Institutional Arrangements in Seasonal Floodplain Management under Community-based Aquaculture in Bangladesh

A.B.M. Mahfuzul Haque
WorldFish Center, Bangladesh and South Asia, Dhaka, Bangladesh
E-mail: shaheen.haque@wur.nl

Leontine E. Visser
Wageningen University, the Netherlands
E-mail: leontine.visser@wur.nl

Madan M. Dey
University of Arkansas at Pine Bluff, USA
E-mail: mdey@uaex.edu

ABSTRACT

Seasonal floodplains under private and public ownership in the Indo-Ganges river basin provide food and income for millions of people in Bangladesh. Floodplain ownership regimes are diverse, covering the whole spectrum from public to private ownership. The paper compares community-based fish culture projects in these floodplains and analyzes the institutional arrangements of three different Floodplain Management Committees (FMC). The paper aimed to understand the complex institutional relations that govern ownership, access, and control of the floodplains under community-based fish culture (CBFC) to increase fish production and the livelihoods of the poor. We followed the stakeholders representing the various institutions and organizations such as the Department of Fisheries (DoF), Department of Land (DoL), and FMC. Other important stakeholders were the lease-holders of public water bodies in the floodplains, private landowners, seasonal, and professional fishers. The analysis demonstrates a significant increase of benefits to all stakeholders, including the poor, through the sharing of benefits derived from their involvement in the project. The willingness of different social classes to work together, the adoption of new technologies, and the societal embeddedness of local government institutions appear to be important inputs for policy making.

INTRODUCTION

Bangladesh is endowed with three principal river systems: the Brahmaputra (Jamuna), Ganges (Padma), and Meghna rivers. In the agro-based economy of Bangladesh, fisheries plays an important role in providing employment (full-time employment for 1.4 million people and part-time employment for 11 million people), nutrition (60% of animal protein intake), and foreign exchange earnings (5% to the gross domestic product (GDP) and 10% to export earnings). In 2006-2007, the total production of fish in Bangladesh was 2.44 million tons (t) (Fisheries Resources Survey System [FRSS] 2008), and about 80 percent of it (1.95 million t) comes from inland fresh water resources. Inland fisheries resources are broadly classified into inland open waters and inland closed waters, which comprise an area of 4.05 million hectares (ha) and 0.53 million ha, respectively. Inland open waters contribute over 1.0 million t (41%) to total fish production while inland closed waters contribute 0.95 million t (39%). Among the 4.05 million ha of inland open water resources, the major proportion consists of floodplains with an area of 2.8 million ha contributing 0.77 million t of fish in 2006-07 (FRSS 2008).

Seasonal floodplains are water bodies that retain water for five to six months during which they are suitable to grow fish and other aquatic animals. Recent studies have revealed that if 25 percent of the 2.8 million ha of floodplains can be brought under community management, calculating 50 percent to be accessible, then 6.7 million people would benefit, including 2.7 million landless people. The annual fish production is expected to then increase four to five times as compared to the existing production (Dey and Prein 2006; Department of Fisheries [DoF] 2005; WorldFish Center 2007).

In the floodplains, agricultural production dominates during the dry season, mainly through rice cropping and the production of commodities for sale and domestic consumption. During the dry season the boundaries between privately and commonly-owned lands are relatively clear. In the monsoon season, land boundaries in the flooded areas become indistinct, making it difficult to distinguish the plots owned by individual households. In most cases, such floodplain areas are used as a resource system for aquatic production with both owners and non-owners having open access. This is beneficial to the livelihoods of many people including the poor, landless fishers. However, the open access to these resources and its indiscriminate use have resulted in overexploitation and decrease of productivity, and fisheries management of the floodplains has proven to be unsustainable (Haque et al. 2008).

Floodplains and Community-based Fish Culture Management

The floodplains differ in physical features, size, ownership, and location. Previously, irrespective of ownership regimes, most of the floodplains were used as common-pool resource (CPR) for the harvesting of fish and other aquatic animals and plants during the monsoon. In recent years the demand for floodplain fish production has increased due to decreasing capture of fish from the floodplains (DoF 2005). It was also realized that floodplains would potentially offer increased production through fish culture during the monsoon season. However, attempts to bring the floodplains under fish culture, and at the same time, include the poor in sharing the benefits appeared to be complex. Institutional issues are among the most important challenges for achieving success.

Ownership regimes of the floodplains in Bangladesh are diverse and complex with some floodplains being completely under public ownership, some are public land but surrounded by private lands, and some are completely private. Public floodplains are normally leased out by the Department of Land (DoL) in auction. Priority is given to registered fishers' societies, but in most cases, the wealthy and politically-influential people who can afford to pay the lease stake control over the floodplains for fish culture. Initiatives to bring privately-owned floodplains under contract between the owners and individual entrepreneurs do exist, but initiatives to bring public and privately-owned floodplains under community-based systems with multiple beneficiaries are less common.

The WorldFish Center took the initiative to have more people benefit from increased fish production by a community-based fisheries management (CBFM) program with a major focus on increasing production by implementing conservation measures such as the establishment of sanctuaries and harvesting regulations. This was carried out in the publicly-owned floodplains with a three-year lease to the community from the DoL and with technical and institutional support from DoF. The CBFM program resulted in many valuable lessons on different aspects. For example, the development of community-based organizations (CBOs) in the villages surrounding the floodplains proved an important condition for success. High levels of production have been achieved in fish culture in semi-intensive *daudkandi*[1] systems in seasonal floodplains in Comilla District. This approach largely followed the company-type rule of selling shares to the beneficiaries. This initiative was successful through the active support of a local NGO called 'Shisuk' (WorldFish Center 2007).

An earlier research project on community-based fish culture in seasonally-flooded rice fields was carried out on a limited scale in Bangladesh and Vietnam from 1998 to 2000, and showed positive outcomes in terms of increased production and income. The project demonstrated that fish culture in seasonal floodplains is feasible and may have many positive outcomes. Nevertheless, the technologies may vary from country to country, and between locations within the same country for different floodplains (Dey et al. 2005). These findings emphasized the need for further studies to develop appropriate options for different sociocultural and institutional settings.

This paper intends to improve our understanding of the complex institutional relationships governing community-based fish culture in seasonal floodplains in Bangladesh. The purpose of the study is to identify appropriate institutional options for the sustainable use of floodplains and maximize their benefit to different classes of beneficiaries, including the landless poor.

The Floodplain as a Common-Pool Resource

Property rights define people's rights to access, use, and commercialize natural resources, and the obligations and responsibilities associated with those rights. The definitions and usage of the terms 'common-pool resource' and 'common-property resource' have been found rather inconsistent, creating much confusion (Ostrom 2003). Common-pool resources may be owned by national, regional, or local governments, by communal groups or by private individuals, or corporations. Ostrom and Schlager (cited in Ostrom 2003) have defined five types of property rights (Table 1) which are most relevant to the use of common-

[1] The stocking of fingerlings and regular application of feeds and fertilizers.

Table 1. Property rights most relevant to the use of common-pool resources

Property Right	Definition
Access	The right to enter a defined physical area and enjoy non-subtractive benefits (e.g., hike, canoe, sit in the sun)
Withdrawal	The right to obtain resource units or products of a resource system (e.g., catch fish, divert water)
Management	The right to regulate internal use patterns and transform the resource by making improvements
Exclusion	The right to determine who will have an access right, and how that right may be transferred
Alienation	The right to sell or lease exclusion, management or withdrawal rights

Source: Schlager and Ostrom (1992)

pool resources. These types also apply to our case.

A common property resource possesses two attributes which distinguish it from other economic goods: the good is subtractable or rival, and non-exclusive or non-excludable (Ostrom, Gardner, and Walker 1994). The community-based fish culture in seasonal floodplains includes substractable and non-exclusive elements, but during the monsoon season it is managed according to the rules of an open-access system. This means that all those interested in harvesting fish have free access to the resource. In this case we mainly have three categories: (1) Professional fishers; (2) poor, seasonal, non-landowning fishers; and (3) landowning elites who are not necessarily engaged in fishing.

METHODOLOGY

A Community-based Fish Culture Approach

Community can be defined geographically by political or resource boundaries, or socially as a community of individuals with common interests (National Research Council [NRC] 1999). In the DoF-WorldFish community-based fish project, we considered the floodplain as a community of interest because the people of the surrounding villages have a shared interest to enhance fish production from the seasonally-flooded areas by using a collective approach to fish culture. The criteria for establishing a community-based approach to fish culture were: (1) the presence of an infrastructure suitable for water management, (2) the willingness of the different classes of local people to participate, (3) the interest of local institutions and the support of DoF at district and sub-district levels. Site selection also ensured that floodplains under both public and private ownership regimes were included, whereas mainly larger areas (>30 ha) of land would likely provide benefits to a variety of beneficiaries, including landless seasonal fishers, professional fishers, and landowners.

With the start of the project, the beneficiaries placed *bana* (bamboo) fences at the water inlets and outlets. Usually this bamboo fencing was 1.5-2.0 meters (m) long, 2.0 centimeters (cm) wide, with a mesh size of 1.0 cm. The fences

were installed at the mouth of the inlets and outlets of water bodies to permit the entry of larvae and hatchling of small indigenous species, but preventing the stocked fish from escaping. The peripheral dikes of the water bodies were also raised to hold the water and prevent the escape of stocked fishes.

Several ring culverts were installed at the bottom of the floodplain. The upper sides of the culverts were covered with soil to maintain the water level and prolong the water retention time. The existing sluice gates constructed by the Bangladesh Water Development Board (BWDB) were subject to regulation for retaining water throughout the culture period, and draining out water for final harvesting of fish. The water regulation also facilitated the planting of winter-rice. Earthwork was necessary to raise the embankment of the floodplains.

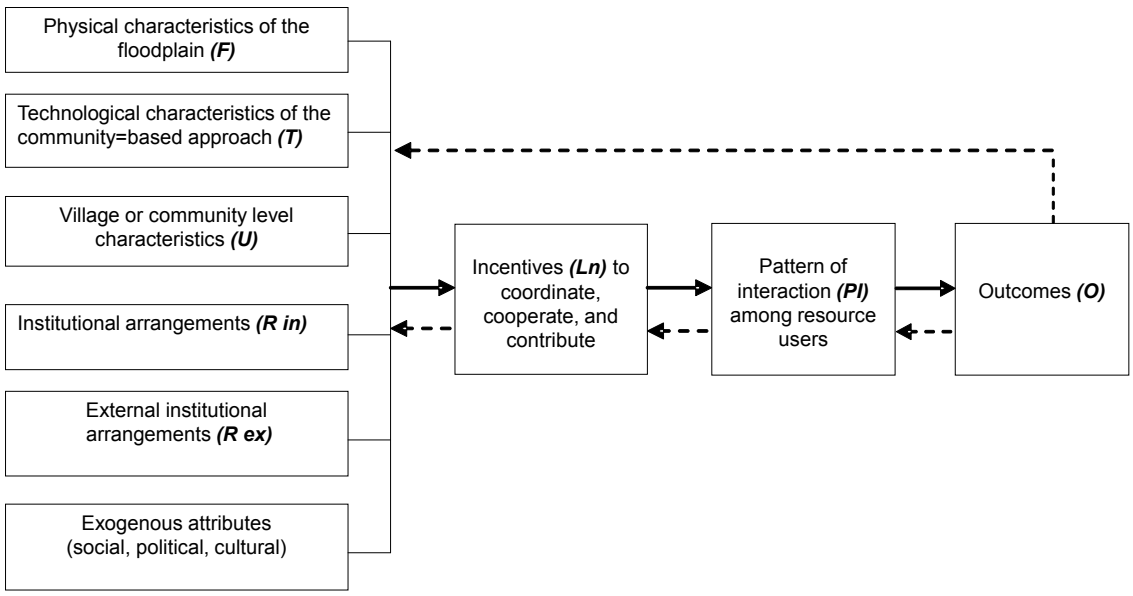
The professionals from DoF and WorldFish determined species combinations, ratios, and stocking densities of fish fingerlings for stocking in the floodplains, based on factors such as local availability of fingerlings, the growth rates of the fish species, and the local people's experiential knowledge. The fingerlings were procured either from nursery farms of the beneficiaries or from nearby commercial farms. Indian major carps and Chinese carps were selected and stocked in the assigned seasonal floodplain area at varying ratios and stocking densities.

The Design of the Study

The conceptual framework used for this paper is based on the institutional approach to natural resource management, adapted from the frameworks for CPR analysis of Oakerson (1992) and Ostrom (1994) to understand how floodplain resources are managed under the different governance structures. In Bangladesh, the community-based fish culture model is self-governed by local communities and organizations, but in some cases government authorities act as advisor.

In our framework for institutional analysis (Figure 1) the characteristics of the floodplain (*F*) refer to the biophysical condition of the resources, the types of fish harvested, and the resource system—the floodplain area. The characteristics of the local user groups (*U*) are the social and economic characteristics of users at an organizational, village, and household level. At the village level, the variables are household size, homogeneity in terms of different social classes, and wealth. At the household level, landholding size, wealth, and income distribution of individual households are relevant variables. The mandate, interests, roles, and linkages of government bodies are proxies for addressing the involvement of the related government authorities (*AU*) in resource management. By institutional arrangement (*R*) we understand local institutional arrangements (*R in*) consisting of operational rules and collective choice rules for governing the floodplain resources. These may be supported by more or less embedded (Cleaver 2002) formal or external institutions (*R ex*). The sets of variables (*F*, *U*, *AU*, and *R*) are considered as contextual variables that shape the incentives (*In*) of local floodplain users. The incentives of local floodplain users to cooperate (*Ln*) refer to the perceptions of the local people about their institutional and organizational practices, including their evaluation of the importance of the resources and resource management. The pattern of interaction (*PI*) refers to how different stakeholders interacted in floodplain management. The kind of management activities, the average number of man-days per household spent on them, the frequency of meetings, and rule enforcement measures are indicators we selected as proxies for patterns of interaction.

Figure 1. Conceptual model



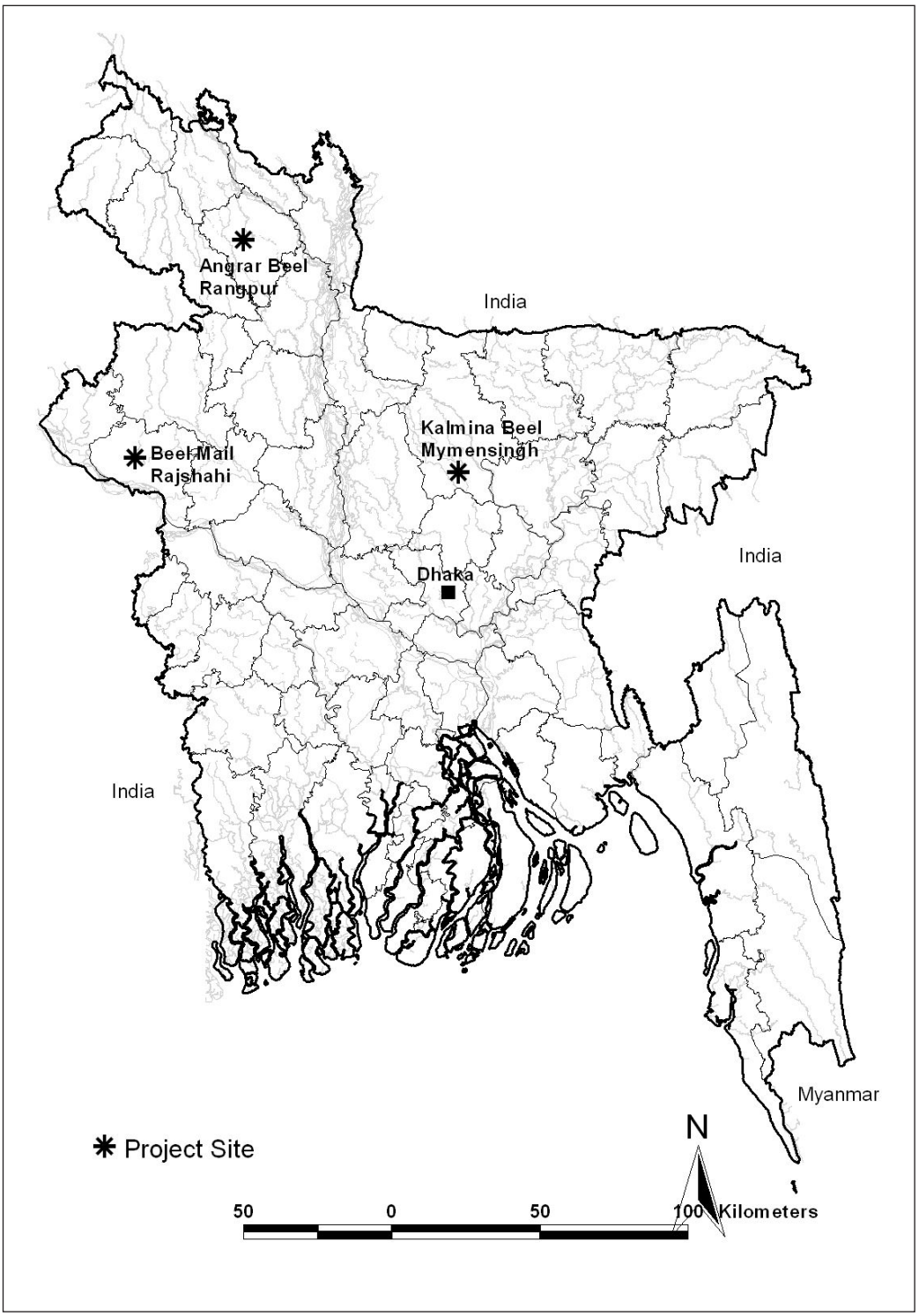
Adapted from Oakerson 1992 and Ostrom 1994

Selection of the Case Studies

In the Indo-Gangetic river basins of Bangladesh, both public and privately-owned floodplains were selected as the basis for an action-research project under the Challenge Program (CP35) of the WorldFish Center, Penang, Malaysia, and implemented by the Bangladesh Department of Fisheries (DoF) in collaboration with the Agricultural Research Council and the Fisheries Research Institute in Dhaka, from 2005 to 2010 (Figure 2). For this paper, three cases have been selected to discuss the results of the community-based fish culture and the development of the Floodplain Management Committees (FMC) in the Padma river basin (Case 1), the Teesta river basin (Case 2), and the Brahamaputra river basin (Case 3). These cases were selected because of their markedly different social and institutional arrangements among the government, fishers' cooperatives, local stakeholders, and classes of beneficiaries.

Between 2007 and 2010, sociological research methods and techniques including semi-structured interviews, focus group discussions, informal discussions with key informants, and quantitative surveys were applied to gather data from the FMCs, villagers, and institutional stakeholders to investigate the use of the floodplain as a CPR and the processes of the formation of local institutions and organizations. In addition, documents on the rules and regulations of FMCs, minutes of meetings, and operational plans for community-based fish culture were analyzed. Detailed inventories of floodplain resources were compiled from operational plans supplemented with records of the DoF and field observations. This paper briefly describes the three cases, followed by a discussion on the results, and an assessment of the institutional arrangements.

Figure 2. Case study areas



Case study 1: FMC in Mail

The Mail *beel*[2] floodplain is located in Mohanpur Upazila in Rajshahi district in the Padma river basin around 40 kilometers (km) north of Rajshahi district town, and eight km from the Mohanpur sub-district. The area of the floodplain is about 40 ha during the monsoon, of which 15.2 ha are government *khas*[3] lands leased from the District Land Authority. In 2005, the Melandi Fishermen Cooperative Society took it as a lease for three years with a yearly lease value of 154,520 Bangladeshi Taka (BDT) (USD 2,240). The fishers' society took the lease in its name but in fact, the wealthy and politically-influential landowning elites from the community surrounding the floodplain provided the lease money. They negotiated with a few of the members of the Melandi cooperative to access and use the floodplain. Surrounding the Mail beel are five villages with 1,112 households and a total population of 6,125. In 2005, the local elites who subleased from the fishers' cooperative had invested in stocking fingerlings in the floodplain, but the amount of fingerlings was low and their size was small.

Case study 2: FMC in Kalmina

The Kalmina beel floodplain is a privately-owned floodplain in the Teesta river basin with an area of 33 ha located in the sub-district of Fulbari, nine km west of Parishad Upazila, and 35 km away from the Mymensingh district town. This floodplain has a higher technical potential and comparatively more lowlands suitable for fish culture. There is one village of 1,238 households with a total population of 5,941 around the floodplain. The villagers normally catch fish in the monsoon season (June-December) and were willing to participate in the fish culture activities. They collectively organized the fingerlings stocking, bamboo fence preparation and the fencing, guarding, harvesting, and marketing. Through our project intervention, the villagers, landowners, and fishermen were inspired to work collectively to implement the community-based fish culture.

Case study 3: FMC in Angrar

The Angrar beel floodplain is a privately-owned seasonal floodplain with a total area of 31 ha located close to the Pirganj Upazila and about 36 km away from Rangpur district town. The location of the floodplain is adjacent to the Asian highway linking Rangpur to Dhaka. The different income classes of land owners, fishers, and poor landless people surrounding the floodplains were identified and primary data about their interests in implementing the project and benefit sharing were collected. This floodplain had a high technical potential and comparatively more lowlands suitable for fish culture than Case 2. Five villages lie around the floodplain with a total of 1,348 households and a total population of 6,740. Most (97%) of the fishers in these five villages live in the Mazipara *uzirpur*[4]. The villagers, whose livelihoods depend on fish and agriculture labor, were willing to participate in the fish culture activities that were collectively managed and were engaged in fingerling stocking, bamboo preparation and fencing, guarding, harvesting, and marketing of cultivated fish.

In all cases, FMCs were formed from the different villages including representatives of all beneficiaries, such as landowners, fishers, and landless fishers. An annual work plan,

[2] *Beel* is a term for a wetland with static water.
[3] *Khas* lands are public lands leased by the fishers or farmers group for a certain number of years.
[4] An *uzirpur* is a big village, one third of the floodplain is surrounded by these villages.

budget, and implementation plan for the community-based fish culture (CBFC) activities in the floodplains were developed with support from DoF. The FMCs consisted of 15-20 members, including a president, vice-president, secWretary, and cashier. The FMC was expected to solve conflicts and ensure that the benefits were distributed among the beneficiaries. For overall supervision and monitoring, local project implementation committees (PIC) were formed with representatives from DoF, other related government departments, the WorldFish research team, and the president and the secretary of the FMCs. PICs aimed to encourage co-management, establish working rules for better management of the floodplain under community-based fish culture, and empower the poorer fishers.

Institutions and Their Roles

Formal institutional linkages between DoF, WorldFish Center, and the Bangladesh Agricultural Research Council (BARC) played a key role in ensuring success. DoF is a government institution with establishments at different administrative levels. Through its linkages with other institutions and collaboration with the research team, DoF ensured technical management support (Rahman et al. 2008) and played an active and strong role in resolving many of the acute social problems. Moreover, DoF played a major role in the selection of floodplains, beneficiaries, and the formation of FMCs and PICs. It also took necessary measures to protect fish from uncontrolled harvest, ensure benefits to the poor, and securing a five-year lease from the DoL for the Mail beel floodplain. This significantly empowered the fishers, as they were no longer facing the loss of their lease through a public auction. Government institutions also provided the necessary monitoring and support. The institutional linkages of DoF with the other institutions involved in floodplain management are shown in Figure 3.

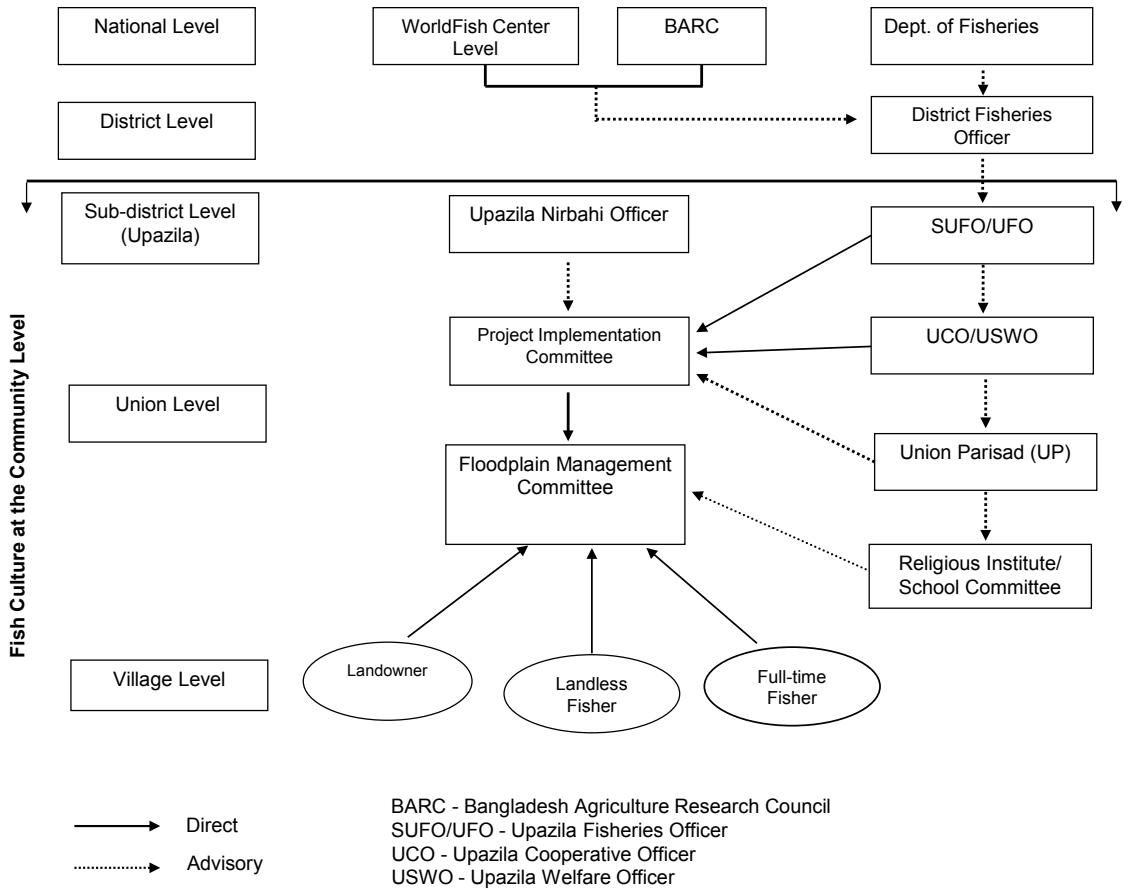
For small floodplains with fewer beneficiaries, the promotion of community-based fish culture by NGOs was implemented successfully in collaboration with other institutions (Dey et al. 2005). In all floodplains, the involvement of school committees and mosque committees encouraged people to participate in community-based systems and utilize the unused potential of floodplains by bringing them under fish culture. These informal institutional organizations play a vital role in organizing and educating people, and supporting the establishment of communal action as well as benefit-sharing mechanisms.

RESULTS AND DISCUSSION OF THE THREE CASES

The ineffectiveness of market and administrative structures in managing large natural resources has led to an interest in the role of local communities in the management of natural resources (Agrawal 2001). The transfer of the rights and responsibilities from formal governmental institutions to local organizations was advocated (Larson and Ribot 2004) on the argument that the incentive for local communities to sustainably use their resources is their dependency on them for their livelihood. Other important factors that have led to the focus on community participation in resource management are the decision-making process in the management of natural resources by the increased participation and the need for the social empowerment of resource-poor local users (Meinzen-Dick, Knox, and Gregorio 2001).

Analysis of natural resources management cases indicates that the most significant conditions for successful implementation

Figure 3. Institutional relationships among the different stakeholders



of collective action in community-based management is often the formation of a representative, rationally acting, and self-interested group, which maximizes the utility by creating incentives for collective action through an appropriate institutional design (Ostrom 1990; Wade 1988; Baland and Platteau 1996). Institutions structure the relationship between people concerning the natural environment through the design and implementation of property rights and rules that govern human interaction with natural resources (Bromley 2001; Schmid 2004). The factors that condition the choice of the institutional structure and the outcome of collective action have been broadly classified into three categories: the physical and technical characteristics of the resource, the social and economic characteristics of the users, and the attributes of the institutions that govern the interaction among the different users of the resource (Tang 1992; Uphoff 1986).

Our intervention and approach to the institutional organization of community-based fish culture supports the literature in the sense that the creation of FMCs created and supported the collective action of different classes of users. The FMCs that were established locally with DoF support indeed helped develop a collective management of community-based fish culture in different ownership regimes, with different power relationships among stakeholders, and under different physical, technical, and

demographic conditions of the floodplains and the surrounding villages, irrespective of the public or private ownership of the land in the floodplains. The three cases we selected for discussion in this paper show interesting results regarding the following issues:

1. Ownership and access to the floodplains and fisheries resources
2. Institutional arrangement and rules developed by the FMCs
3. Distribution of benefits of community-based fish culture

Ownership and Access to the Floodplains and Fisheries Resources

Ownership and access depend on the two most important characteristics of a natural resource emphasized in the literature, namely, the high exclusion cost of the resource system and the subtractability of its units. In a natural resource system like a floodplain, it is difficult to exclude people who live in the surrounding villages from accessing and appropriating the resource for their own benefit (Schmid 2004). The floodplains can be characterized by both a low exclusion cost and a low subtractability because of the ample availability of the resources. This applies to the fish culture, the multiple agricultural and fisheries uses of the water, as much as the increased soil fertility by seasonal inundation of the cultivated fields. The floodplain as a resource system includes cultured fish, unstocked fish, water for irrigation, and the aquatic flora and fauna as resource units. While the resource system is a low exclusion good only during a particular period of time—the monsoon season—the resource units or the floodplain products are compatible-use goods because of their high subtractability. This has two effects. First, a user/appropriator of the CPR subtracts a flow of benefits potentially available to others. Second, cumulative use of the resource by many users without further intervention will eventually result in a decrease of the total yield.

This is an important point when we look at the productivity of the fish resources because it may affect the potential for collective management of the resource. Though the floodplain as a resource system is a non-rival good, there may be conflicting interests between the appropriators and users of the fish as a consequence of its multiple uses. In order to increase the fish production in the floodplain, the members of the FMC would prefer to stock fingerlings, whereas non-members, fishers, and landless seasonal fishers alike, cannot afford to do this.

Our cases also support the literature (Uphoff, Wickramasinghe, and Wijayaratna 1990; Wade 1988; Rasmussen and Meinzen-Dick 1995) that increased income is an important economic incentive for the expansion of community-based fish culture in Bangladesh. However, we see an important difference between project interventions in private and public floodplains. On privately-owned land inundated during the monsoon season, the floodplains under private ownership, such as Angrar beel (Case 3) and Kalmina beel (Case 2) are similar in size, with comparable percentages of beneficiaries and similar numbers of communities surrounding the floodplains. However, the distribution of beneficiaries among the classes differs, with more landowners than landless seasonal fishers benefitting (Table 2). The households of seasonal fishers, who are mainly landless, fully depend on fishing in the floodplains during the monsoon season. The households of full-time fishers with fishing as their main profession during the whole year are involved as lease holders of the private floodplains; they benefit from project intervention as members of the FMCs. These two cases show that the FMCs

Table 2. Numbers of different beneficiaries of community-based fish culture in the floodplains

Floodplain	Number of Beneficiaries			
	Landless Seasonal Fishers	Full-time Fishers	Landowners	Total
Mail	22 (18)	68 (55)	34 (27)	124 (100)
Kalmina	52 (29)	25 (14)	97 (57)	174 (100)
Angrar	38 (22)	23 (13)	110 (65)	171 (100)
Total	112 (24)	116(25)	241 (51)	469 (100)

Note: Numbers in parentheses indicate percentages

normally allow these non-members to access the floodplains, but only to harvest unstocked fish using local gears. This means that the CPR character of the management by the FMCs shows a certain permissiveness or permeable boundary regarding landless non-members under strict spatial and temporal conditions. Regulation and conservation, thus, guarantee the availability of unstocked small fish in the floodplains with a high catch by artisanal gears, which results in higher incomes and related benefits to the poorer households. Households who own land or ditches in the floodplains do not depend on unstocked fish as they have ponds to trap and harvest fish obtained in the wild. Additionally, during the dry season, they may use land in lowland areas for crop production.

The Mail beel (Case 1), a public floodplain surrounded by private lands, differs most from the other two cases. Here, the public area, including the private land owned by the affluent and politically influential stakeholders, is leased out to fishers during the monsoon. The floodplain is larger than in the other two cases, but both the percentages of landless fishers and landowners are lower, making the class of the landowning professional fishers the majority (55%) among the beneficiaries.

Institutional Arrangement and Rules

In the CPR literature, institutional arrangements are defined as the rules and regulations governing the use of resources (Ostrom 1990). Institutional arrangements for natural resource management have been classified under three categories: operational rules, collective choice rules, and constitutional rules. Operational rules include boundary and access rules, allocation rules, penalty rules, input rules, and conflict resolution rules. Collective choice rules include the guidelines for formulating, changing, and enforcing operational rules. Constitutional rules provide the broader framework within which collective and operational rules work. It includes property rights protected by public regulation, the level of delegation of decision making, environmental and natural resource regulation, the rights of reorganization, and market arrangements (Ostrom 1990; Rasmussen and Meinzen-Dick 1995).

Generally, the rules and regulations that apply to public and privately-owned floodplains are written down in a Memorandum of Understanding (MoU) between DoF and the individual FMC's in a non-judicial construction. In their regular meetings, the FMCs also document the daily practices of the rules related to fish culture and management in the minutes that are distributed among its members.

Rules and regulations governing access to the public and privately-owned floodplains are presented below. It appears that in the three cases, comparable rules and regulations for fish culture are applied to the public and to the private floodplains. Some rules are derived from the national fisheries law.

Operational rules

This study shows that it is necessary to carefully differentiate between CPR and open-access situations through the different seasons. During the monsoon fish culture period when the public (Case 1) and private lands (Cases 2 and 3) are inundated, the floodplains become a semi-open access space for fishing by the surrounding villages, particularly for the year-round full-time fishers and the seasonal landless fishers, on the condition that they use local gears. Moreover, their fishing is restricted to the ditches or refuge pond areas where temporary fish shelters were established. Finally, after the stocking of fingerlings, access to the floodplain is restricted for one week to avoid stocked fish mortality.

Before harvesting the stocked fish, the FMC conducts a meeting with their fisher-members at the village level to discuss the composition of the harvesting groups, the gears used, the quantity of fish to be harvested, and the cost-sharing regulation. We found that in the privately-owned floodplains (Cases 2 and 3), two to three groups were formed for the fish harvesting; each group consisting of nine to 10 fishers. In the public floodplain (Case 1), however, as many as 10 groups were formed and the number of members per group varied from four to 10 fishers, according to their experience in fish harvesting and the gears used.

The fisher groups took turns harvesting the fish by agreeing on a schedule for the week. The amount of fish to be harvested was decided on a daily basis considering the local market demand. The fishing costs were determined, distributed, and shared equally among the members of each fish harvest group. When the water level went down at the end of the season, the fishing cost determined which species of fish would be caught, what sizes, and the amounts of fish that would be harvested from the floodplain.

Collective choice rules

The study shows that the collective choice rules for the formulation and enforcement of operational rules change. In the two privately-owned floodplains, the total number of members of the committees varied from 13-16 members over two years. The composition of these committees involved all the beneficiaries, such as (non-fishing) landowners, landowning fishers, and landless seasonal fishers. However, participation in the FMC was open to some more than to others, hence, fishers and landless seasonal fishers were clearly under-represented as compared to the larger landowners. This may be due to the fact that FMC members were elected by their fellow villagers primarily for their managerial capabilities, their power positions, and dependency of the community people. Still, all classes were represented in the FMC membership and their election followed a democratic process because it involved all villagers in appointing their own representatives.

Constitutional rules

During the project period, not all the FMCs were registered as an organization. Though the FMCs had no constitution, they did have clearly-defined membership criteria. In our cases, the FMCs created additional rules and regulations, and membership criteria according to the MOU between the FMC and DoF. The criteria for selecting leaders included: the capability to speak for and manage, acceptance by all beneficiaries, transparency, and accountability. A leader was selected for a term of two years, after which, the beneficiaries replaced him. In Case 2 (Angrar), however, the beneficiaries replaced the leader after only one year because he was corrupt. Two full-time representative fishers were also included in the executive committee. Leaders were observed to play an active role in the decision-making process about operational and collective management work.

Distribution of the Benefits of Community-based Fish Culture: Comparison of Cases

All stakeholders agreed about the benefit-sharing of the fish production from the floodplains at the start of the project. However, commitment varied among the classes of beneficiaries and across the cases. The FMC provided full-time fishers a secure employment during the monsoon months of fish harvesting from the floodplains. In addition, they received benefits directly through their own harvesting of stocked fish in the form of a share of the fish or cash after harvest as well as a share of net income earnings from the fish production. Some of the members of the fisher communities added to their income by establishing fish nurseries in their homestead, or they rented ponds and supplied fingerlings stock to the floodplain. Benefits also took the form of activities indirectly related to fishing. Some benefited as van pullers to transport fish fingerlings from the nurseries to the floodplains for stocking. Others were involved as traders of consumption fish in the village markets or as mobile traders selling fish door-to-door. In addition, these full-time fishers benefited through their involvement in activities related to the management of floodplains, such as the preparation of bamboo fencing of inlets and outlets and working as a security guard. Thus, their income earning opportunities were highly diversified and increased with community management.

The households of the landless seasonal fishers fully depended on fishing in the floodplains for their livelihoods during monsoon season. Due to regulation and conservation measures, the availability of unstocked small fish in the floodplains has increased, which has resulted in a bigger catch of seasonal fishers using local gears leading to higher incomes and related benefits to the households of landless seasonal fishers.

Finally, the landowning class who usually do not fish themselves develop ditches in the floodplains that form trap ponds to harvest fish naturally, or they own lands in lowland areas which may be used for crop production in the dry months. The landowners also benefit from the project by receiving better income from selling fish. If they use their land for crop production during the dry season, they also benefit because their land demands little or no labor for transplantation of rice seedlings, little water for irrigation, no pesticides, and little fertilizer.

Others with lands in the lowland areas usually grow rice during the monsoon months or in the periphery of the floodplains that receives water, thus, benefitng from fish production without hampering their crop production. The project has introduced water control measures that enabled the floodplains to function as a water reservoir so that households who have

access to lands in higher elevation areas benefit by getting a supply of water for their crops through supplementary irrigation.

In addition to fish production and water management for rice production, households also collect aquatic weeds and aquatic animals other than fish from the floodplains. In the floodplains located close to the communities, women are involved in rearing ducks and goats, collecting fodder from the floodplains to feed the goats and cattle, and gathering aquatic weeds and snails for chickens. Adivasi women are involved in the collection of crabs, snails, and mussels for sale that provides them with a small income. Finally, mud is collected from the deeper parts of the floodplains to be used in the construction of homesteads and pits to protect the village from flooding, which also helped to excavate the deeper part of the floodplains to grow fish, especially in the lowland areas.

Table 3 compares incomes before and after the intervention. There is a significant increase in income derived from the stakeholders' involvement in fish culture. A comparison of the project baseline (2006) and impact (2009) surveys suggests that the real average income of all three classes of beneficiaries increased significantly. Table 3 shows that overall income from fish culture increased by 164 percent in Case 1, by 189 percent in Case 2, and by 200 percent in Case 3. Apart from the increase in income as compared to 2006, the relative share of the fishers' average household income from fishing also increased, which indicates that the project increased the fishers' access to fish. In all cases, the landless seasonal fishers gained most from fishing between 2009 and 2006. During the dry season, landowners received additional income from cropping.

The sharing arrangement was decided and agreed upon by the beneficiaries and the FMC (Tables 4 and 5). In all the floodplains, net income was calculated by deducting the lease value and the fingerling cost for continuing the fish culture in the subsequent year. For the Mail beel (Case 1) floodplain, after the deductions of the lease value and the fingerling cost, the fishers received around 40 percent net income increase and the landowners received almost 38 percent of net income increase, as they

Table 3. Changes in income (US Dollar) from the floodplains between 2006 and 2009 due to project intervention in fish culture (1 BDT = 0.01449 US Dollar)

Beneficiaries	Case 1 (Mail)			Case 2 (Kalmina)			Case 3 (Angrar)		
	2006	2009	%	2006	2009	%	2006	2009	%
Full-time Fishers (n=60)	47	126	169	33	103	213	33	123	277
Landless Seasonal Fishers (n=60)	33	55	66	33	63	93	32	56	75
Landowners (n=60)	15	71	359	11	56	397	12	51	322
All (N=180)	32	84	164	26	74	189	25	76	200

had to pay the lease money for the floodplain. According to the bilateral agreement with the fisheries cooperative, 20 percent of their net income would be given to a cooperative fund. The fishers in the floodplain considerably benefited by taking control of the fish harvest from the floodplain. They received 50 percent of the price of the harvest of unstocked fish and 10-15 percent of the stocked fish.

Like Case 1, the net income in Cases 2 and 3 was determined by deducting the fingerling cost from the total income. In the Kalmina (Case 2) and Angrar (Case 3) floodplains, all classes of stakeholders deposited around 25 percent of their net income in a revolving fund. The fishers' group got their income from the final harvesting of fish as they received 50 percent of the income from the harvest of unstocked fish and 10-15 percent of the stocked fish. The landowners received 50 percent of the income from their land. In the Angrar floodplain (Case 3), the fishers and landowners received a similar net income (45%) from the floodplain. The landless seasonal fishers had open access to the non-stocked fish during the monsoon in both cases. In all the three cases, the users of the floodplain contributed a small portion of their income to social work such as the development of the mosque or the Hindu temple.

The income increase was higher for fishers in the public CPR (Case 1) than in the privately-owned CPR (Cases 2 and 3). Landowners were better off in Cases 1 and 3, and landless seasonal fishers benefited more in the privately-owned floodplains of Cases 2 and 3.

CONCLUSIONS AND RECOMMENDATIONS

The three cases presented in this paper show that there is a marked difference between community-based fish culture in public and privately-owned floodplains. The DoF-WorldFish project on fish culture has proven that it is technologically and socially feasible to successfully integrate large floodplains into community-based fish culture, irrespective of

Table 4. Sharing arrangement of Case 1 (Mail) floodplain from 2007-2009

Stakeholders	Net Income (%)
Participating landowners	38
Full-time fishers	40
Fisheries cooperatives fund	20
Contribution to social work	2

Table 5. Sharing arrangement of Case 2 (Kalmina) and Case 3 (Angrar) floodplains from 2007-2009

Stakeholders	Net Income (%)	
	Case 2 (Kalmina)	Case 3 (Angrar)
Landowner and ditch owners	50	45
Fishers	10	10
Landless seasonal fishers	5	5
Deposit fund for next year	25	25
Contribution to social work	10	15

whether they are subject to public or private ownership. Institutional embedding of the DoF through the FMCs as implementing institutions appeared highly instrumental. Large numbers of people, including landless poor seasonal fishers, professional landowning fishers, and non-fishing landowners, benefited from the successful implementation of the CBFC activities in the floodplains. The outcomes demonstrate a significant increase in income among all classes of beneficiaries through the income derived from their involvement in the fisheries cooperative and fish culture.

Despite the conflicts that arose, an environment with a win-win situation was created for large numbers of people, with active and strategic participation of the DoF in the implementation of the project. The outcomes of the present study support and expand the data from similar studies carried out in privately-owned seasonal floodplains (Dey et al. 2005) and demonstrate that community-based fish culture can also be successfully implemented in large publicly-owned floodplains, if supported by effective institutional arrangements.

REFERENCES

Agrawal, A. 2001. Common Property Institutions and Sustainable Governance of Resources. *World Development* 29 (10): 1623-48.

Baland, J.M., and J.P. Platteau. 1996. *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Oxford, UK: Food and Agriculture Organization and Clarendon Press.

Bromley, D.W. 2001. "Property Regimes and Institutional Change." Paper presented at the Conference on Property Rights and Institutional Change, Fredericia, Denmark, September 9-11.

Cleaver, F. 2002. Reinventing Institutions: Bricolage and the Social Embeddedness of Natural Resource Management. *The European Journal of Development Research* 14 (2): 11-30.

Dey, M.M., and M. Prein. 2006. Community-based Fish Culture in Seasonal Floodplains. *NAGA* 29 (1&2): 21-27.

Dey, M.M., M. Prein, A.B.M.M. Haque, P. Sultana, N.C. Dan, and N.V. Hao. 2005. Economic Feasibility of Community Based Fish Culture in Seasonally Flooded Rice Fields in Bangladesh and Vietnam. *Aquaculture Economics Management* 9 (1): 65-88.

Department of Fisheries (DoF). 2005. *Inland Capture Fisheries Strategy*. Dhaka, Bangladesh: Department of Fisheries.

Fisheries Resources Survey System (FRSS). 2008. *Fishery Statistical Yearbook of Bangladesh 2006-2007*. Dhaka, Bangladesh: Department of Fisheries.

Haque, A.B.M.M., B.K. Barman, and M.M. Dey. 2008. "Institutional Issues on Management of Seasonal Floodplains under Community-based Aquaculture to Benefit the Poor in Bangladesh." Vol. 2 of *Proceedings of the CGIAR Challenge Program on Water and Food 2nd International Forum on Water and Food*, Addis Ababa, Ethiopia, November 10-14. Colombo, Sri Lanka: The CGIAR Challenge Program on Water and Food.

Larson, A.M., and J.C. Ribot. 2004. Democratic Decentralization Through a Natural Resource Lens: An Introduction. *The European Journal of Development Research* 16 (1): 1-25.

Meinzen-Dick, R., A. Knox, and M.D. Gregorio. 2001. "Collective Action, Property Rights, and Devolution of Natural Resource Management: Exchange of Knowledge and Implications for Policy." *Proceedings of the Workshop on Property Rights, Collective Action and Devolution of Natural Resource Management*, Puerto Azul, Philipines, June 21-25, 1999. Feldafing, Germany: DSE/ZEL.

National Research Council (NRC). 1999. *Sustaining Marine Fisheries*. Washington, D.C., USA: Committee for Ecosystem Management for Sustainable Marine Fisheries, NRC and National Academy Press.

Oakerson, R.J. 1992. "Analyzing the Commons: a Framework." In *Making the Common Works*: *Theory, Practice and Policy* edited by D. Bromly. Institute for Contemporary Studies, San Francisco: ICs Press.

Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press.

Ostrom, E. 1994. "Institutional Analysis, Design Principles and Threats to Sustainable Community Governance and Management of Commons." In *Community Management and Common Property of Coastal Fisheries in Asia and the Pacific: Concepts, Methods and Experiences*. Edited by R.S. Pomeroy. Manila, Philippines: International Center for Living Aquatic Resources Management.

Ostrom, E. 2003. "Doing Institutional Analysis: Digging Deeper than Markets and Hierarchies." In *Workshop Readings in Political Theory and Policy Analysis.* Bloomington, Indiana: Indiana University Press.

Ostrom, E., R. Gardner, and J. Walker. 1994. *Rules, Games and Common Pool Resources*. Ann Arbor, Michigan: University of Michigan Press.

Rahman, M.F., B.K. Barman, M.K. Ahmed, and S. Dewan. 2008. "Technical issues on management of seasonal floodplains under community-based fish culture in Bangladesh". Vol. 2 of *Proceedings of the CGIAR Challenge Program on Water and Food 2nd International Forum on Water and Food*, Addis Ababa, Ethiopia, November 10-14. Colombo, Sri Lanka: The CGIAR Challenge Program on Water and Food.

Rasmussen, L.N., and R. Meinzen-Dick. 1995. Local Organizations for Natural Resource Management: Lessons from Theoretical and Empirical Literature. *IFPRI Discussion Paper* 11: 40.

Schmid, A.A. 2004. *Conflict and Cooperation: Institutional and Behavioral Economics*. Oxford: Blackwell.

Schlager, E., and E. Ostrom. 1992. Property Rights Regimes and Natural Resources: A Conceptual Analysis. *Land Economics* 68 (3): 249-62.

Tang, S.Y. 1992. *Institutions and Collective Action: Self-Governance in Irrigation.* California: Institute for Contemporary Studies Press.

Uphoff, N. 1986. *Local Institutional Development: An Analytical Sourcebook with Cases.* West Hartford, Conneticut: Kumarian Press.

Uphoff, N., M.L. Wickramasinghe, and C.M. Wijayaratna. 1990. Optimum Participation in Irrigation Management: Issues and Evidence from Sri Lanka. *Human Organization* 49 (1): 26-40.

Wade, R. 1988. *Village Republics: Economic Conditions for Collective Action in South India.* Oxford: Cambridge University Press.

WorldFish Center. 2007. *Floodplain Aquaculture Booklet No. 8.* Dhaka, Bangladesh: The WorldFish Center Bangladesh and South Asia Office.