood and leaves, and the annual collection of sungrass and house-broom grass, may not be harmful for habitat conservation, but the collection of bamboo, green fuelwood, and the cutting of saplings for use as sticks for betel leaf is a major concern for the recruitment of naturally regenerated plants (GIZ 2011). Local people also collect edible wild fruits, seeds, roots, tubers, and leaves for food. Agricultural laborers and the unemployed frequently go to the forest to collect forest products for subsistence and for cash sale (Uddin and Foisal 2006). Encroachment occurs on forestland inside the sanctuary for agriculture, betel leaf cultivation, vegetable gardening, and the establishment of new settlements. In addition, there are a number of water bodies inside the CWS that are used by influential local people for fish cultivation. All of these activities contribute to elephant habitat fragmentation and degradation.

Conflicts between humans and elephants have become an important issue for conservationists. In Bangladesh, elephants come into conflict with humans because of inadequate space-they compete for the same habitat (IUCN 2011). Major incidents of conflict in CWS involve agricultural crop damage. In the Chunati Range, people have expressed severe complaints as elephants damage portions of their crops or entire fields, resulting in low crop yields. In the Jaldi Range, elephants frequently

come to the villages as well as to the fields. People complain that elephants destroy their home gardens and their vegetable gardens. Paddy lands are the most severely damaged by elephants, and conflicts are intensified during the paddy maturity periods. Elephants raid crops as these provide an easy source of highly nutritious food (Sukumar *et al.* 1987). Elephants come to the villages to eat and destroy banana, coconut, jackfruit, guava, and bamboo groves in home gardens, and they prefer to eat watermelon, sugarcane, cucumber, green chili, pineapple, potato, sweet potato, brinjal (eggplant), and pea plants in the vegetable gardens. Often a single bull elephant, or sometimes two to three elephants, comes to the villages for food, but during crop raiding the elephants come in large groups. The local FD office does not have any official records, but they have estimated that the economic loss from crop destruction is around 5,000,000 BDT (about USD 59,000) per year in and around CWS. HEC is mainly due to such agricultural intrusions; there have been very few incidents of house or infrastructure destruction or human-elephant casualties reported in the sanctuary. CWS is a site for the Monitoring of Illegal Killing of Elephants (MIKE) Program, authorized by a resolution of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Conference of the Parties (CoP 10) in Harar e, Zimbabwe in 1997. MIKE is a monitoring program aimed at providing the information needed to make appropriate management and enforcement decisions, and to build institutional capacity within the elephant range countries. FD officials regularly send monthly reports to the MIKE headquarters in Kenya.

FD started co-management activities in CWS in 2004, through the Nishorgo Support Project. The organizations responsible for co-management are the co-management councils and co-management committees, and Nishorgo assisted in forming two of each. These councils and committees are comprised of representatives of civil society groups, local administrators, local villagers, and representatives of various government organizations. The councils are responsible for planning, management, and decision making in CWS, whereas the committees are the operational bodies responsible for the implementation of the decisions and plans approved by the council. Community patrolling groups (CPGs) have been created through consultations with the committees and are responsible for regular patrolling with FD officials. Village conservation forums (VCFs) consist of forest-dependent households in each para, which enlist and motivate each other, as well as other community members. There are 12 CPGs, including 220 male and 49 female members, and 60 VCFs with a total of 2,694 male and 601 female members. Under the NSP, almost all CPG members have received direct cash incentives, ranging from 3,500 to 5,000 BDT (USD 41 to 60), as well as training and uniforms. After the NSP completed its efforts in 2008, the Integrated Protected Area Co-management (IPAC) project began its work with the same co-management organizations in 2009, with assistance from USAID. Up to December 2011, IPAC provided AIGA support to 56 VCF members in the Chunati Range and 28 VCF members in the Jaldi Range, for weaving fishing nets and bamboo baskets and for vegetable cultivation. CPG members in Chunati and Jaldi Ranges planted 300 seedlings of fruit trees, timber trees, and various medicinal

species; while VCF members in the Chunati Range planted a total of 350 seedlings of these same species. Co-management organization (CMO) members conduct regular patrolling with FD officials and are also building awareness among non-members. However, no concrete measures have been taken for reducing HEC, except in a few cases in Jaldi Range in which some CPG members helped FD officials to drive elephants back into the forest.

FD prepared a management plan for CWS in 2006, under the NSP. The management plan stated that elephant habitat would be conserved by protecting remaining vegetation from illicit harvesting, encroachment, grazing, and fire; by encouraging natural regeneration through the active involvement of co-management organizations; and by rehabilitating degraded forests by raising enrichment plantations of fruit-bearing shrubs, trees, and palatable grasses. Under this plan, existing water bodies would be repaired and excavated, and unwanted weeds would be removed. Unauthorized fishing, hunting, and cattle grazing would be curbed, the contamination of water would be reduced or eliminated, and the development and use of fisheries by local people would be implemented on a shared basis. Furthermore, privately owned land within the sanctuary would be acquired by the FD by offering suitable compensation to the owners. Provisions for giving compensation for the damage of property or personal casualty would also be ensured.

The FD has implemented several planting programs in CWS for improving elephant habitat. They have established a 429-hectare buffer zone area through participatory planting with co-management organization members as well as 1,123 hectares of long-rotation plantations with rare and endangered indigenous species; 243 hectares of fruit and fodder plantations; 81 hectares of medicinal plantations; and 77 hectares of habitat enrichment plantations (Hossain 2011). The FD has some provisions for compensation of damages caused by elephants and has amended the Wildlife (Preservation) (Amendment) Act, 1974 (i.e. Wildlife Act), to include compensation for damage caused by elephants. However, several measures mentioned in the management plan that may also contribute to elephant habitat conservation have not yet been implemented.

Methodology

This research combines qualitative and quantitative research methods, including a household survey; semi-structured interviews with both households and key informants, such as local-level FD officials and elephant researchers; and focus group discussions with co-management organizations like the co-management committee (CMC), community patrolling group, and village conservation forum. I also collected and incorporated secondary literature on CWS, Asian elephants, and the status of Asian elephants in CWS.

I conducted the survey during my field visits to CWS in November and December 2011, using a semi-structured questionnaire for household surveys, focus group discussions, and key informant interviews. Specifically, I collected data on people's perceptions of how co-management does or does not contribute to elephant habitat conservation, as well as their level of knowledge about their roles and responsibilities regarding elephant habitat conservation and HEC mitigation. I also used key informant interviews to assess deficiencies of ongoing management practices and to identify opportunities to improve elephant habitat conservation and reduce human-elephant conflict.

The study sites were situated in the Chunati Wildlife Sanctuary Range and the Jaldi Wildlife Sanctuary Range. I selected villages that elephants visited frequently, identifying two beats from each range and one village from each beat, for a total of four villages. In each village, I selected two categories of households: households related to CMOs and households not related to CMOs. Out of the 627 households in the four selected villages, 174 households were included in the CMO. Of these, 64 households are receiving AIGA assistance and 110 households are not receiving any AIGA support. I randomly selected eight households from those receiving AIGA support and eight households from those not receiving support, and also conducted household surveys with male and female respondents in 16 of the 453 non-member households. To ensure a more diverse sample, I deliberately selected respondents with different occupations, like agricultural workers, small business owners, day laborers, and others. In addition, I conducted focus group discussions with two CMCs working in CWS, four of the 12 CPGs, and 12 of the 60 VCFs. I selected the VCFs and CPGs that are working in the four selected villages. I also conducted key informant interviews with FD officials, two Range Officers and seven Beat Officers working in the area, since their work is directly related to co-management. Finally, I interviewed some independent wildlife researchers in order to triangulate the data by including an impartial, expert opinion for improving elephant habitat conservation and reducing human-elephant conflict.

Results and Discussion

Assessment of Current Conditions and Effects of Co-management

To find out about the current conditions of elephant habitat, I reviewed recently published and unpublished study reports on CWS. I have conducted interviews and gathered opinions from CMO members (local people working with co-management organizations like CMCs, CPGs, and VCFs), non-members (local people not working with the co-management organizations), local-level FD officials, and wildlife experts. I have tried to determine the level of awareness among CMO members and non-members about elephants, their habitat conservation, and the Wildlife Act. I also

assessed the level of forest dependence and the perception of habitat conditions among both CMO members and non-members, to determine if co-management has had any effect on elephant habitat pressure and conservation. In addition, I have tried to determine the nature and extent of damage caused by elephants, the reasons behind these damages, and what relationship, if any, might exist between human-elephant conflict and co-management activities.

Awareness of elephants and habitat conservation. Awareness about elephants and the conservation of their habitat is an important factor in improving these habitats and in reducing human-elephant conflict (HEC). I asked 16 non-member households and 16 CMO households whether the forest resource that is, the elephant habitat should remain protected. As you can see from the table 1 below, all of the CMO households (HHs) participating in AIGAs replied that the forest should remain protected; whereas six of the CMO households not participating in AIGAs replied that the forest should remain protected, and two replied that the forest should not remain protected. Among non-member households, 10 replied that the forest should remain protected, two replied that the forest should not remain protected, and four replied that they did not know.

Table 1: Perceptions about elephant habitat conservation

Response	CMO HHs with AIGA (n = 8)	CMO HHs without AIGA (n = 8)	All CMO HHs (n = 16)	Non-member HHs (n = 16)
Forest should remain protected	8 (100%)	6 (75%)	14 (87.5%)	10 (62.5%)
Forest should not remain protected	0 (0%)	2 (25%)	2 (12.5%)	2 (12.5%)
Don't know	0 (0%)	0 (0%)	0 (0%)	4 (25%)

I also asked 16 CMO households and 16 non-member households whether they feel elephants are a threat or a blessing to them. Among the CMO households with AIGAs, all replied that they feel elephants are a blessing; while among the CMO households without AIGAs, two saw elephants as a threat and six thought that they were a blessing. Among the non-member households, 13 replied that they were threats and three said that they were a blessing. These results are reported in Table 2 below.

Table 2: Perceptions about elephant conservation

Response	CMO HHs with AIGA (n = 8)	CMO HHs without AIGA (n = 8)	All CMO HHs (n = 16)	Non-member HHs (n = 16)
Threat	0 (0%)	2 (25%)	2 (12.5%)	13 (81%)
Blessing	8 (100%)	6 (75%)	14 (87.5%)	3 (29%)

The Wildlife Act is important for wildlife conservation efforts in Bangladesh. The recent amendments that include the provision of compensation for damage caused by elephants may be a milestone in ongoing efforts to reduce human-elephant conflict. Awareness of local people about the Wildlife Act may have an impact on wildlife habitat conservation. I asked 32 households 16 CMO members (both with and without AIGAs) and 16 non-members if they were aware of the Wildlife Act. The results showed that all (100%) of the eight CMO households with AIGAs surveyed were aware of the Act, compared with just five of the eight CMO households without AIGAs (62.5%), and only four of the 16 non-participant households (25%), as reflected in Table 3.

Table 3: Awareness of the Wildlife Act

Response	CMO HHs with AIGA (n = 8)	CMO HHs without AIGA (n = 8)	All CMO HHs (n = 16)	Non-member HHs (n = 16)
Know about Wildlife Act	8 (100%)	5 (62.5%)	13 (82%)	4 (25%)
Don't know about Wildlife Act	0 (0%)	3 (37.5%)	3 (18%)	12 (75%)

The above data seem to indicate that among local people, CMO members are more aware of elephants and habitat conservation than non-members. This also suggests that, among all the CMO members, those receiving AIGA support are more aware than those without AIGAs. There may be many other factors influencing respondents' level of awareness such as literacy, access to different media, and NGO activities but this study suggests that involvement in co-management and in AIGAs in particular, has had a positive impact on raising awareness about elephant habitat conservation.

Forest dependence. Dependence of local people on the forest resource is a major concern for elephant habitat conservation and human-elephant conflict mitigation. To identify the impact of co-management on elephant habitat conservation, I first asked if the respondent was using the forest resource and, if they were, whether their collection of forest products was for subsistence or other purposes. Among the eight CMO households with AIGAs, only one reported using the forest. However, among the eight CMO households without AIGAs, four used the forest. The non-member households showed the highest rate of forest use, with over 50 percent (9 of 16) responding that they use the forest (table 4).

Table 4: Number of forest-dependent households

Variable	CMO households with AIGAs (n = 8)	CMO households without AIGA (n = 8)	All CMO households (n = 16)	Non-member households (n = 16)
Use forest	1 (12.5%)	4 (50%)	5 (31.25%)	9 (56.25%)
Do not use forest	7 (87.5%)	4 (50%)	11 (68.75%)	7 (43.75%)

The GIZ (2011) study found that 50 percent of the households in CWS are forest dependent; whereas my study found that about 44 percent (14 out of 32) are forest dependent. The results of the two studies are similar, but it is evident from my study that only 12.5 percent of CMO members getting AIGAs depend on the forest, which means that involvement in AIGAs provided by the Nishorgo/IPAC initiatives may be one factor helping to reduce forest dependence, and thereby contributing to elephant habitat conservation.

Habitat conditions. The collection of forest products by community members puts pressure on elephant habitats. The extraction of dry and fallen fuelwood and leaves, and the annual collection of sungrass and house-broom grass, may not be harmful for habitat conservation, but the collection of bamboo and green fuelwood are major threats. Table 5 below shows that, of the resources collected by forest dependent households, the most commonly used are fuelwood, sungrass, house-broom grass, and bamboo, in that order.

Table 5: Collection of elephant fodder species by households

Forest product	CMO household with AIGAs (n = 8)	CMO household without AIGAs (n = 8)	Non-member households (n = 16)
Fuelwood	1 (12.5%)	3 (37.5%)	8 (50.0%)
Bamboo	0 (0%)	0 (0%)	2 (12.5%)
House-broom grass	0 (0%)	0 (0%)	3 (18.75%)
Sungrass	1 (12.5%)	3 (37.5%)	7 (43.75%)

Among the CMO households, only 12.5 percent (1 of 8) of those with AIGAs collect fuelwood and sungrass, and 37.5 percent (3 of 8) of those without AIGAs collect fuelwood and sungrass. Among non-member households the rate of collection is higher. Since the collection of fuelwood is one of the major threats to elephant habitat conservation, and since this data indicate a strong positive correlation between non-participation in CMOs and fuelwood collection, this study seems to indicate that participation in CMOs helps reduce threats to elephant habitat conservation.

In addition to speaking with CMO members in focus group discussions, I conducted interviews with nine FD officials as key informants about the status of elephants in

CWS. I asked them how many herds of elephants were found and the number of elephants in each herd. The majority replied that they found five to six herds, though the number in each herd was reported to vary based on the time of year and the activity engaged in by the herd. One to three elephants come to the villages to eat seasonal fruits and vegetables, whereas the number typically increases from five to six, and can be up to 15 to 16, during crop raiding. Respondents indicated that the frequency of crop raiding was increasing. I also asked about the reasons for the increased number of elephants. The majority expressed that it was due to elephant habitat improvements, followed by better protection of forests and elephants coming from nearby areas.

The GIZ (2011) survey report stated that, after co-management was adopted, natural regeneration of trees is increasing rapidly and the amount of wildlife has grown. The presence of natural regeneration in CWS is another indicator of improving habitat conditions. My study echoes these results. While there may be some other factors, it seems clear that after the adoption of co-management in CWS the elephant habitat is in a better condition.

Nature and extent of HEC. Conflict between humans and elephants has become an important issue for elephant conservation. I have tried to determine the causes and extent of HEC in CWS, and to assess whether co-management has had an impact in reducing HEC. I asked 16 households in the Chunati Range and 16 households in the Jaldi Range whether they have been affected by elephants or not. Of those surveyed, 13 households in Chunati Range and nine households in Jaldi Range (22 households total) replied that they have been affected by elephants. Furthermore, a majority of those households affected by elephants indicated that the frequency of elephant incursions has grown significantly in the last few years. Figure 1 shows a comparison of elephant impact in the Chunati and the Jaldi Wildlife Sanctuary Ranges.

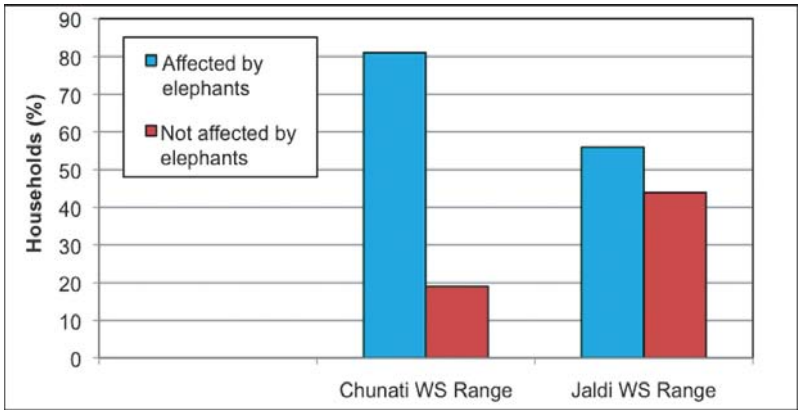
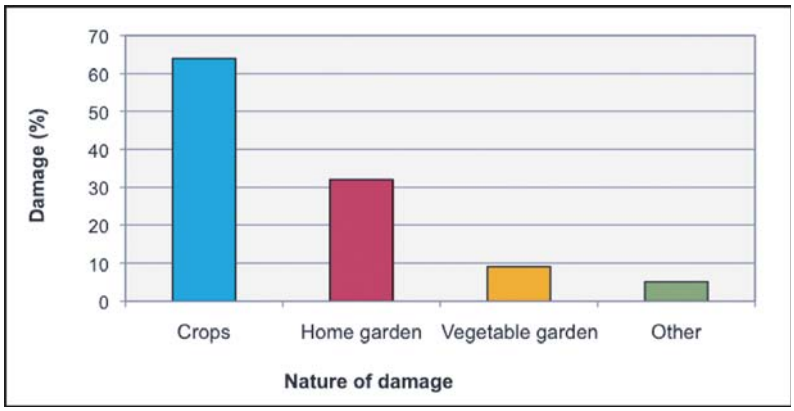


Figure 1: Comparison of elephant impacts in Chunati WS Range vs. Jaldi WS Range

I also asked the 22 households affected by elephants about the nature of the damage caused by elephants. Results show that crop raiding is the most frequent form of damage, affecting 64 percent (14) of the respondents, followed by the destruction of home gardens at 32 percent (7 households), vegetable gardens at 9 percent (2 households), and other forms of damage at 5 percent (1 household). These results are shown in Figure 2.



Note: Respondents could choose more than one response, so total exceeds 100%.

Figure 2: Nature of elephant damage in Chunati WS Range and Jaldi WS Range

Although local people believe that a shortage of food in the forest is the main cause of increased human-elephant conflict in CWS, according to other sources, including scientific research conducted on elephants, it is likely that elephants raid crop lands and vegetable and home gardens not only due to the scarcity of food in the forests, but also because crops and vegetables are easy sources of food and meet some mineral requirements.

My research suggests that the increasing number of elephants is one of the causes of increased human-elephant conflict in CWS. In fact, the success of co-management in enhancing elephant habitat may be contributing to an increase in human-elephant conflict in CWS. Historically the sanctuary area has functioned as a corridor for elephants moving between surrounding forests, so while elephants do not always remain in CWS, they frequently pass through it. Currently, because of the heavily fragmented and depleted forests in surrounding areas, elephants feel more comfortable remaining in the sanctuary. While this may be contributing to increased HEC, there are means of reducing the incidence and impacts of conflict while increasing elephant populations, such as participatory elephant monitoring and crop-raiding (conservation) response units.

Expected and Actual Roles and Responsibilities of Non-members, Co-management Institutions, and FD Officials

Expected vs. actual roles of non-member households. Determining if gaps exist between the expected and actual roles of community people in co-management can provide important information to determine methods for improving co-management. I interviewed CMO households, FD officials, and wildlife experts to determine their perceptions about this. The results reveal that most of these respondents expected that non-members should not go to the forest to harvest elephant fodder and should not disturb the elephants. In addition, FD officials and experts expected that non-members should not engage in cultivation in forestlands and should not plant fruit and fodder species that are preferred food sources for elephants in their home gardens. The question is, what are the non-members actually doing? A majority of CMO households and FD officials said that they do not disturb the elephants, but about one third think that non-members are going to the forest to harvest forest products. In addition, very few CMO households believed that non-members should not go to the forest for cultivation, or that they should not plant certain crops (i.e. fruit and fodder species) that elephants like to eat in their home gardens. Community people practice some traditional methods to drive away elephants from croplands like shouting, making fires (*ujala*), and keeping a human-like decoy (*kak tarua*) in the crop fields, but they said that the elephants have adapted to these methods so they do not work well any more.

Expected vs. actual role of CMO members. One of the foundations of co-management is the idea that members of co-management institutions are expected to play an important role in the improvement of elephant habitat conservation and in the reduction of human-elephant conflict. I asked non-members, FD officials, and wildlife experts about the expected and actual role of CMO members. Non-members said CPG and VCF members are performing their duties well, but they should be more active to ensure effective elephant habitat protection. Beat officers of the FD said that CPG members are helpful for their protection duty, but that their contribution of only three members per day is insufficient. Each CPG member received a cash incentive in the past, which is now only 10 BDT (USD 0.12) per patrol duty, which makes them frustrated. VCF members are not getting appropriate AIGA support and in many paras you will find few active members. FD officials working in the Jaldi Range said that some CPG members have helped them to drive elephants back into the sanctuary during three separate incidents last year when two to three bull elephants entered a village that was several kilometers from the sanctuary and created anxiety among villagers. CMO members have not received any specific training about elephants. Both FD officials and experts said that if CPG members were trained and involved in participatory elephant monitoring, participatory crop protection methods, awareness building, and motivating local people for elephant and habitat conservation, then human-elephant conflict could be reduced.

Expected role and actual role of FD officials. FD officials are key figures in co-management, due to their authority to control and manage activities in CWS. Thus, they are expected to perform a major role in improving elephant habitat conservation and reducing human-elephant conflict. I asked questions of CMO members, non-members, and experts about the expected and actual role of the FD officials. Of these respondents, the majority of CMO members, and a few non-members and experts, said that the FD raised some enrichment, fodder, and fruit plantations for elephant habitat improvement, and that they conduct regular patrolling with CPG members for habitat protection. Because CWS is a MIKE site, FD officials are required to send monthly reports to the MIKE director in Kenya. FD officials discussed the elephant issue in several monthly meetings of the CMC. All CMO members, non-members, and researchers felt that the FD officials should raise fruit and fodder plantations with indigenous species, excavate and renovate water bodies, establish salt slabs, and ensure habitat protection measures. Some CMO members and non-members said that the FD should establish special elephant patrol parties with trained FD officials, elephant mahouts, and CPG members so that they can help people during crop maturation periods and during an emergency. Researchers and experts placed emphasis on the need to mark elephant corridors and keep them free for elephant movements. They also recommended community-based elephant monitoring and crop patrolling.

Deficiencies of Ongoing Management Practices and Suggestions for Improving Elephant Habitat Conservation and Reducing HEC in CWS

Deficiencies. Hungry people do not obey every law. People living in and around CWS are very poor, so it is unlikely that they will stop using the forest resources that they need for their livelihoods until they have some viable alternatives. Out of 9,400 households in the area surrounding CWS, 3,564 have been included in co-management organizations. Only 620 households are currently participating in AIGAs, which represent only 17 percent of all CMO households and just 0.07 percent of the households living in and around CWS (IPAC 2011). This study has identified some significant behavioral changes of CMO members with AIGAs, but due to the scope of both co-management activities and this study, it is difficult to draw definitive conclusions about positive impacts of co-management on the sanctuary.

The FD prepared a co-management plan for CWS under the Nishorgo Support Project in 2006 and has undertaken some management measures, including enrichment plantations, fruit and fodder species plantations, and participatory plantations in the buffer zone. The GIZ (2011) study stated that 60 percent of the tree stock in CWS is composed of exotic species, and elephant experts working in CWS have indicated that increasing biomass by planting exotic species may not improve the overall elephant habitat. Several other management measures including the renovation and excavation of water bodies, the development of fisheries involving local people on a

usufruct rights basis, the control of unauthorized fishing and cattle grazing, the acquisition of privately owned land within the sanctuary, and the raising of elephant-palatable grasses have not yet been implemented.

The household surveys show that 14 (44%) of the 32 households interviewed go to the forest to collect forest products, and that nearly all households do not agree with the opinions of FD officials and experts that they should not cultivate crops, vegetables, and betel leaf inside the sanctuary. Furthermore, neither CMO members, nor non-members, nor FD officials have received any training on elephant-related issues; and no awareness-building initiatives, such as meetings with local people or the making of banners, posters, signboards, or billboards, have been undertaken by the CMC.

In CWS, co-management activities have not incorporated any notable efforts to reduce human-elephant conflict. The FD's initiative to amend the Wildlife Act, including the provision of compensation for damages caused by elephants, is greatly appreciated by all, but has yet to be effectively implemented both CMO members and non-members said that they do not know the official procedures for how or where to apply, and, in fact, no one has received any compensation payments yet.

Measures needed to improve elephant habitat conservation and reduce HEC. Co-management experts have noted that, since many of the people living around the CWS forests are poor, a revenue-sharing arrangement involving the local people could be created to provide financial resources for the CMOs to invest in community development.

Some experts have voiced their opinion that all CMO members should be supported by sustainable AIGAs, which would help ensure better protection of elephant habitat. The FD needs to play a pivotal role in strengthening and organizing the CMOs. CMO members, non-members, and FD officials should be trained in elephant-related issues, and awareness-building activities, like meetings and the making of banners, posters, signboards, and billboards, should be undertaken by the CMC.

The co-management plan prepared by the FD is a very good document for elephant habitat conservation. Although it is very challenging to implement every measure, doing so would make a significant contribution to elephant habitat conservation.

Landscape-scale management strategies like habitat restoration and habitat improvement for reducing HEC are essential, but they are conceptually and politically challenging to devise and would take many years to implement. Meanwhile, community tolerance for elephants may deteriorate, which could undermine large-scale conservation efforts (Zimmermann *et al.* 2009). Community-based human-elephant conflict management in Assam, India has successfully introduced

participatory elephant monitoring for early warning and participatory crop protection with innovative techniques to deter elephants. Conservation response units (CRU) have been in use in Sumatra, Indonesia (Azmi 2006) and some other countries in Africa and Asia for human-elephant conflict management. Since HEC is increasing in CWS, successful participatory HEC management programs should be studied and implemented in CWS.

Conclusions

Co-management in CWS has brought about some significant changes among the households belonging to CMOs, especially those participating in AIGAs. Their awareness about elephants and elephant habitat conservation, as well as about the Wildlife Act, has increased. Households participating in AIGAs have also made positive changes in the use of forest resources and have reported a reduction in their forest dependence. Despite a number of threats to elephant habitats, CWS now seems to be in a better condition than in the recent past. Significant natural regeneration is occurring every year, and the amount of wildlife is also increasing. However, human-elephant conflict has also increased significantly in and around CWS. This study suggests that the main types of conflict include crop raiding and the destruction of home and vegetable gardens by elephants. Local people and FD officials believe that the number of elephants in CWS has increased due to habitat improvement and better protection. Therefore, this study suggests that the increased number of elephants is one of the causes of increased HEC in CWS, and that conservation-oriented co-management initiatives, if not run well, could result in increased HEC.

Although this may appear to contradict the earlier claim that fragmentation of elephant habitat has contributed to increased HEC, it is important to look at the larger historical and landscape-level trends. Habitat destruction and fragmentation have been a basic problem for elephant conservation and a root cause of HEC, not only within CWS, but in other areas as well. These are not new problems. Heavy destruction of the CWS forests occured between 1980 and 1995. The GIZ study (2011) suggests that the habitat in CWS is now in a much better condition than in the recent past. Findings from my household surveys and FGDs indicate that HEC has increased during the last two to three cropping periods. So my conclusion is that elephants are feeling more comfortable remaining longer in CWS due to better protection from co-management, resulting in more potential for HEC. If co-management does not address these elephant related issues, HEC may increase in the future to a level where community tolerance may deteriorate and ultimately hamper long-term conservation efforts for the entire ecosystem. However, if co-management is run well, it can provide better protection for elephants by taking appropriate measures to reduce conflict, and also benefit the surrounding communities.

This study has identified some gaps between the expected and actual roles of non-

CMO members, non-members, and FD officials. Non-members are expected to reduce their dependence on CWS for forest products, cultivation of agricultural crops, betel leaf production, unauthorized fishing, and settlements. Local people should plant those fruits and fodder species that are less appealing to elephants. Local FD officials recognized the help of CMO members in forest protection, but the AIGA support they are receiving is insufficient and covers very few members. The FD initiative to provide compensation for property damage is appreciated, but so far no one has received any compensation. These issues and shortcomings suggest the need for several measures that could enhance the social and ecological outcomes of co-management:

- All CMO members should be supported by sustainable AIGAs.
- A revenue-sharing mechanism involving local people should be created whereby a proportion of government revenue from CWS would go to the CMO for investments in community development.
- A training program on elephant issues should be implemented for FD officials, CMO members, and community leaders.
- CMCs should conduct awareness-raising programs like campaigns and the making of banners, posters, signboards, and billboards.
- The FD should play a leading role in strengthening and organizing the CMOs.
- All measures stated in the co-management plan for elephant habitat restoration and improvement should be implemented.
- Species selection for plantations in CWS should favor plants that are important to the elephants' survival.
- All elephant movement corridors should be marked and kept free of obstructions or disturbances to ensure free movement of elephants and minimize the potential for conflict.
- Legal provisions for damage compensation should be ensured.
- The FD should undertake a special program for elephant habitat restoration and management, including HEC mitigation.

In addition to these specific measures, participatory elephant monitoring, participatory crop protection through innovative elephant deterrent techniques, and conservation response units comprised of captive elephants with mahouts, trained FD officials, and CPG members, which have been successfully introduced in some elephant range states, can be studied and replicated to enhance HEC management in the future.

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Impact of Baikka Beel Sanctuary on Protection and Restoration of Fish Biodiversity and Enhancement of Local Livelihoods

Md. Mahbub Ul Haque

Abstract

Fish sanctuaries have been found to be effective for the protection and conservation of fish biodiversity. This paper discusses fish biodiversity in beels adjacent to and removed from protected areas, current fishing practices, perceptions among local community members about the effectiveness of the Baikka Beel Sanctuary, and benefits that local fishers derive from the sanctuary. Data collection was carried out through catch monitoring, focus group discussions, and semi-structured interviews. Results show that there were 31 species of fish recorded in Balla Beel and 24 species in Sixty Two Beel during the study period. The dominant species in the beels adjacent to Baikka Beel is boal (Wallago attu). Some other exotic species like grass carp (Ctenopharyngodon idella) and common carp (Cyprinus carpio) are also common in both wetlands. Indigenous species like Ompok bimaculatus, Puntius sarana, Nandus nandus, Labeo gonius, and Chitala chitala, which were rare before the establishment of the fish sanctuary, are now common in both beels. Findings also reveal that most of the respondents' beliefs about the effectiveness of the sanctuary concern increased fish biodiversity, though they also report some additional direct and indirect benefits from it. This study is encouraging because it indicates that the overall fish biodiversity in Balla Beel and Sixty Two Beel is increasing as a result of the establishment of the Baikka Beel Fish Sanctuary. It suggests that careful planning, management, and regulatory practices, along with active community participation, can have a positive impact on fish biodiversity.

Introduction

Most inland fisheries in the developing world are heavily exploited. Freshwater biodiversity has declined faster than both terrestrial and marine biodiversity during the past 30 years (Jenkins 2003). Inland fisheries comprise a large share of the total fish production in Bangladesh, which makes this issue particularly important.

In Bangladesh, inland water bodies cover an area of 4,652,665 hectares, of which 4,024,934 hectares (87%) are open water and 627,731 hectares (13%) are closed

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water. The inland open-water fisheries resources of Bangladesh are the third richest in the world, following those of China and India. In 2009–2010, the total fish production of Bangladesh was 2,899,198 metric tons (DoF 2011). The fisheries sector is also rich in species composition, with 260 species of freshwater fish, 475 marine species, 24 prawn species, and 36 shrimp species. The climate and geography of Bangladesh are especially conducive to aquaculture and fisheries management (Chowdhury 2001). With an abundance of water resources, native and exotic cultivable species in Bangladesh have great potential for aquaculture.

In the past, open inland water bodies contributed more than 80% of the country's fish production, but over the last four decades this production has declined significantly. This decline has had significant negative impacts on fish biodiversity and the fishing community. Natural inland fish stocks have declined significantly and biodiversity has been seriously negatively affected due to overfishing, including the use of harmful fishing gear and fishing systems; degradation and loss of fish habitats; obstruction of fish migration routes by construction of embankments and water-control structures to increase agriculture production; and siltation of water bodies and water pollution from industrial and agricultural sources (Ali 1997). Poor fishers' livelihoods have been adversely affected. According to a study by the International Union for Conservation of Nature, some 42 fish species are endangered and another 12 species are critically endangered (IUCN 2000).

The dry season is a critical time for fish species. Water levels in the rivers, canals, and *beels* (seasonally isolated ponds) drop dramatically, leaving fewer places of refuge for the fishes and making them increasingly vulnerable to intensive and harmful overfishing. As a result, fish stocks, particularly the brood stock, have been depleted to such levels that they cannot sustain the fisheries. Both production and catch levels have gradually declined. Therefore, a major issue for sustainability is how to protect sufficient brood stock to maintain the population at sustainable levels.

Among the measures implemented to reduce stress on inland fisheries, fish sanctuaries have been found to be effective for the protection of broods, while other management measures are difficult to implement in the face of current administrative and social contexts (Ali *et al.* 2009). With this in mind, the Bangladesh Department of Fisheries (DoF) has established fish sanctuaries since the 1960s, but especially in the past decade, and the government is planning for more fish sanctuaries in the future. To date, over 400 fish sanctuaries have been established in the inland open waters of the country through different development projects and programs of the DoF and other agencies. This paper seeks to test the hypothesis that fish sanctuaries protect and restore fish biodiversity. I will attempt to determine the effect of the Baikka Beel Fish Sanctuary on the adjacent beels in terms of biodiversity. This information will help researchers, policy makers, and NGO workers in their efforts to ensure fishing sustainability. The specific objectives of this research are to:

1. Assess the biological impact of the fish sanctuary established in Baikka Beel by examining fish biodiversity in beels adjacent to and removed from the protected area;
2. Discover the current fishing practices in these adjacent sites and their implications for the sustainable management of the Baikka Beel fisheries;
3. Gauge perceptions among local community members about the effectiveness of the Baikka Beel Sanctuary; and
4. Assess the benefits that local fishers derive from the sanctuary.

Background

Hail Haor is a large wetland in Sreemongol Upazila, Moulvibazar District, in northeastern Bangladesh. This haor covers an area of about 14,000 hectares in the wet season, but in the dry season it shrinks to become about 130 beels and narrow canals covering a total area of less than 400 hectares. More than 172,000 people in 30,000 households live in 60 villages surrounding the haor. Over 80 percent of those households are involved in fishing in the haor, many as regular professionals (Chakraborty *et al.* 2005).

The natural productivity and biodiversity of the haor has been declining due to both natural factors and man-made inputs. Due to the pressure from human practices such as fishing by draining ponds during the dry season, pesticides application, irrigation, harmful fishing gear use, and other practices, fish production and biodiversity in this area have declined. Furthermore, there was a natural channel between the Monu River and Hail Haor, but this channel was closed about 25 years ago by the construction of a dam. The lack of migration channels may also be a cause of declining fish stocks and biodiversity at this site. Baikka Beel is a part of Hail Haor. It currently supports about 90 species of fish and is also important as a bird sanctuary. During the winter season, hundreds of bird species come here every year and tourists from home and abroad visit this place for its natural beauty and biological diversity.

Baikka Beel Sanctuary was designed to conserve and restore fish. About 100 hectares was set aside by the government as a sanctuary in 2003. This site was managed through a project funded by the United States Agency for International Development (USAID) called Management of Aquatic Ecosystem through Community Husbandry (MACH), which was implemented by a consortium of NGOs including Winrock International, the Centre for Natural Resources Studies (CNRS), Caritas, and the Bangladesh Centre for Advanced Studies (BCAS). After the MACH project ended in 2008, the sanctuary continued to operate and now has links with a successor USAID-funded initiative called the Integrated Protected Area Co-management (IPAC) Project. IPAC provides support to a wide range of protected areas in Bangladesh, including the Hail Haor wetland of which Baikka Beel is a part.

Local communities are actively involved in the management and protection of the 100-hectare sanctuary of Baikka Beel within the greater Hail Haor in Sreemongol District. They protect this sanctuary from other communities and outsiders who are allowed to fish and collect aquatic plants in other water bodies in the haor. Previously, the local government leased out Baikka Beel for fishing. As a sanctuary, it is now protected by the local community through the Baragangina Resource Management Organization (RMO). They follow a management plan that was prepared through consultation with local communities and is approved by a committee comprised of local officials, *union parishad* (local government) chairs, and leaders of community organizations. The beel is a rare example of a successful community-managed wetland sanctuary in Bangladesh.

Study Area

Both Balla Beel and Sixty Two Beel are located within Hail Haor (Figure 1). They are situated about five kilometers west and two kilometers southeast of Baikka Beel, respectively. The villages of Monargaon and West Varaora are located in Kalapur and Sreemongol Unions. Monargaon is about five kilometers northwest and West Varaora is about two kilometers northwest from the Sreemongol Upazila headquarters. The villages are close to Baikka Beel as well as to Hail Haor. Baikka Beel is famous as a healthy fish breeding and spawning ground. Due to their proximity to the haor, most of the villagers of these two villages are engaged in fishing either full-time or as a part-time professional occupation. Traditionally, people from both villages catch fish from the haor and sell them to the local community or the nearby fish market; or, if they have sufficient volume, they sell them in the wholesale market in the upazila headquarters.

Figure 1: Map of Hail Haor showing the study area (Source: IPAC)

Methodology

Both qualitative and quantitative data were collected for this study using semi-structured questionnaires, focus group discussions, personal observations, and fish-catch monitoring. Prior to selecting the study sites, I visited the area and selected the two villages and the two beels to be representative. This initial visit offered me a better understanding of local livelihoods, socio-economic conditions, and fishing activities. Based on the information I gathered from the site visit, I designed my questionnaire to collect both qualitative and quantitative data. I visited the study area for data collection each month from August to December 2011.

I chose these two beels because of their distance from Baikka Beel. Sixty Two Beel is adjacent to the Baikka Beel Fish Sanctuary, and Balla Beel is a short distance from it. The inhabitants of both villages are heavily dependent on these beels for fishing. I also selected these two villages because most villagers are fishers, providing a broad population from which a selection of respondents would be representative.

To determine biodiversity, I collected data from the fishermen engaged in fishing in those beels. Non-selective gear was used to collect the species composition of fish in those areas one time each month. I also visited the nearby fish markets of Baruna Ghaterbazar, Hajipur Ghaterbazar, and Bhairabgonj in order to learn more about the fish species that are collected from the study area and also the nearby area. I collected secondary data from various sources, including MACH project documents, reports, and other publications, to identify and better understand the impacts of fish sanctuaries on fish biodiversity, and the current management practices of the sanctuary. During each monthly visit, I also interviewed individual fishers to collect data about the type of fishing gear used, gear efficiency, dominant species caught, and the number of endangered species that have been revived.

There is a list of fishers in each village in the Upazila Fisheries Office. From this list, I selected those fishermen who had been engaged in fishing for several years, because they could provide historical information about fish biodiversity at the sites. As those normally engaged in fishing in this region are male, my target group for data collection was also male. To conduct the socio-economic survey of the villagers, I used a pre-tested, semi-structured questionnaire. This questionnaire included information about the following variables: age, sex, occupation, daily income, hygiene and sanitation, fish marketing channels, and attitudes towards the sanctuary.

I also conducted two focus group discussions (FGD), one in each village, to collect data about the current management practices of the sanctuary, implementation of the Fish Act, attitudes towards the sanctuary, perceived benefits from the sanctuary, current problems facing the sanctuary, and possible recommendations for enhancing its management.

All numerical data were tabulated into a spreadsheet and analyzed with Microsoft Excel. Qualitative information collected through FGDs and questionnaire surveys from the respondents was also analyzed in tabular format.

Results and Discussion

Current Management Practices of the Sanctuary

Baikka Beel Fish Sanctuary is managed by members of the Baragangina RMO. The Baragangina RMO is comprised of several members from 45 villages. There are multiple members including representatives of fishers, farmers, women, and local leaders. They follow a management plan that was prepared through consultation with local people and approved by a committee comprised of local officials, the union parishad chairman, and leaders of the community organizations. Members of this organization are also involved in managing different parts of Hail Haor.

There is also an observation tower in the sanctuary area of Baikka Beel. Baragangina RMO recruited two men to guard the sanctuary full time, in order to prevent fish poaching by some dishonest fishers in the sanctuary area. The guards only receive 4,500 BDT per month each as remuneration. In the wet season the area becomes much larger so they recruit an additional four men as guards. All these expenses are borne by the Baragangina RMO.

According to Ali *et al.* (2009), evidence from 12 case studies of fish sanctuaries in Bangladesh shows that management practices have deteriorated in eight cases due to weak capacity and conflicts in community organizations and a lack of government support; that practices have improved in two cases; and that they have remained the same in two cases. A comparison of the monitoring of biological and socio-economic parameters in one sanctuary site and a control site reveal better production and biodiversity performance in the sanctuary site. In the case of Baikka Beel Fish Sanctuary, I found that there is strong management by the local community and also that support from the local administration has yielded good results. Such factors could explain why practices have improved in some fish sanctuaries, but not in others.

Impact of Baikka Beel Fish Sanctuary on Biodiversity

To assess the impact of the fish sanctuary on biodiversity, I looked at the total number of fish species found, the presence and trend of each species in the two beels, the catch composition, and the extent of revival of previously threatened species.

Biodiversity based on catch monitoring data. During the study period, 31 species of fish were recorded in Balla Beel and 24 species were recorded in Sixty Two Beel. The

maximum number of species in both wetlands (27 and 24, respectively, as determined using different types of fishing gear) was found during the month of August. The number of species found during each month of my research in both of the wetlands is shown in Figure 2. According to MACH (2003), the number of fish species found during the baseline period was 71. Combining all six "impact years" defined by MACH (2001–2006), a total of 85 species have been recorded in Hail Haor. This number is for the whole haor, but the current study is only for two beels in the Hail Haor. In addition, the study period was only six months, and data collection was not so intensive, so the numbers of fish species differ from those found in the MACH study.

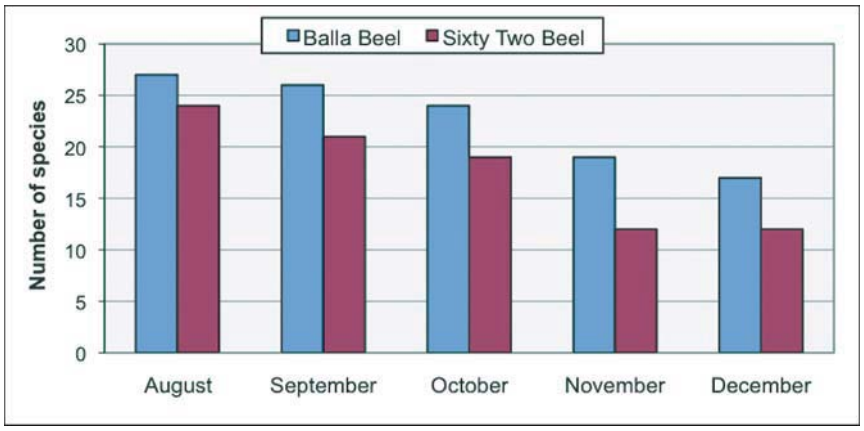

Figure 2: Number of species recorded from catch monitoring by month at two study sites (August–December 2011)

The above data show that in both beels the maximum number of species was found in the month of August, and that for each month it was lower in Sixty Two Beel than in Balla Beel. Normally the rainy season begins in Bangladesh in June or July and this is the peak breeding time for most fish species. In the wet season, all the beels in the Hail Haor area become part of a single water body. Thus, there is a close biological link between the sanctuary and the two beels in my study site. The decline of biodiversity over time may be related to the seasonal connectivity of the sanctuary with these beels. In the wet season, species diversity is generally high in the surrounding beels due to connectivity with the sanctuary; but in the dry season, the beels become separated from the sanctuary and species diversity in any one of them is lower.

In the winter season, the water level of the beels decreases and fishing intensifies in these smaller areas. The gradual decrease of fish species may be related to this. On the other hand, Balla Beel is currently managed by Baragangina RMO, and the associated restrictions and bans on the use of destructive types of fishing gear, as well as a more effective management system, may have contributed to a higher species

diversity in comparison with Sixty Two Beel. Sixty Two Beel is not under the management of an RMO and it is subject to a commercial leasing system. Leases are only valid for a limited time period, so leaseholders try to maximize profits by catching all the fish they can within this period. As a result, none of the legal restrictions, such as those of the Fish Act, are enforced in Sixty Two Beel.

Fish species found in Balla Beel and Sixty Two Beel. I identified a number of fish species from Balla Beel and Sixty Two Beel through catch monitoring data and discussions with fishers engaged in fishing in the two beels. During the study period, a total of 31 species were identified in Balla Beel and 24 species were identified in Sixty Two Beel. A list of these fish species is given in Table 1, along with the associated trend in proportion of catch in Hail Haor from the study by Thompson *et al.* (2007).

Table 1: Fish species found in Balla Beel and Sixty Two Beel during the study period

Sl No	Local Name	Scientific Name	Found in Balla Beel	Found in Sixty Two Beel	Trend in proportion in Hail Haor*
1	Ayre	*Aorichthys aor*	√	√	Decline
2	Baila	*Glossogobius giuris*	√	√	Increase
3	Bacha	*Eutropiichthys vacha*	√		-
4	Bighead	*Aristichthys nobilis*	√	√	-
5	Boal	*Wallago attu*	√	√	Decline
6	Bujuri tengra	*Mystus tengra*	√	√	Decline
7	Catla	*Catla catla*	√		Increase
8	Chapila	*Gudusia chapra*	√	√	-
9	Chital	*Chitala chitala*	√		-
10	Common carp	*Cyprinus carpio*	√	√	-
11	Darkina	*Esomus danricus*	√	√	Stable
12	Foli	*Notopterus notopterus*	√	√	Increase
13	Gazar	*Channa marulius*	√	√	-
14	Gonia	*Labeo gonius*	√	√	Increase
15	Golsa	*Mystus bleekeri*	√	√	Decline
16	Grass carp	*Ctenopharyngodon idella*	√	√	-
17	Gutum	*Lapedocephalus guntea*	√		-
18	Kakila	*Xenentodon cancila*	√	√	Increase
19	Kalibaush	*Labeo calbasu*	√		-
20	Kani pabda	*Ompok bimaculatus*	√		Increase
21	Koi	*Anabas testudineus*	√	√	Decline
22	Kholsa	*Colisa fasciata*	√	√	Decline
23	Lamba chanda	*Chanda nama*	√	√	-
24	Magur	*Clarias batrachus*	√	√	-
25	Mola	*Amblypharyngodon mola*	√	√	Increase
26	Ranga chanda	*Parambassis lala*	√		-
27	Sarputi	*Puntius sarana*	√	√	-
28	Shol	*Channa striatus*	√	√	Increase
29	Taki	*Channa punctatus*	√	√	-
30	Tit puti	*Puntius ticto*	√	√	Increase
31	Veda	*Nandus nandus*	√	√	-

*Source: Thompson *et al*. 2007. Note: Dash (-) means data is unavailable.

From the proportion trend of different fish species (Thompson *et al.* 2007), it appears that some species are declining in Hail Haor. However, in my study, most of the declining species were available in both of the beels. This may be partially due to the establishment of the Baikka Beel Sanctuary.

C***atch composition based on catch monitoring data.*** I have ranked the top 10 species according to their overall contribution to the total catch. In Balla Beel, common species caught by various types of gear (and their percentage of the total catch) were boal (W*allago attu,* 8.9%), taki (C*hanna punctatus,* 7.2%), shol (C*hanna striatus,* 6.5%), foli (N*otopterus notopterus,* 6.3%) and common carp (C*yprinus carpio,* 5.8%). This analysis reveals that 10 main species contributed 58.7% of the total catch by weight. Figure 3 shows the percentages of total catch for each of these 10 main species. In Balla Beel, W*allago attu* (boal) *i*s the species with the highest contribution to total catch in Balla Beel.

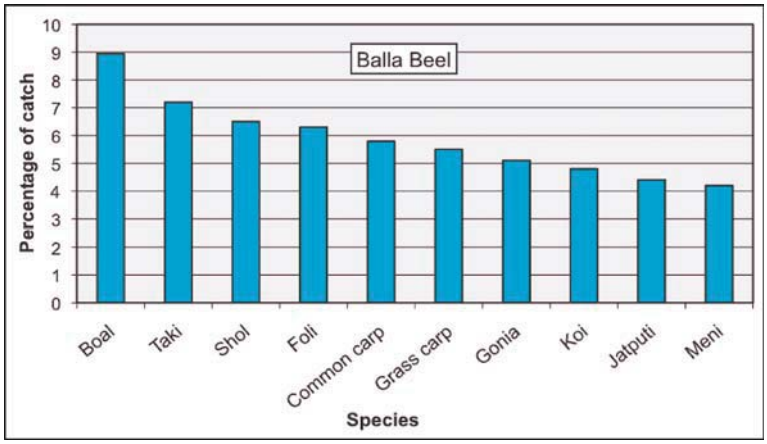

Figure 3: Percentage contribution to total catch of the 10 main species in Balla Beel

In the case of Sixty Two Beel, the most common species caught by various types of gear were boal (W*allago attu,* 8.40%), grass carp (C*tenopharyngodon idella,* 7.90%), gonia (L*abeo gonius,* 7.10%), foli (N*otopterus notopterus,* 6.45%), and shol (C*hanna striatus,* 6.12%). My analysis reveals that the 10 main species contributed 60.02% of the total catch by weight. The percentage contribution of the 10 main species to the total catch in Sixty Two Beel is shown in Figure 4. W*allago attu (*boal) is the species with the highest contribution to the total catch in Sixty Two Beel as well .

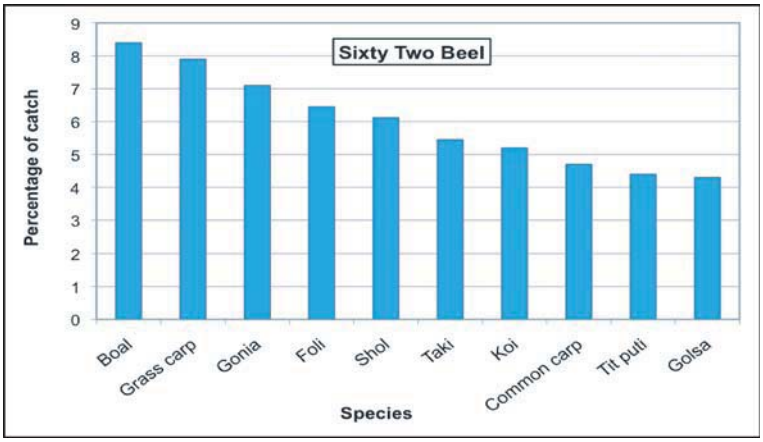

Figure 4: Percentage contribution to total catch of the 10 main species in Sixty Two Beel

From these results we see that the dominant species of the beels adjacent to Baikka Beel in Hail Haor is boal (W*allago attu)*. Some other exotic species like grass carp (C*tenopharyngodon idella) a*nd common carp (C*yprinus carpio)* are also common in both wetlands. This suggests the increasing trend towards the stocking of exotic species around the Baikka Beel. Although these species compete with native species for food and habitat, they are not directly harmful in terms of predation on native species or domination of total fish production. These results suggest that the Baikka Beel Fish Sanctuary helps to protect not only native species, but also some exotic species.

Species revived after establishment of the sanctuary. According to the catch monitoring data and interviews with community members, I found five species of fish that had been revived and are commonly caught now in the study area. These species were rare in that area before, but they are now more widely available due to the establishment of the sanctuary and to the managed reintroduction of some species. A list of these revived species is shown in Table 2.

Table 2: Fish species revived and their status after sanctuary establishmente

Local name	Scientific name	IUCN (2000) status	Current status in the sites*
Kani pabda	*Ompok bimaculatus*	Endangered	Common
Sarputi	*Puntius sarana*	Critically endangered	Common
Meni/Veda	*Nandus nandus*	Vulnerable	Abundant
Gonia	*Labeo gonius*	Endangered	Abundant
Chital	*Chitala chitala*	Endangered	Common

*Note: Assessment based on local fishers' perceptions

These revivals are due to the re-introduction of some species in the sanctuary area and to the creation of a suitable environment for breeding of these species by providing shelter, restoring habitat, guarding them from theft, and facilitating their movement. Because of the high connectivity among the beels during the monsoon season, the presence of these species in Balla Beel and Sixty Two Beel can be used as a proxy for their availability in the Baikka Beel Sanctuary.

Current Fishing Practices and Implications for Biodiversity

Major gear used in the beels. Various types of fishing gear are used in Balla Beel and Sixty Two Beel, as well as in Hail Haor. The type of gear used differs according to the target species, type of water body, labor intensity, cost, materials available, and profit. Cast nets, spears, lift nets, and gill nets are operated both day and night. However, the trap units are used only at night, while push nets and seine nets are used only during the daytime. Furthermore, the use of spears and lift nets is seasonal, limited to the wet season. A list of the most common gear used in the two beels is included in Table 3.

Table 3: Name, use, and impact of common gear types used in the study area

Name of gear	Local Bengali name	Main use of the gear types	Impact on biodiversity
Gill net	Pata jal, Fash jal, Current jal	Mono-filament gill net (current jal); the most effective for catching small fish	High: The most commonly used and most destructive for fish biodiversity
Seine net	Ber jal, Jagat ber jal, Katha ber jal	More fish are caught by seine nets than any other basic method. Can have large, medium or very small mesh. Operated from water bank	Medium/High: Impact depends on mesh size; small-mesh seine net (chat jal) is much more destructive than small-mesh gill nets
Lift net	Dharma jal/Veshal jal	Common and primitive nets used all	Medium: Use of this gear during post breeding season is destructive for biodiversity
Cast net	Khepla jal, Toira jal, Jhaki jal	over the country, operated by a single person on the bank, in shallow water, or from a boat in open areas	Low: Generally not harmful for fish biodiversity
Push net	Thela jal	Small net mounted on a triangular bamboo frame. Used in late monsoon and dry seasons.	Medium: Harmful during post breeding season
Trap	Kholsun, Polo, Charai, Fala, Bair	Generally set in the water in the evening and carefully pulled up during early morning	Medium: Harmful during post breeding season
Spear	Achra, Koch, Teta	Spears are used during early and late monsoon periods	Low: Not harmful
Others	Bana, Katha, Kua, by Hand	In dry season, fish are often caught with these traditional gear types.	Low: Not harmful

Gear efficiency. Use of different fishing gear and traps can also serve as a rough indicator of the availability of different fish species. Some gear is species-selective such as gill nets, traps, hook and lines, and long lines. After assessing the efficiency of each gear type, I observed that gill nets resulted in the highest catch during the study period in both Balla Beel (29%) and Sixty Two Beel (36%), while fish traps produced the second highest catch in both Balla Beel (23%) and Sixty Two Beel

(28%). The proportion of catch using different types of fishing gear and traps in the two beels is presented in Figure 5.

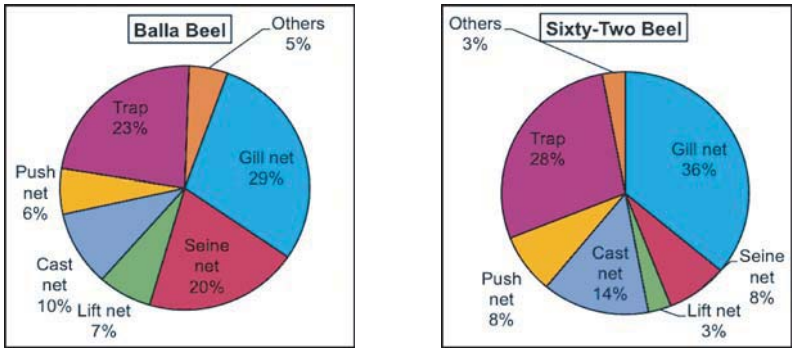

Figure 5: Proportion of catch by different gear types in Balla Beel and Sixty Two Beel

Gill nets are mainly used in open water bodies, including those of Balla Beel and Sixty Two Beel, because they are cheaper and require less effort to operate. Due to these characteristics, they can harvest many fish, especially small ones, which makes small-meshed gill nets especially harmful for fish biodiversity. The use of various types of gill nets and traps in the breeding season is excessive in both beels and is very harmful for both fish fry and small indigenous species. Therefore, it should be a matter of concern to the local administrative authorities. In order to address this issue, the use of different types of fishing gear (such as small-meshed gill nets and small-meshed seine nets) must be restricted during the breeding season.

Local Community Perceptions towards the Effectiveness of the Fish Sanctuary

I asked the respondents in each village about the sanctuary by using a questionnaire to gather information about community perceptions towards the sanctuary. Out of the 40 respondents, none had a negative perception of the sanctuary, but the level of positivity varied. Nineteen respondents (47.5%) indicated that this sanctuary is very effective in regards to increasing fish biodiversity. Fourteen respondents (35%) responded that it is "effective in regards to increasing fish catch," and only seven (17.5%) responded that the sanctuary was effective in regards to both increasing fish catch and improving fish biodiversity. No one responded that the sanctuary was "not effective" in achieving these outcomes. The responses of the local community towards the sanctuary are summarized in Table 4.

Table 4: Perceptions of local community towards effectiveness of Baikka Beel Sanctuary

Perceptions	Number of respondents
Baikka Beel Fish Sanctuary is very effective in regards to increasing fish biodiversity.	19 (47.5%)
Baikka Beel Fish Sanctuary is very effective in regards to increasing fish catch.	14 (35%)
Baikka Beel Fish Sanctuary is effective in regards to both increasing fish catch and improving fish biodiversity.	7 (17.5%)
Baikka Beel Fish Sanctuary is not effective in achieving any of these outcomes.	0 (0%)

Note: Due to multiple responses, totals equal more than 100 percent.

Direct and Indirect Benefits to Local Fishers from Baikka Beel Fish Sanctuary

To assess the positive effects local fishers receive from the sanctuary, I asked all 40 respondents about both direct and indirect benefits. Thirty respondents (75%) believe that their fish catch has increased due to the establishment of the fish sanctuary; and 26 respondents (65%) reported that they have benefited from a better food supply. Views on the specific direct and indirect benefits, and the number of fishers who reported receiving them, are shown in Table 5.

Table 5: Perceived direct and indirect benefits from the Baikka Beel sanctuary

Direct benefits	Number of respondents	Indirect benefits	Number of respondents
Increased fish catch	30 (75%)	Improved housing facilities	20 (50%)
Income increased	12 (30%)	More food available	26 (65%)
Increased fish intake	24 (60%)	Improved sanitation facilities	16 (40%)
Employment opportunities	8 (20%)	Better health facilities	22 (55%)
Saved money	12 (30%)	Improved education facilities	23 (57.5%)

Note: Due to multiple responses, totals equal more than 100 percent.

According to MACH (2003), the overall fish consumption increased significantly in all sites including the Hail Haor. Major findings indicate that small-beel and wetland resident fish and prawns constitute the main fish consumed for all households, and particularly among poorer households.

Problems and Recommendations Regarding Baikka Beel Fish Sanctuary

As fish become more abundant in a sanctuary it becomes more attractive for poaching; this is a major problem for the Baikka Beel Fish Sanctuary. By setting a gill net (current jal), one can catch a lot of fish easily. Using brush piles or other

structures in the sanctuary to deter such practices by creating obstacles helps to reduce this risk, but negligence or dishonesty by guards is a big risk. Another potential problem is that naturally occurring extreme drought or the pumping of water out of the sanctuary for agriculture can reduce the water depth and area of the beel, resulting in heavy natural mortality and degradation of water quality, and increasing the likelihood of fish disease outbreaks.

The most important part of a sanctuary is its management, especially protection against poaching. Community participation and co-management approaches have, in many cases, proven to be more effective than traditional approaches, with higher compliance with rules, provided that the community is properly organized and motivated. Precautionary measures have to be taken to protect major species and to maintain the sustainability of the resources.

The use of seine and gill nets (mono-filament) needs to be reduced during the peak breeding season. And also the high dependence on fishing of the local community must be reduced. There is a need to establish more sanctuaries in the Hail Haor area that are effectively managed by the local community, like Baikka Beel Sanctuary. Some additional sanctuaries were established in the Hail Haor area based on the fisher community's interests, but they are not well managed yet.

Siltation is another issue. It results in a raised bottom of the beel and therefore the overall water level of the sanctuary drops. Fish movements are more visible due to this low water level. This can contribute to poaching in the sanctuary area. Excavation of the sanctuary site is the best remedy for this problem. Leasing of the beels for commercial harvesting adjacent to Baikka Beel is another problem that must be addressed. The Ministry of Land through the Deputy Commissioner and the Upazila Nirbahi Officer has taken steps to lease out some of the beels adjacent to Baikka Beel, which could have an effect on Baikka Beel itself. Those who take a lease from the government have no incentive to take any steps to safeguard the ecological integrity or biodiversity of the beels. As a result, the biodiversity of the area may decrease in the future. To solve this problem, the best approach would be to cancel these leases.

Conclusion

From the data collected from the adjacent beels, and also from the perceptions of local people dependent on the beels, it is clear that the Baikka Beel Fish Sanctuary is quite effective in terms of promoting the restoration of fish biodiversity and fish production. It also indirectly affects the livelihoods of the surrounding communities. The management practices in this sanctuary are based on a community approach. This approach can be replicated in other parts of the country. This study also identified some issues that need to be addressed.

Future management and development plans for the Baikka Beel Fish Sanctuary should be geared towards improving fish diversity, conservation, and restoration. The fishing communities adjacent to the beels are an important component of this management. There are several fisher groups in the Baikka Beel area that have traditionally been engaged in fishing as their full-time occupation. This study is encouraging because it suggests that the overall fish biodiversity in Balla Beel and Sixty Two Beel is increasing, perhaps as a result of the establishment of the Baikka Beel Fish Sanctuary, which has been supported by the Government of Bangladesh, the MACH program, other NGOs, the upazila administration, local government, and the community members themselves.

Thus, careful planning, required management and regulatory practices, and active community participation in management can have a positive impact on fish biodiversity. However, more long-term, participatory research is needed to gain greater insights into fish biodiversity trends in the Baikka Beel Fish Sanctuary and its effect on adjacent beels. This type of research is very important for biodiversity conservation and natural resources management. It is needed both for better planning and for raising awareness among policymakers, government agencies, NGOs, and local community members.

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Impact of Co-management on Fish Biodiversity in Dhali-Baila Beel, Kangsha-Malijhee, Sherpur District

Mohammad Abdur Rouf

Abstract

Community-based co-management is an effective tool for the sustainable management of open water bodies. Through this approach, the management of fisheries resources in open water bodies is led by local communities, with the support of local administrators. This paper discusses the present status of fish biodiversity, as well as the impacts of co-management on fish biodiversity at Dhali-Baila Beel (a MACH site) and Shaitandaha Beel (a non-MACH site) in Sherpur District of Bangladesh. Data were collected through field visits, observations, consultations with community members and key informants, focus group discussions, and one-on-one interviews using questionnaires. Forty-four fish species were recorded at the MACH site and 15 fish species were found at the non-MACH site. The average fish production was 313 kilograms per hectare at the MACH site, and 196 kilograms per hectare at the non-MACH site. Eleven fish species were found to be endangered at the non-MACH site, compared to only one species at the MACH site. Furthermore, eight fish species were revived at the MACH site and no fish species was revived at the non-MACH site. Destructive fishing gear was used less frequently for fishing at the MACH site than at the non-MACH site. In addition, 95 percent of respondents are aware of the establishment of the fish sanctuary; 88 percent acknowledge a need for better enforcement of the Protection and Conservation of Fish Act; 89 percent recognize the accomplishments of the fingerling stocking program; and 100 percent feel that the implementation of alternative income-generating activities has had a positive impact on biodiversity conservation overall. The results of this research indicate that fish biodiversity at the MACH site is richer than at the non-MACH site, and that the impacts of co-management on fish biodiversity conservation in this important wetland ecosystem have been positive overall.

Introduction

Bangladesh is a country of numerous rivers, *haors* (floodplain areas that are inundated during the monsoon season), *baors* (oxbow lakes, where water remains throughout the year), *beels* (deeper depressions where water remains throughout the

Senior Upazila Fisheries Officer, Mitamoin, Kishoregonj

year) and canals. The country also has rich fishery resources. About 4.64 million hectares, or 33 percent of the total area of Bangladesh, are occupied by inland fisheries resources. The fisheries sector plays an important role in the economy of Bangladesh, contributing 3.74 percent of the annual gross domestic product and comprising 22.23 percent of the total agricultural sector and 2.70 percent of all export earnings. Furthermore, fish supplies 58 percent of the nation's animal protein. About 10 percent of people in Bangladesh are directly or indirectly dependent on the fisheries sector for their livelihoods (DoF 2011). But fish production is gradually declining in Bangladesh due to a number of factors, including natural degradation through siltation and the loss of natural breeding grounds, as well as human interventions like catching young and undersized fish, unregulated use of insecticides and pesticides, and construction of bridges, embankments, dams, and culverts that disturb the aquatic ecosystem. These activities have negatively affected the breeding, growth, and development of natural fish populations, resulting in depleted fish stocks and reduced animal protein supplies. Moreover, intensive fishing, the conversion of wetlands into agricultural lands, and the use of agrochemicals continually reduce and degrade fish habitat. According to the International Union for Conservation of Nature (IUCN), among the 260 freshwater fish species in Bangladesh, 54 are threatened, 12 are critically endangered, 28 are endangered, and 14 are vulnerable (IUCN 2000).

In the fisheries context, co-management is defined as "a management arrangement whereby government and user groups share responsibility for managing and utilizing fishery resources with the goal of achieving a balance between economic and social goals, and within a framework of preserving ecosystem and fishery resources" (Nielsen 1996). Co-management represents an important tool for realizing the sustainable management of inland fisheries resources. Since 1998, the Management of Aquatic Ecosystems through Community Husbandry (MACH) project has been working in different wetlands to conserve biodiversity through a community-based co-management approach and promoting a sustainable supply of food for the poor of Bangladesh. As a result of MACH's accomplishments, more than 50,000 people have benefited from ecosystem and biodiversity preservation, most directly through increased fish production and improved nutrition and incomes (MACH 2004). At MACH sites where fish production had previously been in decline, production increased by 39 percent from 2000 to 2003, from 144 kilograms per hectare to 200 kilograms per hectare (MACH 2004). Through a community-based fisheries co-management project in Mitamoin Upazila of Kishoreganj District, six sanctuaries were established in Dopi Beel and nine in Mohisherkandi Boranpur Beel (Azher *et al.* 2007b). Due to numerous co-management activities, fish production in these two beels was three times greater than in Borodhiga Beel and Chotadhiga Beel, where co-management activities were not implemented (Azher *et al.* 2007a).

Dhali-Baila Beel of Jhenaigati Upazila in Sherpur District is a target area of the Integrated Protected Area Co-management (IPAC) project at the Kangsha-Malijhee

site, which is rich in fish biodiversity. In this area, many people's livelihoods are fully dependent on wetland resources. The MACH project has been working there for more than 10 years. The project formed a resource management organization (RMO) and a resource users group (RUG) to promote proper management and sustainable use of wetland resources. Staff members and officials from the RMO, RUG, MACH project, local government, Department of Fisheries (DoF), and local administration are all directly involved in the co-management of Dhali-Baila Beel.

The main objective of this research is to study the present status of fish biodiversity and to examine how co-management contributes to its conservation at Dhali-Baila Beel in Jhenaigati Upazila of Sherpur District. More specifically, this study seeks to compare fish biodiversity at a MACH site (Dhali-Baila Beel) to that of a non-MACH site (Shaitandaha Beel).

Background

The study area is located in north-central Bangladesh in the Jhenaigati and Sreebordi Upazilas of Sherpur District (Figure 1). Geographically, these areas are a part of the Garo and Tura Hills and include the catchments of the upper Kangsha and Malijhee river systems. The areas were once covered with natural sal (*Shorea robusta*) forests, but these have now disappeared and only managed secondary forests remain. The wetland/floodplain of Jhenaigati Upazila comprises approximately 8,000 hectares during the wet season, diminishing to only about 900 hectares in the dry season. The floodplain contains 47 beels, of which 18 are perennial (MACH 2004). The total area is about 231 square kilometers and the population is approximately 165,000. The total area of Sreebordi Upazila is about 252 square kilometers and the population is approximately 242,320. The floodplain area of Sreebordi Upazila contains 15 beels that cover nearly 150 hectares during the wet season.

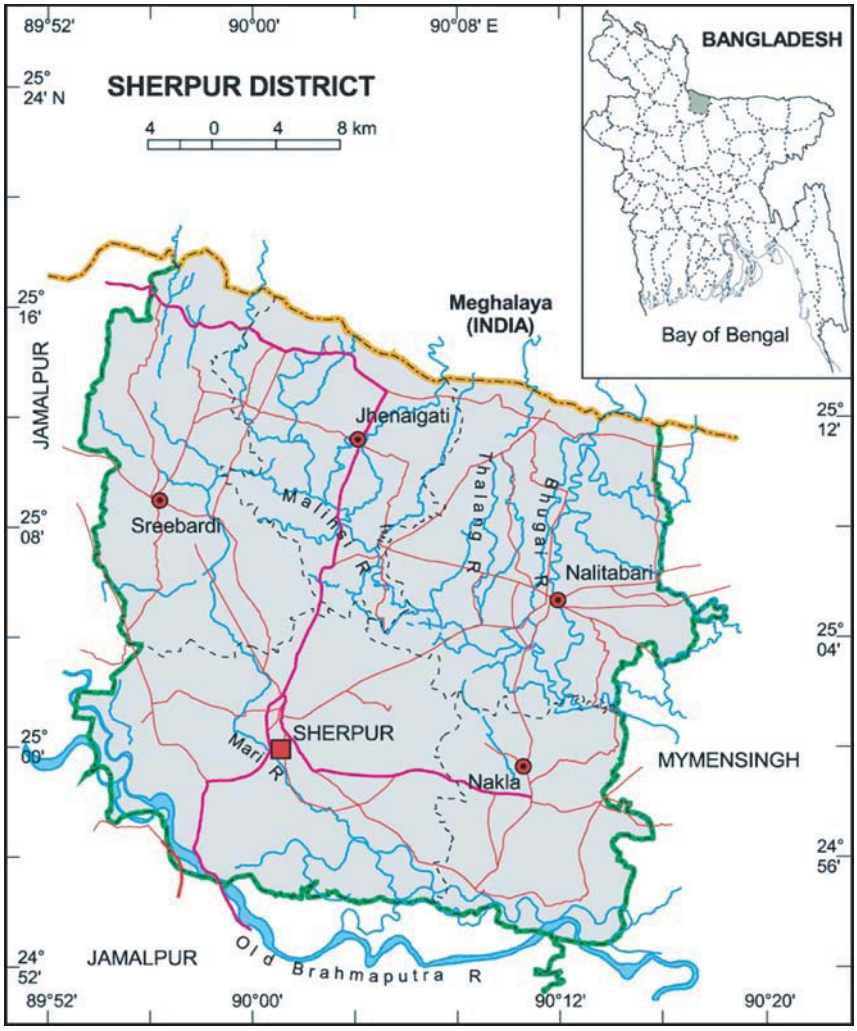

Figure 1: Map of the study area, Sherpur District, Bangladesh (Source: Banglapedia 2006)

The study site is a flash-flood prone area. Farmers suffer heavy damage to their crops from the Shomeswari, Malijhee, and Chellahkhaly rivers more than once each year as water spills over the banks, flooding large portions of the area. Employment opportunities are limited. Villagers in this area who reside near water bodies are mostly fishers and depend primarily on fishing for their livelihoods. The socio-economic condition of the people is poor.

Dhali-Baila Beel is situated in the southwest corner of Jhenaigati Upazila,

approximately 12 kilometers from the Upazila headquarters in Jhenaigati Sadar Union. Shaitandaha Beel is situated in the southeast corner of Sreebordi Upazila, approximately 10 kilometers from the Upazila headquarters in Kurikahonia Union. The surveyed villages of Sarikalinagar and Darikalinagar are adjacent to Dhali-Baila Beel and Indilpur and Garjaripa are adjacent to Shaitandaha Beel.

Methods

After discussions with DoF officials and IPAC staff members, and after reviewing MACH/IPAC reports, I chose four villages Sarikalinagar, Darikalinagar, Indilpur, and Garjaripa for my study sites. Of these villages, the two adjacent to Dhali-Baila Beel (Sarikalinagar and Darikalinagar) are MACH sites, while the two adjacent to Shaitandaha Beel (Indilpur and Garjaripa) are non-MACH sites. The main criteria for selecting these villages were: (1) they are predominantly surrounded by the beel area and are easily accessible, and (2) a high number of subsistence fishers and MACH beneficiaries reside in them.

I gathered both primary and secondary data, using four different techniques for primary data collection. These included field visits and observations, group consultations with community people and key informants, focus group discussions, and one-on-one interviews using semi-structured questionnaires. I gathered secondary data by consulting relevant published and unpublished documents, including reports from the DoF, the Department of Agricultural Extension, the Local Government and Engineering Department, and other relevant organizations. While collecting data from fishers in all villages, I defined fishers as people who use any type of fishing gear for fishing (because of time limitations I could not sample by gear type), and who are long-term residents who have been fishing in the study area from at least 1998 to the present.

At the beginning of the study, I discussed with the local inhabitants and key informants in each village about the background of the area and local communities, the current beel conditions, the local co-management activities, and the present livelihood conditions. At the MACH sites, I first introduced myself to the target groups in my study villages at the RMO/RUG offices in Darikalinagar and Sarikalinagar and informed them about the purpose of my visit and survey.

At the MACH site, I completed two focus group discussions and three individual interviews with community members in each village per visit. One discussion was held with the RMO members, another discussion was conducted with the RUG members. I also selected two members from one of the Dhali-Baila RMOs, five members from one of the Dhali-Baila RUGs, and three subsistence fishers from each village for individual interviews. These interviews were conducted at the RMO office, at the RUG office, and on the bank and in adjacent villages of the beel. The

interviewees were selected randomly from the group members and the subsistence fishers. Interviews took 20 to 30 minutes for each group and 15 to 20 minutes for each individual. At the non-MACH sites, I interviewed five subsistence fishers in each of the two villages, Indilpur and Garjaripa, using the prepared questionnaire. All interviewees were selected randomly. Each interview took 15 to 20 minutes for each individual.

Data were collected two times per month between August 2011 and December 2011. Focus group discussions were designed to help me learn more about co-management objectives, overall beel management activities, the benefits of participating in co-management, and the problems and recommendations of each group.

Information was collected from the study area through a focus group discussion and one-on-one interviews with the subsistence fishers using prepared questionnaires in order to gather knowledge about fish production (kilograms per hectare), and species composition at the MACH and non-MACH sites, and about the impact of co-management on fish biodiversity at Dhali-Baila Beel (the MACH site). A summary of the research activities is shown in Table 1.

The monthly production (i.e. catch) of fish was calculated using the following formula:

$$P = A \times D \times F$$

Where, P = Production per month
A = Amount (kg) of fish caught per fisher per day
D = Average fishing days per fisher per month
F = Average number of fishers per day

The average production (kilograms per hectare) was derived from the total monthly production divided by total area of the beel.

Table 1: Summary of the research activities

Management regime	Research activities	Location	Number of interviews/ discussions	Number of interviewees	Total interviewees
MACH site	Discussions	Darikalinagar	9	63	179
		Sarikalinagar	9	63	
	Interviews	Darikalinagar	27	27	
		Sarikalinagar	26	26	
Non-MACH site	Interviews	Indilpur	45	45	90
		Garjaripa	45	45	

Results and Discussion

Fish Production

In order to determine the fish production of Dhali-Baila Beel, the MACH site, I conducted interviews with 179 respondents, including the RMO and RUG members and the subsistence fishers of Darikalinagar and Sarikalinagar villages, using a prepared questionnaire. To contrast this with fish production at the non-MACH site, Shaitandaha Beel, I conducted interviews with 90 subsistence fishers of Garjaripa and Indilpur villages using the same questionnaire.

These efforts showed that the average fish production was approximately 313 kilograms per hectare in Dhali-Baila Beel and 196 kilograms per hectare in Shaitandaha Beel. A maximum fish production of 523 kilograms per hectare and 284 kilograms per hectare were recorded in September, while a minimum production of 119 kilograms per hectare and 103 kilograms per hectare were recorded in December at Dhali-Baila Beel and at Shaitandaha Beel respectively. The high fish production in September may be due to the fact that this is the peak fishing season, while the low catch per hectare in December may have occurred because fishing resources are often depleted at this time. Data for the high and low production at Dhali-Baila Beel match closely with the data (279 kilogram per hectare) recorded in the catch monitoring study conducted by IPAC (2012).

The average monthly fish production at Dhali-Baila Beel is 313 kilograms per hectare, which is significantly higher than both Shaitandaha Beel's 196 kilograms per hectare and the MACH baseline survey's report of 144 kilograms per hectare (MACH 2004). It is also similar to the results (279 kilogram per hectare) of the IPAC catch monitoring report (IPAC 2012). Fish production data from Dhali-Baila Beel and Shaitandaha Beel are shown in Figure 2.

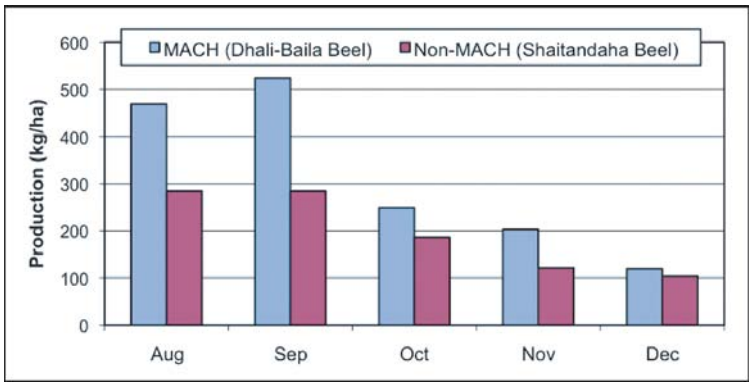

Figure 2: Fish production at the MACH and non-MACH sites

Fish Species Composition

During the study period, I recorded a total of 44 and 15 species of fish in Dhali-Baila Beel and Shaitandaha Beel, respectively. Furthermore, highs of 23 and 8 fish species were found in December, and lows of 17 and 7 fish species were found in November at Dhali-Baila Beel and Shaitandaha Beel, respectively. These numbers were supported by eight interviewees. More species were harvested in December because the receding water in the water bodies makes it easier for fish to be caught by different types of gear and traps. There was no noticeable difference in the gear used in the two beels; fish were caught using various types of fishing gear and traps like gill nets, seine nets, long lines, spears, cast nets, push nets, and lift nets in both beels during the study period. The fish species that were recorded in the study period at Dhali-Baila Beel and at Shaitandaha Beel are given in Table 2.

Table 2: Fish species recorded at Dhali-Baila Beel and Shaitandaha Beel

Local name	Scientific name	Dhali-Baila Beel (MACH site)	Shaitandaha Beel (non-MACH site)
Boal	*Wallago attu*	√	√
Tengra	*Mystus vittatus*	√	√
Baila	*Glossogobius giuris*	√	-
Taki	*Channa punctatus*	√	√
Rui	*Labeo rohita*	√	√
Mrigal	*Cirrhinus cirrhosus*	√	√
Mani/beda	*Nandus nandus*	√	-
Deshi puti	*Puntius sarana*	√	-
Mola	*Amblypharyngodon mola*	√	√
Phulchela	*Salmostoma phulo*	√	-
Narkal chela	*Salmostoma bacaila*	√	-
Chanda	*Chanda nama*	√	√
Carpeo	*Cyprinus carpio*	√	-
Air	*Aorichthys aor*	√	-
Guzi	*Aorichthys seenghala*	√	-
Darkina	*Esomus danricus*	√	√
Titputi	*Puntius ticto*	√	-
Borobaim	*Mastacembelus armatus*	√	√
Cheng	*Channa orientalis*	√	√
Pabda	*Ompok pabda*	√	-
Batai/Batasi	*Pseudeutropius atherinoides*	√	√
Guchibaim	*Macrognathus pancalus*	√	√
Dhela	*Osteobrama cotio*	√	-
Kalibaush	*Labeo calbasu*	√	-
Chingri	Chingri (prawn)	√	√
Bujuri	*Mystus tengara*	√	-
Chapila	*Gudusia chapra*	√	-
Cheka	*Chaca chaca*	√	-
Darkina	*Rasbora daniconius*	√	-
Foli	*Notopterus notopterus*	√	-
Gutum	*Nemachilus botia*	√	-
Grass carp	*Ctenopharyngodon idella*	√	-
Ghonoa	*Labeo gonius*	√	-
Kajuli	*Ailia coila*	√	-
Kakila	*Xenentodon cancila*	√	-
Magur	*Clarias batrachus*	√	-
Shoal	*Channa striatus*	√	-
Shing	*Heteropneustes fossilis*	√	-
Kuche	*Monopterus cuchia*	√	-
Gulsha	*Mystus cavasius*	√	-
Koi	*Anabas testudineus*	√	√
Kholisha	*Colisa chuna*	√	-
Catla	*Catla catla*	√	-
Chela	*Chela bacaila*	√	√
TOTALS		44	15

The total number of fish species recorded at Dhali-Baila Beel during the study period was 44, which is comparable to the IPAC study results (32 species) (IPAC 2012). This is significantly more than the 15 species recorded at Shaitandaha Beel. The total number of fish species found at MACH and non-MACH sites during each month of the study period is shown in Figure 3.

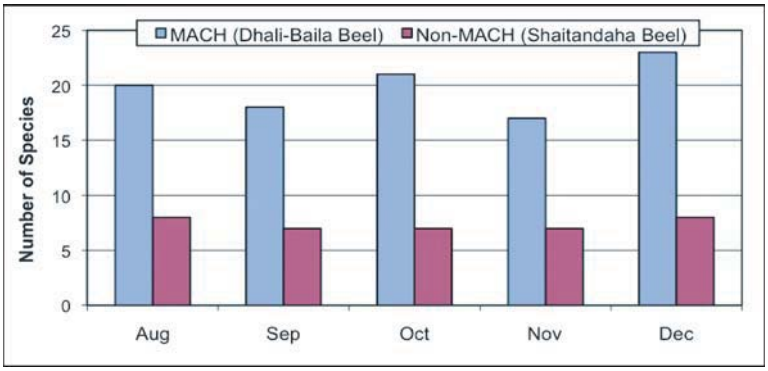

Figure 3: Fish species found at the MACH and non-MACH sites

A greater number of small *chingri* (prawns) were caught at Shaitandaha Beel compared to other species. Graaf *et al.* (2001) argue that the presence of a high proportion of shrimp in floodplain catches is an indicator of a fishery that has been severely damaged, as it lacks appropriate conditions for the breeding and recruitment of larger beel-resident fish. Therefore, this could be an indicator of the poor state of fish biodiversity at Shaitandaha Beel.

Endangered Fish Species

In my study, the interviews with community members revealed that one fish species is endangered at Dhali-Baila Beel and 11 fish species are endangered at Shaitandaha Beel. The fish species that are endangered at Dhali-Baila Beel and Shaitandaha Beel are shown in Table 3.

Table 3: Species of fish endangered at Dhali-Baila Beel and at Shaitandaha Beel

Local name	Scientific name	Dhali-Baila Beel	Shaitandaha Beel
Gozar	*Channa marulius*	√	√
Mani/beda	*Nandus nandus*	-	√
Deshi puti	*Puntius sarana*	-	√
Shoal	*Channa striatus*	-	√
Pabda	*Ompok pabda*	-	√
Kalibaush	*Labeo calbasu*	-	√
Chital	*Notopterus chitala*	-	√
Gulsha	*Mystus cavasius*	-	√
Koi	*Anabas testudineus*	-	√
Kholisha	*Colisa chuna*	-	√
Magur	*Clarias batrachus*	-	√
TOTAL		1	11

Using a questionnaire, I collected information from members of the RMOs, RUGs, and subsistence fishers on the incidence of endangered fish species in my study area. At the non-MACH site, I found that, out of 179 respondents, 21 respondents (12%) said that deshi puti *i*s non-existent, 56 (31%) said mani/beda *i*s non-existent, 47 (26%) said that shoal is non-existent, 20 (11%) said gozar is non-existent, six (3%) said koi is non-existent, and a few respondents said kalibaush, gulsha, pabda, kholisha, and magur are all non-existent. In contrast, at the MACH site, eight (4.5%) of the respondents said that gozar is non-existent. Respondents' perceptions of the incidence of endangered species at the MACH site and non-MACH site are shown in Figure 4.

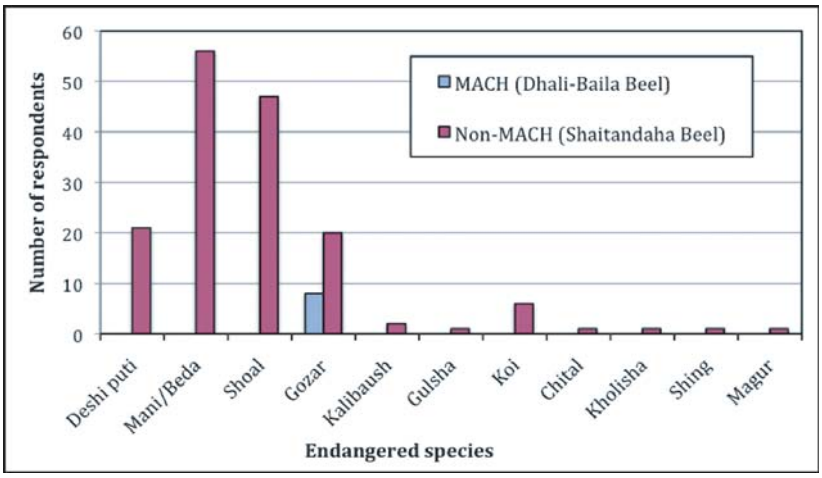

Figure 4: Perceived incidence of endangered fish species at MACH and non-MACH sites

Eleven fish species were recorded as endangered at Shaitandaha Beel during the study period, which is significantly greater than the number at Dhali-Baila Beel. A smaller number of endangered fish species indicates better management of water bodies and suggests a positive impact of co-management on fish biodiversity in general.

Revived Species of Fish

My interviews with members of the RMOs, RUGs, and subsistence fishers revealed that eight species of fish were revived and are currently caught in sufficient quantity at the MACH site. Eight fish species (N*andus nandus, Puntius sarana, Amblypharyngodon mola, Ompok pabda, Labeo calbasu, Notopterus notopterus, Heteropneustes fossilis,* a*nd Channa marulius)* were recorded as revived at Dhali-Baila Beel, and none were recorded revived at Shaitandaha Beel. This too suggests that co-management could be contributing to the better management of water bodies and having positive impacts on fish biodiversity.

Use of Destructive Gear

I found that destructive fishing gear was used less frequently for fishing at the MACH site than at the non-MACH site during my study period. In August, September, and December two (MACH site) and three (non-MACH site) uses of destructive gear use were recorded and in October and November one (MACH) and two (non-MACH) uses of destructive gear were recorded. The lower use of destructive gear at the MACH site is also a potential indicator of the positive influence of co-management on sustainable management of water bodies and fish biodiversity conservation. The number of uses of destructive gear at the MACH and non-MACH sites is shown in Figure 5.

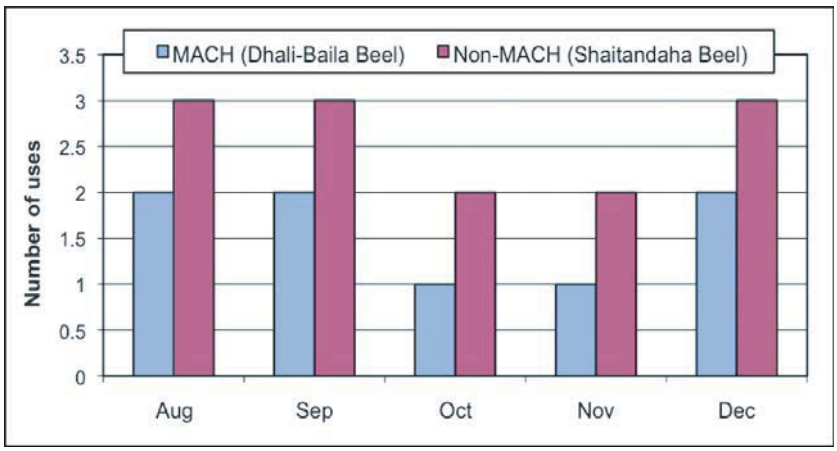

Figure 5: Number of uses of destructive gear at the MACH and non-MACH site

Impact of the Fish Sanctuary on Fish Biodiversity Conservation

To gauge the impact of the sanctuary on fish biodiversity conservation, I asked the respondents (RMO and RUG members and subsistence fishers) whether they perceive any positive impacts of the sanctuary on fish biodiversity conservation. None of the 179 respondents perceived a negative impact, 170 (95%) perceived a positive impact, and nine respondents (5%) gave no comment. The perceptions of community members of the impacts of the sanctuary on fish biodiversity are summarized in Table 4.

Table 4: Community perceptions of the impact of the sanctuary on fish biodiversity

Month	Positive (%)	Negative (%)	No comment (%)	Total respondents
August	39 (100)	0 (0)	0	39
September	35 (87.5)	0 (0)	5 (12.5)	40
October	38 (95)	0 (0)	2 (5)	40
November	100	0 (0)	0	40
December	18 (90)	0 (0)	2 (10)	20
Average	95%	0%	5%	35.8

Impact of Enforcement of the Fish Act on Fish Biodiversity

I collected some information about local community members' perceptions of the impact on fish biodiversity of enforcement of the Protection and Conservation of Fish Act through a questionnaire. I found that, of the 179 respondents, none (100%) perceived negative impacts, while 157 (88%) perceived positive impacts, and 22 (12%) gave no comment (see Table 5).

Table 5: Perceptions of the impact of enforcement of the Fish Act on fish biodiversity

Month	Positive (%)	Negative (%)	No comment (%)	Total respondents
August	36 (92)	0 (0)	3 (8)	39
September	34 (85)	0 (0)	6 (15)	40
October	38 (95)	0 (0)	2 (5)	40
November	35 (87.5)	0 (0)	5 (12.5)	40
December	16 (80)	0 (0)	4 (20)	20
Average	88.0%	0%	12.0%	35.8

Impact of Fingerling Stocking on Fish Biodiversity

I collected information about local community members' perceptions about the impact of stocking of fingerlings on fish biodiversity. Out of the 179 respondents, none perceived a negative result and 159 (89%) perceived a positive result, while 20 (11%) had no comment (Table 6).

Table 6: Community perceptions of impact of fingerling stocking on fish biodiversity

Month	Positive (%)	Negative (%)	No comment (%)	Total respondents
August	38 (97)	0 (0)	1 (3)	39
September	40 (100)	0 (0)	0 (0)	40
October	38 (95)	0 (0)	2 (5)	40
November	33 (82.5)	0 (0)	7 (17.5)	40
December	28 (70)	0 (0)	12 (30)	40
Average	89%	0%	11%	39.8

Impact of AIGAs on Fish Biodiversity Conservation

I gathered some information on local community members' perceptions of the impact of alternative income-generating activities (AIGAs) on fish biodiversity conservation by asking them whether they think AIGAs are helpful or not in promoting the conservation of fish biodiversity. I found that all 126 respondents (28 per month from August to November, and 14 in December) felt there was a positive impact on fish biodiversity conservation (Table 7).

Table 7: Community perceptions of the impact of AIGAs on fish biodiversity

Month	Positive (%)	Negative (%)	No comment (%)	Total respondents
August	28 (100)	0 (0)	0 (0)	28
September	28 (100)	0 (0)	0 (0)	28
October	28 (100)	0 (0)	0 (0)	28
November	28 (100)	0 (0)	0 (0)	28
December	14 (100)	0 (0)	0 (0)	14
Average	100%	0%	0%	25.2
			TOTAL =	126

Conclusion

This research was designed to study the impacts of co-management on freshwater fish production and fish biodiversity in Dhali-Baila Beel, by comparing this MACH site with a non-MACH site (Shaitandaha Beel), and to study the impact of co-management on local people's behavior, as well as their perceptions of co-management at the MACH site. It was conducted over a six-month period, from July to December 2011.

Average monthly fish production (i.e. catch) was estimated to be 313 kilograms/hectare in Dhali-Baila Beel and 196 kilograms per hectare in Shaitandaha

Beel. A maximum fish production of 524 kilograms per hectare and 284 kilograms per hectare were recorded in September 2011, and a minimum production of 119 kilograms per hectare and 103 kilograms per hectare were recorded in December 2011 at Dhali-Baila Beel and Shaitandaha Beel, respectively. The high fish catch in September may be due to the fact that it is the peak fishing season and the low catch in December might be because this is the lean fishing season when fish stocks have been depleted. The data for the highest and lowest production at Dhali-Baila Beel closely match the data recorded in the catch monitoring study conducted by IPAC (IPAC 2012). The average fish catch at Dhali-Baila Beel is significantly higher than that of Shaitandaha Beel. The total number of fish species recorded at Dhali-Baila Beel during the study period was 44, which is comparable to the IPAC (2012) study results (32 species) and significantly higher than the 15 species recorded at Shaitandaha Beel.

In terms of biodiversity conservation indicators, 11 fish species were recorded as locally endangered at the non-MACH site and only one such species was identified at the MACH site during the study period. Thus, the number of endangered species at the non-MACH site is significantly greater than at the MACH site. Furthermore, eight revived species were recorded at the MACH site whereas no revived species were found at the non-MACH site. These findings indicate the effective management of these water bodies and suggest that co-management has had a positive impact on fish biodiversity in the area. In addition, fishers used less destructive types of fishing gear at the MACH site than at the non-MACH site. These findings could be an indication of the enhanced management of the protected beels in particular, and suggest that co-management has had a positive impact on fish biodiversity conservation in the area in general.

I interviewed RMO and RUG members, as well as subsistence fishers, about their perceptions of the impacts of the fish sanctuary, enforcement of the Protection and Conservation of Fish Act, and the stocking of fingerlings on fish biodiversity at the MACH site. Out of 179 respondents, 95 percent perceived positive impacts from the sanctuary, 88 percent perceived positive impacts of enforcement of the Protection and Conservation of Fish Act, and 89 percent perceived positive impacts of stocking fingerlings on fish biodiversity in respect to fish production and species composition at the MACH site. Moreover, 100 percent of the respondents perceived positive impacts of AIGAs on fish biodiversity conservation. This reveals strong support for co-management, and for the conservation of these sites and their fish resources.

The major findings of the study are: (1) the fish biodiversity at the MACH site is richer than that at the non-MACH site, and (2) the impact of co-management on local people's behaviors and perceptions at a MACH site is overwhelmingly positive. This suggests that, overall, the social and biological impacts of co-management have been positive at the protected (MACH) sites. According to these findings, I would recommend that community-based co-management of fisheries resources should be

expanded to include non-MACH sites and continued at MACH sites over the long term through the existing system of RMOs and RUGs to ensure the effective conservation of fish biodiversity in this area, as well as in other open water bodies of Bangladesh.

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One of the poorest and most densely populated nations in the world, Bangladesh is also arguably the most vulnerable to the negative impacts of climate change. Increased salinity of soils in coastal regions as well as increased incidence and severity of cyclones and other natural disasters lend credence to the argument that the impacts of climate change are already here. Thus, Bangladesh must struggle in its efforts toward poverty alleviation and food security, and build a foundation of resilience to ensure gains made today can be sustained into the future. Increasingly, Bangladesh government officials and civil society recognize the importance of a healthy and integrated protected area system as a fundamental building block in its foundation of resilience. An integrated protected area system ensures that forests and wetlands are managed to conserve and sustain key environmental services - especially the provision of a stable supply of water - into the future. Based on the principles of co-management, government and communities are working together to ensure conservation of existing protected areas, to demonstrate the development benefits of conservation of protected areas, and to expand this network in size and complexity through the Nishorgo Network.

This book is a contribution to strengthening co-management of Bangladesh's protected area system. Papers in this volume are based on research funded as part of the Nishorgo Network's Integrated Protected Area Co-Management (IPAC) program. Research funds were allotted to government officers from various departments, as well as to one research fellow from Bangladesh University of Engineering and Technology (BUET), to support site-specific research pertaining to issues of co-management initiatives implemented by IPAC in wetlands and forests of Bangladesh. It is expected that the research findings reported in this book will illuminate new directions for policy and implementation strategies for creating arrangements that meet the goals of co-management through participation and governance, livelihoods and resources. Spending time to investigate the realities of local resource users in both wetland and forest environments will help in tailoring co-management initiatives launched in association with the Government of Bangladesh and the United States Agency for International Development (USAID), and with the formal involvement of local communities.

The IPAC project is a five-year USAID contract working with the government and people of Bangladesh to establish a robust national protected area system based on the principle of co-management. IPAC is implemented through a consortium of partners led by International Resources Group (IRG) and including the international organizations East-West Center, WorldFish, and WWF-US, as well as leading Bangladesh NGOs BELA, CODEC, and CNRS. Components of the program have been designed to meet the needs of co-management arrangements at national, regional, and local levels. These include policy development, institutional capacity building, and support for site-specific implementation.

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