Community Based Fish Culture in the Public and Private Floodplains of Bangladesh

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This thesis is dedicated to my wife, Sabina Nazneen, my son Mahtamim Haque and my parents, late A.K.Mahmudul Haque and Meher Afroz Banu.

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Table of Contents

Chapter 2: Institutional Arrangements and Community Based Fish Culture

Chapter 3: Power and Decision-Making in Fish Culture Management in Public and Private Floodplains

Chapter 4: Impacts Community Based Fish Culture on Income, Food Security and Employment in Bangladesh

List of Tables

List of Figures

Chapter 1

Introduction

1.1 The floodplains of Bangladesh

Bangladesh is endowed by three principal river systems: the rivers Brahmaputra (Jamuna), Ganges (Padma), and Meghna. In the agro-based economy of Bangladesh, fisheries play an important role in nutrition, employment and foreign exchange earnings, contributing 4.37% to GDP, 2.01% to export earning, 60% to animal protein intake, in addition to providing 1.4 million people full time and 11 million part time employment. In 2012-2013 the total production of fish in Bangladesh was 3.41 million tons (FRSS, 2014). About 82.73% of the fish production (2.82 million tons) comes from the inland fresh water resources and 17.27% from marine resources (0.58 million tons). Inland fisheries resources are broadly classified into inland open waters and inland closed waters which comprises the area of 3.91 million ha and 0.78 million ha contributing fish production over 1.85 million tons (54.54%) and 0.96 million tons (28.19%) respectively. Among the 4.69 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 tons of fish in 20012-13 (FRSS, 2014).

Seasonal floodplains are water bodies that retain water for 5-6 months during which they are suitable to grow fish and other aquatic animals. Recent studies have revealed that, if 25% of the 2.8 million ha can be brought under community management, calculating 50% to be accessible, then 6.7 million people would be benefited including 2.7 million landless people (Dey and Prein, 2006). Out of 2.8 million ha of medium and deep-flooded areas, about 1.5 million ha are estimated to be suitable for community based fish culture. If 50% of accessible water of these areas is taken under aquaculture and management practices, then annual fish production will be increased 4 to 5 times over the existing production (Dey *et al.,* 2013; DoF, 2005; WorldFish Center, 2005).

The floodplains differ largely in physical features, size, ownership and location. Previously, irrespective of ownership regimes, most of the floodplains were used as common pool resources for harvest of fish and other aquatic animals and plants during the monsoon. In recent years the demand for floodplain fish production has increased largely due to decreasing trends in capture fish production from the floodplains (DoF, 2005). It was also realized that floodplains offer a high potential for increased production through fish culture during the monsoon. Attempts to bring the floodplains under fish culture to increase production and include the poor in sharing the benefits are

surrounded fraught complexities, however. Institutional issues are amongst the most important challenges for achieving success.

During the dry season agricultural production dominates, with the main occupation consisting of cropping rice and other commodities for sale and domestic consumption; the boundaries between privately and commonly owned lands are then relatively clear. In the monsoon or wet season, land boundaries in the flooded areas become indistinct, making it difficult in some cases to identify private land owned by individual households. In most cases floodplains are used as a resource for aquatic production (fish and other aquatic animals and plants) with both owners and non-owners having common access. This is beneficial to the livelihoods of many people including poor fishers. However, the open access to these resources and its indiscriminate use resulted in overexploitation and reduction in productivity. Therefore the benefits provided by the system to the people have proven unsustainable (Haque *et al.,* 2008).

Ownership regimes of the floodplains in Bangladesh are diverse and complex with some floodplains being completely under public ownership, some public but surrounded by private lands, and some under completely private ownership. Floodplains under public ownership are normally leased out by the Department of Land (DoL) in auction. Priority is given to registered fishers' societies, but in most cases it is the moneyed and politically influential people who can afford to pay lease money and take control over the floodplains to use it for fish culture. There are initiatives to bring privately owned floodplains under fish culture by contract between the owners and individual entrepreneurs. Initiatives to bring public and privately owned floodplains under community-based systems with multiple beneficiaries are less common, however.
Taking into account the high potential of fish culture in floodplains, initiatives have been taken to benefit more people through increased fish production. One of the first, the Community-Based Fisheries Management (CBFM) program, had a major focus on increasing production through implementing conservation measures such as the establishment of sanctuaries and implementation of harvesting regulations. These were largely carried out in publicly owned floodplains (largely *beels*) with long-term leases to the community from the Land Department and technical and institutional support from the DOF. The CBFM program resulted in lots of valuable lessons learnt on different aspects, one of which, the development of local level community based organizations (CBOs), proved an important precondition for success.

An earlier research project on community-based fish culture in seasonally flooded rice fields was carried out at a limited scale in Bangladesh and Vietnam between 1998 and 2000, and showed positive outcomes in terms of increased production and income (Dey

et al., 2005b). This previous study demonstrated that fish culture in seasonal floodplains is feasible and can bring lots of positive outcomes. Nevertheless the technologies may vary from country to country and between locations within the same country for different floodplains. This emphasized the need to carry out further studies to better understand the social and economic viability and develop appropriate options for its further promotion under different socio-cultural and institutional settings.

1.2 Project context

1.2.1 Duration and donor support

The Challenge Program on Water and Food project on 'Community-based Fish Culture in Seasonal Floodplains' is a five year interdisciplinary action research project has recently completed. The Bangladesh and South Asia Office of the WorldFish Center in collaboration with the Department of Fisheries (DoF) and the Bangladesh Agricultural Research Council (BARC) implemented the project between 2005 and 2010.

I have been involved in the WorldFish project from its start, carrying out PhD field research in 2007-2009, during my affiliation to Wageningen University as an external PhD researcher. This study is the result of an action research in the sense that I carried out the research (see 1.5) while I also acted as coordinator on behalf of the wider WorldFish intervention with different institutional stakeholders, like the Department of Fisheries and other institutional stakeholders, to effectively implement the project.

1.2.2 Working Area

Six floodplains in three different river basins of Bangladesh were selected for this study. These floodplains are located in the Brahamaputra, Padma and Teesta river basins in Mymensingh, Rajshahi and Rangpur districts, respectively (Figure 1.1). One project site and a comparable control site with similar agro-ecological and socio-economic characteristics were selected from each floodplain. The selected floodplains were under two types of land ownership category: public-private and private. Public floodplains are open access areas during the monsoon season when all land is inundated. Access to private floodplains, on the other hand, then remains in control of the landowners.

Characteristics of the selected floodplains are shown in Table 1.1:

Table 1.1 Characteristics of the selected floodplains

Name of floodplains	Area(ha)	Ownership	River Basin
Project sites:			
Beel Mail	40 (public 15.2 ha, Private 24.8 ha)	Public & private	Padma
Kalmina beel	33	Private	Brahmaputra
Angrar beel	31	Private	Teesta
Control sites:			
Chandpur Beel	50 (public 12.8 ha, Private 37.2 ha)	Public & private	Padma
Andola Beel	16	Private	Brahmaputra
Paingler Beel	20	Private	Teesta

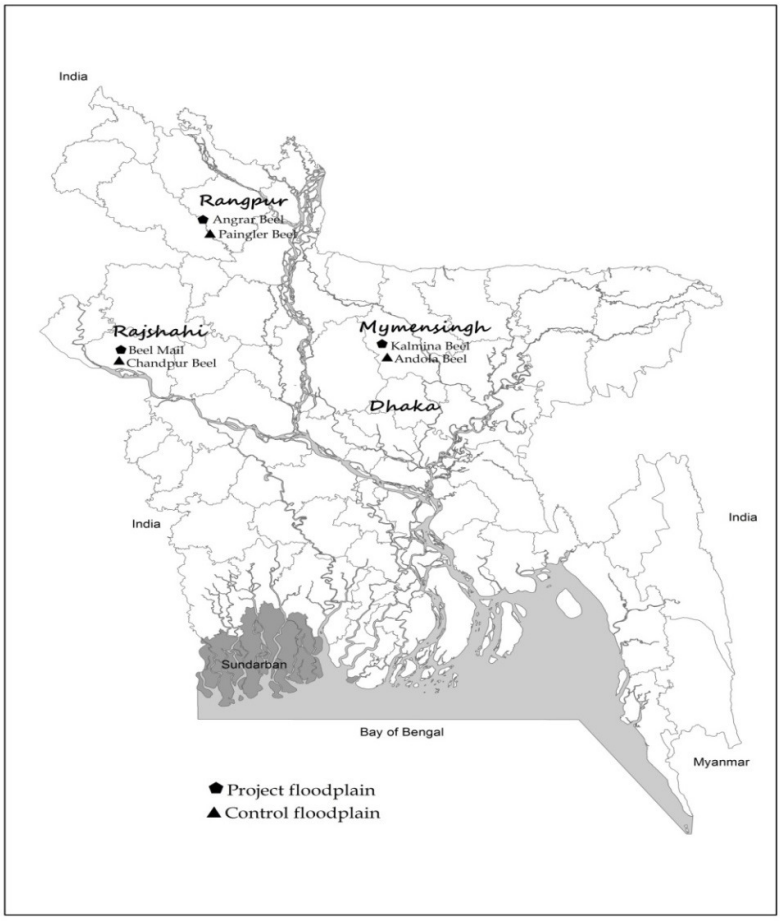

Figure 1.1.Map of Bangladesh showing the location of the study areas
Source: Map generated by author using GIS software

1.2.3 Institutional stakeholders and their role

The three major institutional stakeholders involved in the implementation of the project are the Bangladesh and South Asia Office of the WorldFish Center; the Bangladesh

Agricultural Research Council (BARC) and the Department of Fisheries (DoF). Their major activities are as follows: WorldFish Center holds overall responsibility of the implementation of the project; it provides all necessary technical assistance, support services to researchers and carries out all project management activities. BARC provides national project leadership and technical assistance and has the institutional coordination of the project activities. It plays a crucial role in the forging of close relationships with DoF and the WorldFish Center, and conducts the coordination, monitoring and evaluation of the project activities. DOF plays a role in the selection of the project sites, in the establishment of community based organizations and the implementation of the overall project activities, and it assists the three PhD researchers involved with the project in their data collection supported by district and national level institutions, in coordination with WorldFish and BARC.

1.2.4 Activities of the project

Project based field research activities were largely carried out by three PhD researchers and one MSc students from Bangladesh and abroad. They were supported by DoF, BARC and WorldFish primarily in carrying out the following activities:

Activity 1: Development of a methodology for measuring water productivity at the landscape level

Activity 2: Assessment of the current and potential contribution of aquatic resources

Activity 3: Development of participatory diagnostic and stakeholder-involving diffusion approach for community based fish culture in shared water bodies

Activity 4: Design of technical options for integrating living aquatic resources in irrigation systems and seasonal floodplains

Activity 5: Design of institutional options for community based fish culture in seasonal floodplains (My PhD Research)

Activity 6: Implementation of identified technical and institutional options in selected sites (My PhD Research)

1.2.5 Technical Intervention

Technological intervention included management of the water inlets and outlets and the embankments of the floodplains by fixing bamboo fences at the inlet and outlets permitting the entry of larvae and hatchlings of small indigenous species and preventing stocked fish from escaping (Rahman et al. 2010a). In some cases, the peripheral dikes of the water bodies were also raised for holding water as well as preventing the escape of stocked fish.

Several ring culverts comprising ring concrete culvert (RCC) pipes with round holes of 60cm in diameter were installed at 0.3 meter above the bottom level of the floodplain and the upper side of the culverts was covered with soil for about 0.6 meter to maintain the water level and prolong the water retention time for Kalmina Beel floodplain. In Beel Mail floodplain, the existing sluice gate constructed by the Bangladesh Water Development Board (WAPDA) was regulated to retain water throughout the culture period and facilitate drainage of water for final harvesting of fish and the planting of winter rice.

The species combinations, ratios and stocking densities of fish fingerlings were determined based on factors such as local availability of fingerlings, the growth rates of the fish species and the experience of project participants. The Floodplain Management Committee (FMC) was responsible for selection, procurement and stocking of fish species in the floodplains through formation of different sub-committees with the guidance of Project Implementation Committee (1.2.7). The fingerlings were procured either from the nursery farms of the beneficiaries or from the nearby commercial nursery farms. Indian major carps (Rohu, Catla and Mrigal) and Chinese carps (Silver Carp, Common Carp) were selected and stocked in the respective seasonal floodplains at varying ratios and stocking densities. Prior to stocking, the selected fingerlings were acclimatized in *hapas*[1] placed in the respective floodplains. Fish fingerlings of these different species ranging in weight from 30 to 46g were stocked in the floodplain at the rate of 31-48 kg/ha in different floodplains.

The harvesting of fishes were started after 4 months of stocking and continued up to 6 months. In some cases fishes were harvested over 2-3 months periods of time as decided by the beneficiaries. Harvesting of stocked and non-stocked fish from the floodplains were recorded and used for sale and for household consumption. At harvesting time species wise production and sale records were properly maintained by other in the project.

1.2.6 Development of Floodplain Management Committees (FMC)

In every research site a community level institution, called Floodplain Management Committee (FMC) was formed. These committees comprised 15 to 20 members, and were formed in a participatory way representing all stakeholders who had access and control over the resources, such as wealthy landowners, landowning fishers, and landless, poor fishers (see further below, 1.6.2).

[1] A small net enclosure in the pond/floodplain used for deposition of fish fingerling rearing.

1.2.7 Formation a Project Implementation Committee (PIC)

In the PIC, Senior Upazila Fisheries Officer (SUFO) / Upazila Fisheries Officer (UFO) acted as the chairperson, with the Upazila Agricultural Officer or Upazila Social Welfare Officer or Upazila Youth Development Officer, the Assistant Fisheries Officer (AFO), and the PhD researcher as members. The District Fisheries Officer was an advisor to the PIC. The main responsibilities of the committee were budget preparation, discussions with beneficiaries about fish culture technologies, minimizing conflict regarding the activities and the sharing of responsibilities as well as benefits, and arranging the fish sales during the harvest season including the distribution of proper shares to all stakeholders.

1.2.8 Involvement of local organizations in fish culture

School Committees, Pujha Committees and Mosque committees responsible for educating the people and religious services to the villages, stimulated the villagers to engage in fish culture activities. They also organized a campaign to raise fish together in a common floodplain during the wet season and to share the benefits from the common property resources.

1.2.9 Benefit sharing arrangements

Benefit sharing arrangements were an innovative aspect of the WorldFish project intervention. Benefit sharing takes into account ownership or lease of land, the ownership of ditches or refuges in the floodplain from where the owners receive fish and income, and those who harvest fish using the floodplain as open access resource, especially the poor fishers (part-time or full-time) and other landless poor. Other issues that are addressed in the benefit sharing arrangements to improve sustainability are capital formation for next year's activities, management of FMC funds etc. The benefit sharing arrangements can differ across sites, based on particular participatory and local concerns (see Chapter 2, Chapter 4, and Chapter 5).

1.2.10 Management rules

With the help of the Department of Fisheries the Floodplain Management Committee developed management rules and regulations. The following rules were implemented by the FMC members and adopted in their meetings:

- Decisions regarding community based fish culture in the seasonal floodplain should be taken on a participatory basis;
- In the FMC meeting the president would raise an issue and openly discuss it with the members, and accept their proposals;
- The floodplain should be accessible to all fishers and landless poor by using local gear; they should all agree not to use harmful gears;

- If anyone stakeholder or member of the FMC would act against the rules, the FMC would have the authority to punish him.

1.2.11 Conflict resolution

The FMC and community members, together with the Department of Fisheries, the Fishers Union and the Upazila government, supported the FMC in controlling potential conflicts and resolving them. Outsiders and local elites were likely to illegally catch fish when the project started. The main tool used was a dialogue between the conflicting parties. If dialogue did not work, the communities could seek the assistance of the local authorities including the Upazila Nirbahi Officer (UNO), the Fishers Union's Chairman, the Police, and the Fisheries Officer (UFO).

1.3 Research Methodology

In 2007 I was formally granted admission to the PhD programme of Wageningen University. As a PhD candidate I remained an external candidate to Wageningen University, but WorldFish has generously supported me to visit the Chair group of Rural Development Sociology (presently called Sociology of Development and Change) at Wageningen for shorter periods of time in 2008 and 2012, to closely collaborate with my supervisor and promotor, Professor Dr. L.E. Visser, especially on the social aspects of this research. My co-promotor, Dr. M.M. Dey, has supervised me on the economic part of this study.

The present study aims to improve our understanding of the complex institutional relations governing community-based fish culture in seasonal floodplains. The purpose of the study is to identify appropriate institutional options for the sustainable use of floodplains and maximize their benefits to large numbers of people, including the landless poor around the floodplains of Bangladesh.

1.3.1 Objectives of the study

The overall objective of the study is to test our hypothesis through long term close monitoring of the collective mechanisms, activities and operations so that an effective institutional set up can be arrived at, which can be replicated elsewhere in the country with different resource systems. The specific objectives of this study are:

- To identify appropriate institutional options for the sustainable use of floodplains and maximize their benefit to different classes of beneficiaries, including the landless poor;

- Assess the power relations between the various key actors or stakeholders who are directly or indirectly involved in floodplain fishery in the three research sites of the Indo-Gangetic River Basin;
- To assess the shifting power relations and decision making processes in co-management practices in the different institutional contexts of the three cases;
- To examine the overall impact of project intervention on households involved in community based fish culture in seasonal floodplains, particularly with respect to fish production, consumption, and income generation.
- To evaluate the impact of CBFC on household expenditure and expenditure inequality.

1.3.2 Research Question

This set of objectives generates the following overall research question:

What institutional arrangements can be identified, and how do they influence power relations in order to adequately manage community based fish culture activities? What is the impact of the project on communities and households involved in the project as compared to those not involved?

Specific research questions are:

- What institutional arrangements facilitate better stakeholder participation in community-based aquaculture? Do public floodplains and privately owned floodplains differ? (Chapter 2)
- What are the formal and informal rules on access rights in fish culture? How are formal and informal rules enforced? What sanctions are used? (Chapter 2 and Chapter 3)
- Who are the stakeholders? Are they represented in the decision-making process and how? What is the level of participation of user groups in the decision-making process? (Chapter 3)
- How do community-based institutions improve economic well-being and equity in seasonal floodplains? (Chapter 4 and Chapter 5).

1.4 Theoretical concepts and framework

1.4.1 Co-management and Community Based Fish Culture

Co-management is a participatory, democratic and dynamic approach to the management of fisheries resources where the different partners meet, exchange ideas, negotiate, define and decide between them a sharing of functions, rights and management responsibilities (Pomeroy and Viswanathan, 2003). Sen and Nielsen (1996)

define co-management as an arrangement where responsibility for resource management is shared between government and user groups. During the last decade or more the situation has improved significantly with the support of different donor-funded projects, like The Ford Foundation, DFID, USAID, IFAD, World Bank (Pemsl *et al.,* 2008). Long-term lease arrangements have been introduced for project water bodies, and community based organizations now play a more active role and better governance in resource management. These changes have produced a range of outcomes, including transformations of governance and new management models for inland water fisheries in Bangladesh.

The thrust of the Community Based Fisheries Management (CBFM) is that fishers' communities take charge of the responsible management and harvest of the fishes in their water bodies. The term 'co-management' is used to label a range of institutional arrangements with varying degrees of community participation in management which may vary according to factors such as environment, scale, property rights, and community structure (Thompson, 2004). This is because users are expected to actively participate in the management process, attending meetings to decide the rules for fishing activity, patrolling or guarding water bodies and apprehending infractions. In Bangladesh the co-management approach has been formalized through the formation of Community-Based Organizations (CBOs) with the support of implementing government agencies, mainly the Department of Fisheries (DoF), Department of Youth (DoY) and the Local Government Engineering Department (LGED).

While co-management refers to arrangements where powers and responsibilities, are shared between the fishing communities and Department of Fisheries. Community-based management, in contrast, refers to arrangements where the totality of power and responsibilities is devolved to fishing communities (Bene *et al.,* 2009). The principle behind community managed fisheries is to hand over of the management of fisheries resources to community groups and they will manage the resources sustainably and equitably (Dickson, 2006). For strengthening local level institutions, the WorldFish Center Bangladesh has led a number of projects on co-management throughout the country. All these co-management approaches (mostly project based) identified needs and responses through stakeholder analysis and consultation, primary data collection on fisheries production and consumption, and socio-economic analysis.

Community can be defined by political-administrative or resource boundaries or socially as a community of individuals with common interests. The geographical community is usually a political village unit (the lowest governmental administrative unit), while a social community may be a group of fishers using the same gear type or a fishers' society. Evidently, a community is not necessarily a village, and a village is not necessarily a community in the sense of a homogeneous unit, as there will often be

different interests in a community, based on gender, class, ethnic, and economic variations (NRC, 1999). In the floodplain cases used here, for example, the village elite has markedly different interests in floodplain management compared to landless poor fishers. It is the challenge of this project to bridge these interests and establish integrative FMCs.

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: the presence of an infrastructure suitable for water management, the willingness of the different classes of local people to participate, and the interest of local institutions and the support of DoF at district and sub-district (*upazila*) levels. Site selection also ensured that floodplains under both public and private ownership regimes were included, whereas mainly larger areas (>30ha) of land would be likely to provide benefits to a variety beneficiaries, including landless seasonal fishers, professional fishers, and landowners.

1.4.2 Institutions and the Institutional Analysis and Development (IAD) framework

Institutions can be defined in terms of formal and informal rules or norms, which constrain or foster human behaviour, and are adopted by individuals operating within or across organizations (Ostrom, 1999). Such rules, both formal and informal, can be classified into seven broad categories, like position, boundary, choice, aggregation, information, payoff, and scope rules (Ostrom and Crawford, 2005). In this study these rules are conceptualized as follows:

- Position rules specify the participants (individuals or entities) and their roles in a local level institution;
- Boundary rules define who is eligible to take part in this institution and how participants are selected;
- Choice rules specify the authority transferred to the institution;
- Aggregation rules refer to decision-making procedures, including arrangements to aggregate the preferences of the public and stakeholders into decision-making;
- Information rules define the arrangements for information exchange among participants, and between participants and other stakeholders, the public and other institutions;
- Payoff rules refer to the incentives and disincentives in terms of resources (e.g., human resources and funding) available to the institution to exercise its authority;

- Scope rules define the functional scope and the geographic domain that can be affected by a local level institution.

Numerous frameworks have been developed in the fields of political science, planning and public administration to analyze institutional arrangements. These frameworks often combine mixes of normative and substantive elements, programmatic elements, and criteria and indicators; however the appropriateness of any particular framework depends on the reasons for evaluating an institutional system (Ostrom, 1994). The Institutional Analysis and Development (IAD) framework is unique in that it can analyze the impacts of different institutional arrangements (constitutional, collective and operational) on externalities associated with multiple use and conflicts between stakeholders over resource use. This includes: (1) identifying key institutional arrangements; (2) understanding how they interact and influence human behaviour and, (3) estimating what impact individual actions have on aggregate outcomes for resource use and management.

The IAD model used for this study is based on an 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 community based fish culture is self-governed by local communities and organizations, but in some cases government authorities act as an advisor.

In Fig.1.2 on the institutional analysis of the characteristics of the floodplain, (F) refers to the biophysical condition of the resources, the types of fish harvested, and the resource system which is the floodplain area. The characteristics of the local users groups (U) are the social and economic characteristics of users at an organizational, village, and household level. At village level, the variables are household size, homogeneity in terms of different social classes and wealth. At 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 in) we understand local institutional arrangements consisting of operational rules and collective choice rules for governing the floodplain resources. These may be supported by more or less embedded 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.

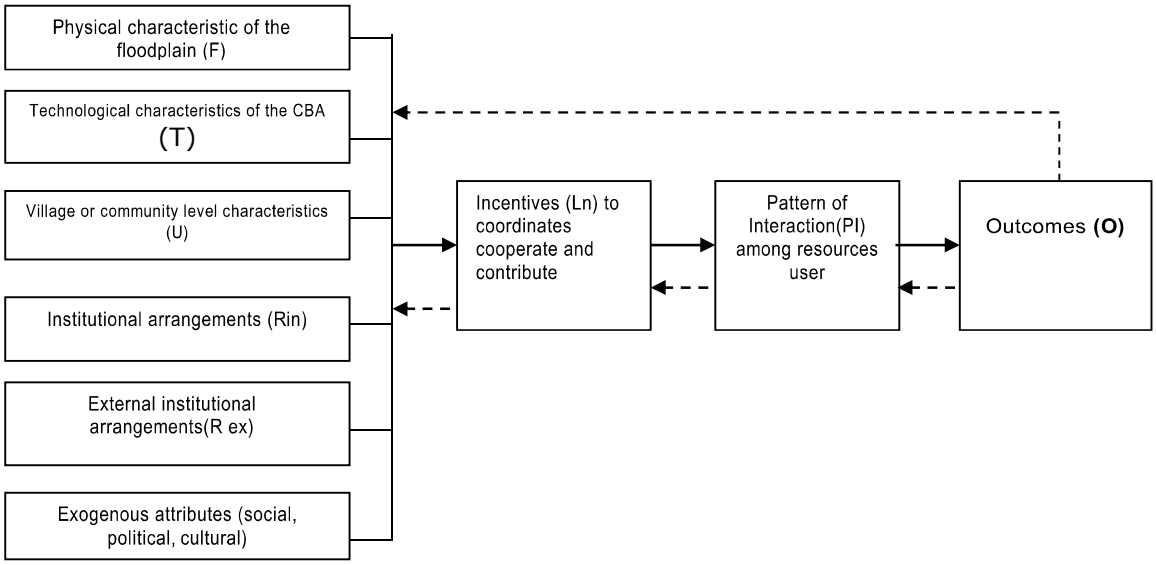

Fig.1.2. Institutional Analysis Model (Adapted from Oakerson 1992 and Ostrom 1994)

1.4.3 Common Pool Resource and property rights

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. Schlager and Ostrom (1992) have defined five types of property rights (see Table 1.2) which are most relevant to the use of common pool resources. These types also apply to our case studies.

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 *et.al.,* 1994). The community based fish culture in seasonal floodplains includes subtractable 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 from the inundated floodplain 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.

Table 1.2 Property rights most relevant for the use of CPRs

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: Adapted from Schlager and Ostrom, 1992: 249-62

To analyze the community based fish culture approach to floodplain management in the context of this study, a set of evaluative criteria is developed by combining the recent theorizing on decentralization of natural resource management (Agrawal and Ribot, 1999; Larson and Ribot, 2004; Meinzen-Dick and Knox, 2001; Ribot, 2002a; Ribot, 2002b) and the institutional aspects of the IAD framework (Ostrom, 2005), as conceptualized above. The resulting evaluative framework is presented in the Table 1.3.

Table 1.3: Evaluative framework for involvement in community based fish culture institutions

Rules	Evaluative Criteria
Position	Participation is representative of and accountable to local populations and all relevant stakeholders. Participation is thus inclusive in nature
Boundary	Selection of participants allows for representative and accountable participation. Selection processes are deemed to be as legitimate and democratic as possible
Choice	Meaningful authority to affect resources management outcomes is transferred from the government to community based institutions. Such authority is exercized independently
Aggregation	Decision-making aggregates the preferences, values and needs of those who are mainly affected by the exercise of power
Information	Communication and interaction with local populations, stakeholders and the central government entail mechanisms for reporting and monitoring performance, enhancing accountability particularly to local populations.
Payoff	Adequate resources are transferred allowing the community based institutions to exercise their authority.
Scope	Authority is transferred to a lower political-administrative and territory hierarchy, e.g., district, sub-district governments; local users groups; floodplains.

1.4.4 Power and decision making

Power and decision making processes are often mentioned as a hindrance to effective, sustainable and equitable natural resource management (Nuijten, 2003; Afsar, 2010; Lemke, 2003; Ratner, 2011). It becomes particularly clear in the notion of empowerment in which power is perceived as a property that persons or groups can possess. Nuijten

(2005) also differentiated between power as strategic games, institutional power, and structural power in natural resource management, although these powers are linked and cannot easily be separated from each other. In fisheries and coastal management, power is seen from the two perspectives of "inside-in" and "outside-in" which is implicit in social conflict, collective action, property right, and gender relations (Jentoft, 2007). In managing the natural resource management power is defined as creating rules, forcing decisions, enforcing compliance, and adjudicating disputes under co-management (Jentoft *et al.,* 2009; Thompson *et al.,* 2003; Toufique, 1999).

Co-management as a form of decentralization involves the formal transfer of powers from a central government to actors and institutions at lower levels in a political-administrative and territory hierarchy (Agrawal and Ribot, 1999; Larson and Ribot, 2004; Ribot, 2002a). It includes the shifting powers from centralized to more localized institutions, such as local government, the civil society and/or local user groups (Meinzen-Dick and Knox, 2001). Current thinking on decentralization of natural resources management (NRM) has promoted more democratic and rights-based approaches (Larson and Ribot, 2004).

By bringing decision-making closer and making it open and accountable to local level users, decentralization is believed to lead to increased equity and efficiency in NRM (Agrawal and Ribot, 1999; Larson and Ribot, 2004; Ribot, 2002a). In this context, effective decentralization is defined by inclusive and accountable processes where local entities are empowered with meaningful discretionary authority over the management of natural resources that are relevant to local populations (Ribot, 2002a; 2002b).

1.4.5 Natural resources, poverty and inequality

The Millennium Development Goals (MDGs) specified eight development dimensions, from consumption poverty to hunger, education, inequality and health to disease, environmental sustainability and development cooperation (UNDP, 2003). Equity and growth is the prerequisite to reduce poverty and achieving food security in developing countries. Around 1.4 billion people earn less than 1.25 US$ per day and faces different types of risk. Livelihoods of these people mainly depend on natural resource (FAO, 2004). But degradation of natural resources such land, water, forest, marine etc. threatens the livelihoods of people, especially the rural poor. In less developed or developing countries, per capita income depends on the availability and efficient use of these resources. Proper utilization of resources therefore became an important factor for reducing poverty in developing countries, including Bangladesh. But unequal distribution and improper management of natural resources create inequality and increased poverty in rural areas. Floodplains are a case in point. In recent years, income enhancement and

poverty reduction through more equitable fisheries and fish culture management has become a most important issue in development-oriented organizations like WorldFish and government agencies in Bangladesh.

In this thesis (Chapters 4 and 5) I primarily consider economic impact and income or expenditure inequality. The level of income/expenditure and the extent of income/consumption inequality are two measures of welfare of any community or society (Kuznets, 1955; Piketty, 2005). In a developing county, expenditure is an unsatisfactory indicator of a sustainable standard of living because poor people are often forced to finance current consumption by borrowing or liquidating assets. The relationship between income and inequality is not straightforward. Piketty (2005) has recently taken up an old debate started by Kuznets (1955) that income distribution becomes more unequal with economic development, particularly in developing countries. He also claimed that when the aggregate per capita income reaches a certain level, income inequality levels off and ultimately diminishes during later stages. As a consequence, the relationship between per capita income and inequality becomes an inverted-U shaped curve.

Community-based nature resource management (CBNRM) is used as a tool for reduction of income and expenditure inequality and improving the livelihoods of the poor. This management system can be considered a management strategy aiming to reduce poverty, as well as to conserve natural resources and promote good governance. It is therefore important to ensure sustainable management of these natural resources. On the other hand, involvements of the communities who depend on floodplain resources are required to contribute to effective and equitable resource management.

Over one-third of Bangladesh is composed of floodplain. Due to lack of proper management policy, these floodplains remain unused at least six months (monsoon season) in a year but millions of people surrounding the floodplains directly depend on them for their food and livelihood. Income of the masses living in these areas depends solely upon natural fish available during the monsoon season. Therefore, overall income of the people living around floodplain areas is low compared to other rural areas; resulting into higher poverty levels. Moreover, local power structure in this area is also hostile to include the majority belonging to low income category. During fish harvesting time, the local landlords exercise their power and catch a major portion of the fish from these floodplains (Islam *et al.,* 2006), depriving landless poor fishers from an income from fishing, and thus contribute to significant income inequality.

It appears that these floodplains are suitable for fish culture during the monsoon season. The WorldFish Center has introduced a new management system with the collaboration of the Bangladesh Department of Fisheries (DoF) where fish is cultured through

community-based management during the monsoon season, while the same land may be privately owned and used for rice cultivation during the non-monsoon season. This system is known as Community-Based Fish Culture (CBFC) and it is the subject of this thesis.

1.5 Conceptual Framework

The framework is developed to help us understand how technical and institutional intervention changes fish production and help develop new institutions or institutional arrangements. Together, the characteristics of the floodplain, types of fish stocked and harvested, the resource system, and the institutions influence floodplain productivity. The characteristics of the local users groups, and the social and economic characteristics of the users also influence organizational, village, and household level institutions. At village level, the variables are household size, homogeneity in terms of different social classes and wealth also influence new institutional arrangement.

The Institutional Analysis model (Fig. 1.2) is not used in this research to test whether or not the conceptual framework (Fig. 1.3) works, but to assess the ways in which it is used in the three cases of community-based fish culture and the management of the floodplain resources to improve floodplain productivity. Our conceptual framework highlights the notion that floodplain users involved in fish culture are subject to new rules, norms, regulations, technologies, forms of collaboration, knowledge, and that shifting power relations through external intervention are contesting, interfering or merging with existing local institutions. In order to address these challenges, floodplain users develop strategies to negotiate, transform or adapt the new institutions producing direct and indirect effects which described in chapter 4.

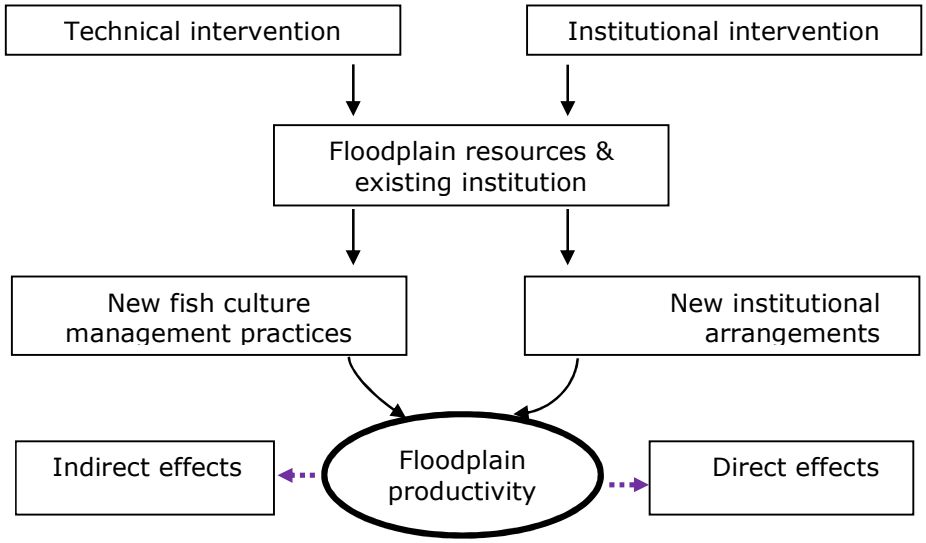

Fig. 1.3 Conceptual framework of the institutional arrangement in Community Based Fish Culture and management practice. (Adapted from Dey *et al.,* 2007)

1.6 Data collection

The WorldFish project provided for three Ph.D. research positions, one each on floodplain productivity, technological intervention and institutional aspects. The present research is organised around the institutional aspect of the community based fish culture in the floodplains. Following the selection of sites, baseline studies were conducted in the target and the control sites in 2006 in order to document the scenario on fish production. A total of 15 FGDs were conducted in surrounding project and control villages to generate baseline data for fish and rice production.

A total of 778 households were selected, comprising 469 households in the project floodplains and 309 in control floodplains outside the project area. Baseline information of all households was gathered, including their demographic situation and socio-economic conditions, ecological conditions, land uses, and the floodplain water management system. WorldFish Center then instructed me to use these project data to conduct a PhD study on the institutional aspects of community based fish culture intervention in these project floodplains. To this purpose, 46.27% of all households from the baseline study of the three project sites and the three control sites were randomly selected for the present study as indicated in table 1.4, including fishers, landless seasonal fishers, and landowners).

Table 1.4. Baseline population and number of sample households

Foodplains	Project/ Control	Baseline household population	Sample households	Sample households as % of population
Beel Mail	Project	124	60	48.38
Kalmina beel	Project	174	60	34.48
Angrar beel	Project	171	60	35.08
Chandpur Beel	Control	91	60	65.93
Andola Beel	Control	105	60	57.14
Painglar Beel	Control	113	60	53.09
All		778	360	46.27

1.6.1 Case study

For this PhD study, three cases were selected to study the implementation of community-based fish culture and the development of the Floodplain Management Committees (FMC): the Padma river basin (case 1), the Teesta river basin (case 2) and the Brahamapura river basin (case 3). These cases were selected because of their markedly different social and institutional arrangements between government, fishers' cooperatives, local stakeholders and classes of beneficiaries.

1.6.2 Methods

Data generation for this PhD study virtually started from 2007 following the selection of household samples from the baseline study. A range of qualitative and quantitative Participatory Rural Appraisal (PRA) techniques was applied including community profiles, participatory resource mapping, and field observations to monitor the changes in the different parameters of the baseline information. Selected parameters from the baseline study and additional parameters that appeared to be of interest regarding community based fish culture were incorporated in the sets of questionnaires used for data collection (Annexes 1 to 6). The collection of monitoring data started in 2007 and continued up to 2010.

I visited the study site in the surrounding village communities every month and collected information from the beneficiaries and from key informants within the community, using sociological research methods and techniques including semi-structured interviews, Focus Group Discussions, informal discussions with key informants, and quantitative surveys. Likewise, data were gathered from Floodplain Management Committees and other stakeholders to investigate the use of the floodplain as a common property resource (CPR) and the processes of the formation of local institutions and organizations. Stakeholders were defined as any group or individual who could affect or be affected by the achievement of management objectives (Grimble and Chan, 1995).

In addition, secondary sources like documents on the rules and regulations of FMCs, minutes of meetings and operational plans for community based fish culture were analyzed. Finally, detailed inventories of floodplain resources were compiled from operational plans supplemented with records of the Department of Fisheries and field observations.

Some of the requirements for institutional analysis were incorporated into structured baseline and longitudinal household monitoring survey formats. The survey included institutional and legal frameworks at community and stakeholder group levels, as well as an assessment of the natural resources system of the floodplain.

In all three cases Floodplain Management Committees (FMC) were formed from the different villages including representatives of all beneficiaries, like landowners, fishers and landless fishers. An annual work plan, budget and implementation plan for the CBFC activities in the floodplains were developed with support from the Department of Fisheries (DoF). The FMCs consisted of 15-20 members, including a president, vice-president, secretary, and cashier. The FMC was expected to solve conflicts and ensure that the benefits were distributed among the beneficiaries. Local project implementation committees (PIC) were formed with representatives from DoF, other related government departments, myself as the representative of the WorldFish research team, and the

president and the secretary of the FMCs for overall supervision and monitoring, to encourage co-management and to establish working rules for better management of the floodplain under community-based fish culture, together with the empowerment of the poorer fishers.

Monitoring was done at floodplain and household levels. Instruments used for collecting data at floodplain level are given in Annexes 1 to 3: Annex 1 provides the institutional checklist, Annex 2 showing the fish production questionnaire, and Annex 3 the rice production questionnaire. Instruments that were used for collecting information from households are given in Annexes 4 to 6: Annex 4 shows the questionnaire for income from fish, non-fish and other incomes and expenditures, Annex 5 seasonal crop production, and Annex 6 fish consumption and food security. These instruments were administered at varied frequency.

Changes of rules and regulation, frequency of meeting, financial management, and organizational accountability, decision making process, governance, and conflict management were all monitored at floodplain level at a monthly basis using the instrument given in Annex 1. Comparative data on fish and rice production in both project floodplains and control floodplains were collected at a six monthly interval by using the questionnaires given in Annex 2 and Annex 3.

Household-level data on the households included in this PhD study was collected using longitudinal surveys on a monthly, quarterly, seasonal (six monthly) basis during the research period (2007-2009). Data on income and expenditure was collected from the sampled households at quarterly (three months) intervals. In addition, data on changes in household livelihood conditions, causes and effects of these changes, the adoption of community-based fish culture activities, and views on potential actions for improvement was also collected on a quarterly basis. The seasonal survey covered the changes in input use for crop production, changes in quality of output from agricultural land and the effects of project intervention on crop production at household level. Finally, a two-weekly survey on the 1st and 15th day of each month was conducted to capture the household consumption pattern, especially the frequency and quantity of fish and meat consumption.

The collected data were tabulated and analyzed in accordance with objectives of the study. Table 1.5 shows the type of data used in the different chapters of this thesis, the various surveys used to obtain the data, and the data collection instruments applied.

Tab. 1.5 List of research instruments and data used per chapter

Chapter	Data type	Data Collection Instruments	Survey conducted	Project /Control	Who conducted
Chapter-2	Institutional data	Institutional Checklist	2006	Project	Project staff
		Institutional questionnaire(Annex 1)	2007, 2008, 2009	Project	Researcher
Chapter-3	Power and decisions data	Institutional questionnaire(Annex 1)	2007, 2008, 2009	Project	Researcher
Chapter-4	Floodplain fish production data	Baseline	2006	Project	Project Staff
		Fish Production and Other Information at Floodplain Level (Annex 4)	2007, 2008, 2009	Project	Researcher
	Rice and irrigation related data	Baseline	2006	Project	Project Staff
		Irrigation and Rice Production Information (Annex 3)	2007, 2008, 2009	Project and Control	Researcher
	Household level-Fish Consumption data	Comprehensive Baseline Survey	2006	Project and control	Project Staff
		Fish Consumption and Food Security(Annex 6)	2007, 2008, 2009	Project and control	Researcher
	Household level-Income data	Quarterly Fish, Non-Fish and Other related Income (Annex 4)and Seasonal Crop Production and Income (Annex 5)	2007, 2008, 2009	Project and control	Researcher
Chapter-5	Expenditure data	Quarterly Fish, Non-Fish and Other related Income (Annex 3)	2007, 2008, 2009	Project and control	Researcher

1.6.3 Implications of action research

My involvement in the WorldFish action research project was as an advisor and, during the period 2007-2009 also as a PhD researcher to obtain more insight, and use it in the process of institutional change in community based fish culture practices through project intervention. I always maintained a critical distance from the way the WorldFish project was implemented. One of objectives of the overall project was to develop appropriate institutional options for increasing water productivity at basin level through integration of community based fish production into existing floodplain and irrigation systems. Project staff and scientists were likewise engaged in designing and testing the institutional options for community based fish culture in the floodplains. But as a PhD student, I primarily tried to capture the institutional arrangements, stakeholder performance, their role and interaction with others in different power positions during the process of change. As an advisor my role was to coordinate with different institutional stakeholders of the wider project, like Department of Fisheries (DoF) and the Bangladesh Agricultural Research Council (BARC), participating in stakeholder meetings, community level

meetings, etc. On the whole, my involvement in the WorldFish project was more in the role an observer than an advisor.

1.7 Organization of the thesis

The thesis consists of an Introduction (Chapter 1) followed by four research chapters, two on social or institutional aspects and two on economic aspects. Each of these chapters has either been published (Chapter 2) or submitted to peer reviewed international journals (Chapters 3, 4, and 5). The last chapter (Chapter 6) contains a discussion of the results and the thesis conclusion.

Chapter 2 compares community-based fish culture projects in the case of one public-private and two private floodplains and analyzes the institutional arrangements of the three different Floodplain Management Committees (FMC). The research (2007-2009) aimed to understand the complex institutional relations that govern ownership, access, and control of the floodplains under CBFC to increase fish production and overall livelihoods of the poor. I followed the stakeholders representing the various institutions and organizations like the Department of Fisheries, the Department of Land, and Floodplain Management Committees. 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 beneficiaries, including poor landless fishers, through the sharing of benefits derived from their involvement. The willingness of the members of the different social classes to work together in the project, the adoption of new technologies, and the societal embeddedness of local government institutions appear to be important inputs for policy making.

Chapter 3 examines the three cases of community based fish culture management with an emphasis on the distribution of power and the decision-making process in different institutional arrangements. I analyzed community based co-management practices through the lens of the power relations at local level where land owners, fishers and landless, poor fishers are key actors. The research shows that existing co-management arrangements are characterized by unequal power distribution among the different actors, often resulting in the marginalization of the professional fishers and the landless poor fishers. The newly introduced community based fish culture model attempted to involve more equal representation of stakeholders, improved distribution of power, conflict resolution, and a mechanism of accountability in the decision making on fish culture activities in the public and privately owned floodplains of Bangladesh.

Chapter 4 examines the impact of community based fish culture in seasonal floodplains on fish production, consumption, income and food security of the participating

households in the various cases. Findings shows that fish production, income and food security of the participating households have increased due to the adoption of an equitable and inclusive multi-stakeholder approach introduced by the WorldFish project. Average fish production has increased to 394 kg/ha/yr. In the project sites the introduced approach generated 36% higher household fishing income in the first year, and 68% in the second year, compared to the control sites. Per capita annual household fish consumption increased from 1.26 kg to 2.31 kg/person/month in the intervention sites, which is 71% higher than in the control sites. Indirect benefits of community-based fish culture include reduced conflict; improved social capital and greater cooperation in the community.

Chapter 5 examines the impact of the Community Based Fish Culture (CBFC) system on expenditure and inequality using three years panel data from the project as well as control sites. Non-parametric propensity score matching method (PSM) method is used for impact assessment. Gini-coefficient and Gini decomposition methods were used to estimate the effect of expenditure in inequality. The results show that the community-based fish culture system has indeed a positive and significant impact on fisher's expenditure. Results also reveal that the CBFC system has an equalization effect on food, clothes and health expenditure. Furthermore, this management system helps to equally distribute total expenditure among the fisher communities.

Chapter 6 presents the Discussion and Conclusion. It discusses the main findings of this action research in answer to the research questions. Scientific and policy recommendations are presented to improve Community-Based Fish Culture in the floodplains of Bangladesh management structures.

Except Chapter 2 which has been published before, I am the single author of all other chapters of this thesis. Presently, chapters 4 and 5 are in preparation of submission to international peer-reviewed journals.

Chapter 2

Institutional Arrangements and Community Based Fish Culture[2]

2.1 Introduction

Bangladesh is located in the northeastern part of the South Asia which lies between 20°34' and 26°38' North longitudes and 88°01' and 92°41' East latitudes. It is bordered by India in the west, north and north-east (along a 2,400 kilometer land frontier) and by Myanmar in the south-eastern tip (193 km land and water frontier). In the south is a highly irregular deltaic coastline of about 710 kilometers, fissured by many rivers and streams flowing into the Bay of Bengal. The territorial waters of Bangladesh extend 22 km outwards, and the exclusive economic zone of the country is 370 km long. Formed by a deltaic plain, Bangladesh is virtually the only drainage outlet for a vast complex river basin made up of the Ganges (bearing the local name of Padma), the Brahmaputra and the Meghna rivers and their network of tributaries. The Padma unites with the Jamuna, the main channel of the Brahmaputra and later joins the Meghna to eventually empty into the Bay of Bengal. The alluvial soil deposited by these rivers every year has created some of the most fertile floodplains in the world.

Bangladesh has a total inland water area of 4.7 million ha of which 86% is used for open water capture fishery and 14% for closed water culture fishery (DoF, 2015). Of the total inland open waters, rivers-estuaries and floodplains cover 22% (0.85 million ha) and 69% (2.69 million ha), respectively. Floodplains contribute most significantly to the total inland open water fisheries as it has the highest contribution, both in terms of area (69%) and production (72%) (DoF, 2015). Bangladesh occupies the fourth and fifth position, respectively, in the world in terms of inland open water and closed water fish production (FAO, 2014). Fishery plays a significant role in the economy, culture, and tradition and food security of the people of Bangladesh. Fishery contributes 3.65% to the total GDP of the country and 22.6% to the agricultural GDP (BER, 2014). More than 2% of the total export earnings come from the fisheries sector which meets about 60% of the animal protein intake, providing full time employment to 1.4 million people and part time employment to 11 million people. In total, more than 11% of the population of the country meets a livelihood from different fishery related activities.

Floodplains are low lying areas that are annually flooded during the monsoon. Seasonal floodplains are water bodies that retain water for 5-6 months during which they are

[2] This chapter is based on A.B.M. Mahfuzul Haque, L.E. Visser and M.M. Dey (2011), Institutional arrangements in seasonal floodplain management under Community-based Aquaculture in Bangladesh. *Asian Journal of Agriculture and Development* 8(1): 1-18.

suitable to grow fish and other aquatic animals. Recent studies have revealed that, if 25% of the almost 2.8 million ha can be brought under community management, calculating 50% to be accessible, then 6.7 million people would benefit from accessing its resources, including 2.7 million landless poor. The annual fish production is expected to then increase four to five times as compared to the existing production (Dey and Prein, 2006, DoF, 2005; WorldFish Center, 2005).

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, open accesses to these resources and their 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).

2.2 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 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 an 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 leases take control over the floodplains for fish culture. Initiatives to bring privately owned floodplains under a 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.

WorldFish 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. These were carried out in the publicly owned floodplains (*beels*) with a three year lease to the community from the Land Department and with technical and institutional support from DoF. The CBFM program resulted in many valuable lessons learnt 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*[3] systems in seasonal floodplains in Comilla District. This approach largely followed the company type of rules of selling shares to the beneficiaries. This initiative was successful through 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 at a limited scale in Bangladesh and Vietnam during 1998 to 2000, and showed positive outcomes in terms of increased production and income. This study 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.,* 2005b). These findings emphasized the need to do further studies to develop appropriate options for different socio-cultural and institutional settings.

The purpose of this 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, in three floodplains in Bangladesh. This chapter aims to improve our understanding of the complex institutional relationships governing community based fish culture in seasonal floodplains under various ownership regimes.

2.3 The floodplain as a Common Property Resource

People's rights to access, use and commercialize natural resources, and the obligations and responsibilities associated with those rights are called property rights. 'Common pool resource' and 'common-property resource' have been found rather inconsistent terms, creating much confusion in the definitions and usage of the terms (Ostrom, 2003). CPRs may be owned by national, regional or local governments, by communal groups or by

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

private individuals or corporations. Schlager and Ostrom (1992) have defined five types of property rights (see Chapter Table 1.2) which are most relevant to the use of common pool resources and also apply to our case. Ostrom, *et al.(*1994) describe two attributes which distinguish a common property good or resource from other economic goods: the good is subtractable or rival, and non-exclusive or non-excludable in common property resource. Community based fish culture in seasonal floodplains includes subtractable and non-exclusive elements, but during the monsoon season the floodplain is managed according to open access rules. This means that all those interested in harvesting fish have free access to the resource. In this case we mainly have three categories of stakeholders and/or beneficiaries: (1) professional fishers; (2) poor, seasonal, non-landowning fishers, and (3) landowning elites who are not necessarily engaged in fishing.

2.4 Selection of the case studies

In the Indo-Gangetic river basins of Bangladesh, both publicly 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. In this chapter, three cases have been selected to discuss the results of 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 Brahamapura river basin (case 3). These cases were selected because of their markedly different social and institutional arrangements between government, fishers' cooperatives, local stakeholders and classes of beneficiaries. Between 2007 and 2010 sociological field research was carried out using a variety of qualitative and quantitative methods were applied (see 1.2 and 1.5) to gather data from Floodplain Management Committees, villagers and institutional stakeholders to investigate the use of the floodplain as a common property resource (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 Department of Fisheries and field observations. This section briefly describes the three cases, followed by a discussion on the results, and an assessment of the institutional arrangements.

Case 1: Floodplain Management Committee (FMC) in Beel Mail

The Beel Mail floodplain is located in Mohanpur *Upazila* in Rajshahi district in the Padma river basin around 40 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*[4] 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 BDT 154,520 (US$ 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 to and use the floodplain. Surrounding the Beel Mail there are five villages with about 1,112 households and a total population of about 6,125. In 2005 the local elites who sub-leased 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 2: Floodplain Management Committee (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 at Fulbari, nine km west of Upazila Parishad, and 35 km away from the Mymensingh district town. This floodplain has a higher technical potential and comparatively more lowlands suitable for fish culture is. There is one village around the floodplain of about 1,238 households and a total population of about 5,941. The villagers normally catch fish in the monsoon season (June-December). They were willing to participate in the fish culture activities and they collectively organized the fingerlings stocking, the 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 3: Floodplain Management Committee (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 about two km east of Upazila Parishad, and about 36 km away from Rangpur district town. The location of the floodplain is adjacent to the Asian Highway from 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 has a high technical potential and comparatively more lowlands than case

[4] *Khas* lands are public lands leased out by the fishers' or farmers' group for the period of one year.

2, and it is suitable for fish culture. Five villages lie around the floodplain with about a total of 1,348 households and a total population about 6,740. Among these five villages 97% of the fishers are living in the *uzirpur*[5] Mazipara. Their livelihood depends on fish and agricultural labour. They were willing to participate in the fish culture activities that were collectively managed and the villagers were engaged in fingerling stocking, *bana* preparation and fencing, the guarding, harvesting, and marketing of cultivated fish.

In all cases Floodplain Management Committees (FMC) were formed from the different villages including representatives of all beneficiaries, like landowners, fishers and landless fishers. An annual work plan, budget and implementation plan for the CBFC activities in the floodplains were developed with support from DoF. The FMCs consisted of 15-20 members, including a president, vice-president, secretary, and cashier. The FMC was expected to solve conflicts and ensure that the benefits were distributed among the beneficiaries. Local project implementation committees (PIC) were formed with representatives from DoF, other related government departments, the representative of the WorldFish research team, and the president and the secretary of the FMCs for overall supervision and monitoring, to encourage co-management and to establish working rules for better management of the floodplain under community-based fish culture, together with the empowerment of the poorer fishers.

2.5 Institutions and their roles

In order to answer the research questions formulated in Chapter 1, regarding what institutional arrangements facilitate stakeholder participation, and how public and privately owned floodplains differ in this respect, it is necessary to first identify the institutions and their linkages. Formal institutional linkages between DoF, WorldFish Center and the Bangladesh Agricultural Research Council (BARC) appeared to play 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 project team, DoF played an active and strong role in resolving many of the acute social problems, and ensured technical management support (Rahman *et al.,* 2008). DoF played a major role in the selection of floodplains, beneficiaries, and the formation of FMCs and PICs (Chapter 1). It also took necessary measures to protect fish from uncontrolled harvest and to ensure benefits to the poor, and ensuring a five years lease from the Department of Lands (DoL) for the public floodplain Beel Mail (case 1). This significantly empowered the fishers, as they were no longer facing the loss of their lease through public auction. Government institutions also provided the necessary monitoring

[5] An *uzirpur* is a big village, one third of the floodplain is surrounded by villages

and support. The institutional linkages of DoF with other the institutions involved in floodplain management are shown in Figure 2.3.

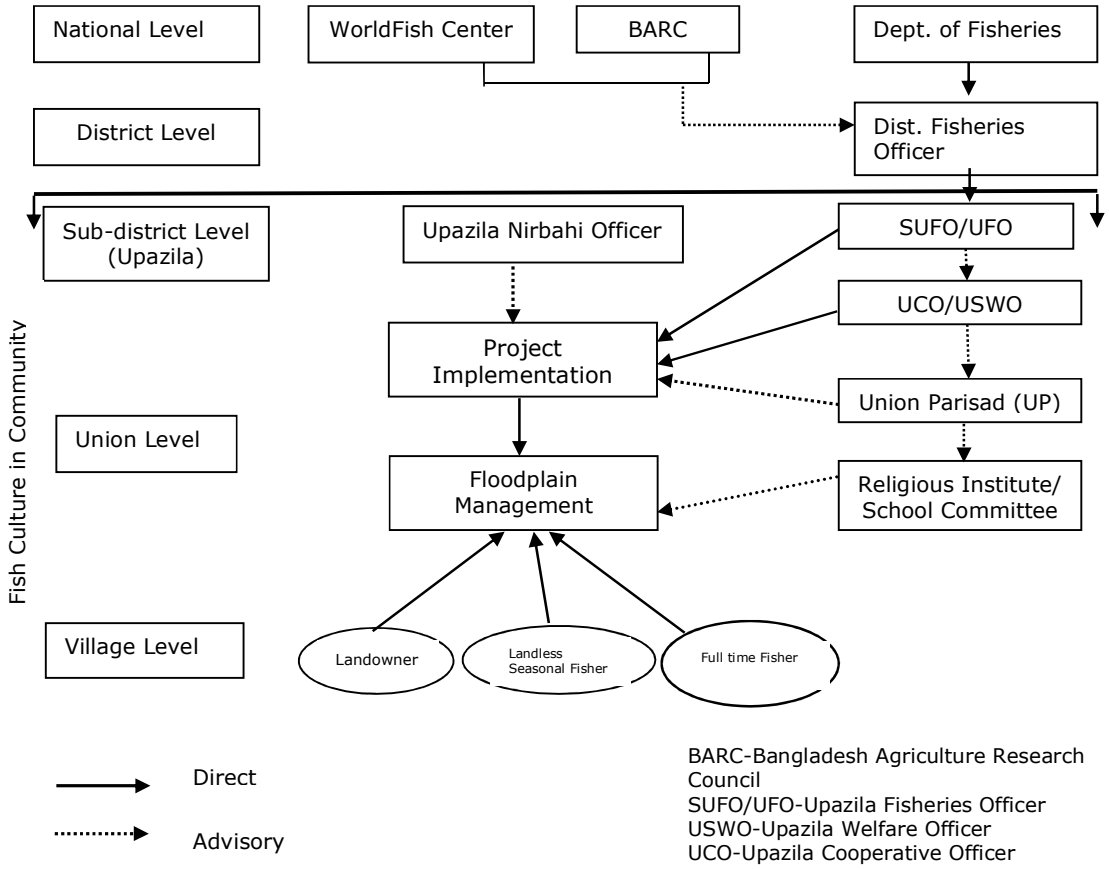

Figure 2.1. Institutional relationships between different stakeholders

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.,* 2005b). In all floodplains the involvement of school committees and mosque committees encouraged people to participate in community based systems and to utilize the unused potential of floodplains by bringing them under fish culture. These informal institutional organizations played a vital role in organizing and educating people and supporting the establishment of communal action as well as benefit sharing mechanisms.

2.6 Status of the three cases

Literature has indicated that ineffectiveness of the 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 on the argument (Larsen and Ribot, 2004) that the incentive for local communities to sustainably use their resources is their dependency on them for their livelihood. The decision making process in the management of natural resources by increased participation of local users and the need for the social empowerment of resource-poor local users are other important factors that have led to a focus on community participation in resource management (Meinzen-Dick and Knox, 2001).

Analysis of natural resources management cases indicates that the most significant conditions for successful implementation of collective action in community based management often is the formation of a representative, rationally acting, and self-interested group who 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 nature and 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 between the different users of the resource (Tang, 1992; Uphoff, 1986).

Project intervention and approach to the institutional organization of community based fish culture supports this literature in the sense that the newly instituted Floodplain Management Committees (FMC) 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 between 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 in this chapter to answer the research questions raised in Chapter 1 show interesting results regarding the following aspects:

a. Ownership and access to the floodplains and fisheries resources,
b. Institutional arrangements and rules developed by the FMCs,
c. Distribution of benefits of community based fish culture.

In the following sub-sections these different aspects will be further discussed.

2.6.1 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 for the fish culture, the multiple agricultural and fisheries uses of the water in the different seasons, as much as for the increased soil fertility by seasonal inundation of the cultivated fields. The floodplain as a resource system includes culture fish, un-stocked 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 difference has two effects: firstly, a user/appropriator of the CPR subtracts a flow of benefits potentially available to others. Secondly, 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 fish culture organization (FMC) would prefer to stock fingerlings, whereas non-members, fishers and landless seasonal fishers alike who catch fish for their daily living, cannot afford to do this.

Our cases are in line with the literature (Uphoff *et al.,*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 (see also Chapters 4 and 5). But there is an important difference between project interventions in private and public floodplains. In the floodplains under private ownership, like Kalmina beel (case 2) and Angrar beel (case 3), land inundated during the monsoon season remains privately owned. Both floodplains are similar in size, with comparable percentages of beneficiaries and similar numbers of communities surrounding the floodplains. However, Table 2.1 shows that the distribution of beneficiaries among the classes differs, with considerably more landowners than landless seasonal fishers benefitting from fishery resources. The livelihood of the households of seasonal fishers – who are mainly landless – fully depend on fishing in the floodplains during the monsoon season. Full time fishers (n= 68) 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,

but especially in the public Beel Mail floodplain (Table 2.1). I now turn to the differences between public and privately owned floodplains (see research questions in 1. 2).

Case 1 (Beel Mail) of the public floodplain, surrounded by private lands, differs most from the other two cases where land is privately owned. In Case 1 the public area is leased out to fishers during the monsoon, including the private land owned by affluent and politically influential stakeholders. The floodplain is larger than in the other two cases, but both the percentages of landless fishers and of landowners are lower, making the class of the landowning professional fishers the majority (55%) among the beneficiaries (Table 2.1).

These cases 2 and 3 of the privately owned floodplains of Kalmina Beel and Angrar Beel, respectively, show that the FMCs normally allow landless seasonal fishers – who are not a member of an FMC - to access the floodplains, but only to harvest un-stocked fish using local gears, considering the importance of fishing to their livelihood. 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 un-stocked 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 un-stocked fish as they can 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.

Of the three floodplains Beel Mail is the one under public-private ownership, while the two other floodplains Kalmina and Angrar are privately owned. The main difference among the stakeholders in the two types of floodplains is found among the classes of beneficiaries. The professional, full time fishers are members of a formal institution, namely the fisheries cooperative society. They are born in a fisher's family and the members of Hindu community. The livelihoods of fishers of this community largely depend on income obtained

Table 2.1: Numbers of different beneficiaries in floodplains under community based fish culture (n= 469)

Floodplain	Number of beneficiaries (%)			
	Landless Seasonal fisher	Full time Fisher	Landowner	Total
Beel 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)

Source: This research. Numbers in parenthesis indicate percentages.

from fishing. Being a member of a professional fishers' community provides them with strong social and institutional networks and linkages with the authorities, like the local Department of Fisheries (DoF) and Department of Land (DoL). As the formal lease holders of the public water of the floodplain over the period of the project they have established their rights as members of the CBO and are fully involved in, and use the benefit from fishing from the floodplain.

The fishers of the Kalmina and Angrar Beel floodplains are the members of the Muslim community. They are not born into fishers families, and have no formal institution to support them. The livelihoods of these fishers depend on fishing and agricultural activities. The have comparatively poor linkages with DoF and DoL, and work like general members of the CBO.

The other classes of beneficiaries of the CBO are the poor, landless, seasonal fishers or non-fishers, who are living in the same communities surrounding the floodplains. Most of them are dependent of the floodplain for their livelihood. They catch un-stocked small fish using local gears (e.g. *khulsan*[6], *darki*[7]) from the floodplains during the wet months mainly for household consumption. The percentages of landless fishers in the three floodplains are comparable, despite the different ownership regimes. As members of the CBOs, they benefit from fish culture in the floodplain in all cases, like the other classes of members. Yet, in addition they are given the opportunity to harvest fish - on the condition of using local gears - for household consumption. Actually, only few of them sell the fish they harvest.

The other participants of the CBOs are the land owners who own the lands located within the floodplains. In case of the Beel Mail floodplain the location of their lands are located in the surrounding of the public area, depending on the season being dry land or

[6] Small size fishing trap which made with bamboo.
[7] Medium size fishing traps which made with bamboo.

water. During the dry season they grow rice (Annex 3), but during the monsoon season their lands are used as an integral part of the floodplain.

2.6.2 Institutional arrangements and rules

A second research question (see 1.2) regards the rules and regulations governing access to the floodplains, and the differences between public and private floodplains. In CPR literature, institutional arrangements are defined as the rules and regulations governing the resources use (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, including property rights protected by public regulation, the level of delegation of decision making, and 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 between DoF and the individual FMC's in a non-judicial construction. Importantly, in their regular meetings the FMC documents the everyday practices of the implementation and compliance with the rules related to fish culture and management, and these minutes are distributed among its members.

The various rules and regulations governing access to the public and privately owned floodplains are presented below. Some rules are derived from the national fisheries law. It appears that in the three cases, comparable rules and regulations for fish culture are applied irrespective of whether they apply to public or to private floodplains.

Operational Rules

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

Before the start of the final harvesting of the stocked fish, the FMC conducts a meeting with their fishers-members at village level to discuss the composition of the harvesting groups, the gear used, the quantity of fish to be harvested, and the cost sharing regulation. I found that in the privately owned floodplains (cases 2 and 3) two or three groups were formed for the fish harvesting; each group consisting of nine to ten fishers. But in the public floodplain (case 1) as many as ten groups were formed and the number of members per group varied from four to ten fishers, according to their experience in fish harvesting, depending on the use of specific gears used to harvest fish.

The fisher groups harvested the fish alternatively by agreeing on a schedule of which group would harvest when during a period of one week. The amount of fish to be harvested was decided upon by the fish harvest group or the FMC on a daily basis, considering local market demand as they contacted the wholesaler. The fishing costs were determined by each fish harvest group, distributed, and shared equally between its members. When, at the end of the season, the water level decreases, the fishing cost determines which species of fish will be caught, and what sizes and amounts of fish will be harvested from the floodplain.

Collective choice rules

My study shows that the collective choice rules for the formulation and enforcement of operational rules may differ. In the two privately-owned floodplains the total number of members of the committees changed over the period of two years varying from 13-16 members. The composition of these committees involved all the beneficiaries, like (non-fishing) landowners, landowning fishers, and landless seasonal fishers. But 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 on their managerial capabilities, their power positions and dependency of the community people. Still, all classes were represented in 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 the three research sites of the project the FMCs made additional rules and regulations according to the MoU between the FMC and DoF, and they also developed additional rules, for example fishing rules and membership criteria. Leaders were selected

considering criteria like capability to speak well in public and be a good organizer, their acceptance by all beneficiaries, transparency and accountability. A leader was selected only for two years after which the beneficiaries would replace him. But in case 2 (Angrar) the beneficiaries replaced the leader already after one year because he was corrupt. They also appointed two full-time representative fishers to the executive committee. Leaders were observed to play an active role in the decision making process about operational and collective management works.

2.6.3 Distribution of the benefits of community based fish culture: comparison of cases

In an action research based study like this, a discussion on rules and regulations to improve benefit sharing in community based fish culture gains in strength if data can be shown on the actual income distribution between classes of beneficiaries in the three different cases. Therefore, I will now discuss the increase and distribution of benefits among the different classes of beneficiaries, like full-time fishers, landless seasonal fishers, and landowning non-fishers.

Benefit sharing of the fish production from the floodplains was agreed in principle at the start of project activities by all stakeholders, but their commitment varied between the classes of beneficiaries and across the cases. The FMC ensured full-time fishers of a secure employment during the monsoon months of fish harvesting from the floodplains; they received benefits directly through their own harvesting of stocked fish in the form of a share of the fish or in cash after harvest. They also received benefits from getting a share of net income earnings from the FMC fish production of the floodplains. Some of the members of fisher communities added to their income by establishing fish nurseries in their homestead or they rented ponds and supplied fingerlings stock to floodplain. Benefits also took the form of activities indirectly related to fishing. Some benefitted 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 collecting it regularly from the floodplain during the harvest period. In addition, these full-time fishers benefited through their involvement in activities related to the management of floodplains, such the preparation of *bana* fencing of inlets and outlets, working as a security guard, etc. Thus, their income earning opportunities were highly diversified and increased with community management.

The households of the seasonal fishers who were mainly landless fully depended on fishing in the floodplains for their livelihoods during monsoon season. Apparently, due to the implementation and compliance to regulation and conservation measures the availability of un-stocked small fish in the floodplains has clearly increased during the project period, which resulted in a bigger catch for seasonal fishers using local gears.

This has resulted in higher income and related benefits to the households of landless seasonal fishers (Tab. 2.2).

Finally, the landowning class who usually do not fish themselves, often construct ditches in the floodplains forming trap ponds to harvest fish naturally. They also own land in lower lying floodplain areas which may be used for crop production during the dry season. Landowners also benefit by receiving a better income from selling fish due to project intervention. If they use their land for crop production during the dry season they also benefit because land fertility has increased, and crop production demands little or no labour for the transplantation of rice seedlings, little water for irrigation, and there is less need for pesticides and fertilizer.

Those owning land in the lowland areas or in the surrounding environment of the floodplain that receives water usually grow rice during the monsoon months. They benefit from fish production without hampering their crop production. The project has introduced water control measures that enable the floodplains to function as a water reservoir. Thus, households who have access to land in more elevated areas benefit for crop production by getting a supply of water through supplementary irrigation.

In addition to fish production and water management for rice production, households also profit from the floodplains through the collection of aquatic weeds and aquatic animals other than fish. In the floodplains located close to the communities, women are involved in rearing ducks, and collecting fodder from the floodplains to feed their goats and cattle, and aquatic weeds and snails for the chicken. 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 for the construction of pits to protect the village from flooding, and for the development of vegetable gardens and growing fruit trees. Mud collection also helps to excavate the deeper parts of the floodplains to grow fish, especially in the lowland areas.

Table 2.2 compares incomes before and after intervention. There is a significant increase of income for different stakeholders derived from their involvement in fish culture. A comparison of the project baseline (2006) and impact survey (2009) results suggest that the real average income of all three classes of beneficiaries increased significantly. Table 2.2 shows that overall income from fish culture increased by 164 % in case 1, by 189 % in case 2 and by 200 % in case 3.

Table 2.2: Increased income (US Dollar) from floodplain between 2006 and 2009 due to project intervention in fish culture.

Beneficiaries	Case 1 (Beel 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

Source: This research. 1 BDT = 0.01449 US Dollar

Apart from the increase in fishing as compared to 2006, the average household income from fishing also increased for each of the classes of beneficiaries, although in varying degrees. Landowners' incomes clearly increased most (more than 300%) in all cases, whether public or private floodplains. Full-time fishers also gained substantively, although more in the private floodplains (cases 2 and 3) than in the public floodplain. But in terms of benefit sharing between all classes of beneficiaries, including the poor landless fishers, it is important to note that this class also saw their incomes increase with 66%, 93%, and 75%, respectively. This means that the project's institutional arrangements resulted in an increase of income for all classes of resource users in the floodplain. My data also show that incomes for all classes increase more in the privately owned floodplains (cases 2 and 3) than in the public floodplain (case 1).

A benefit sharing arrangement was decided and agreed upon by the beneficiaries and finally by the FMC for the research period of 2007-2009 (Table 2.3). In all the floodplains net income was calculated by deducting the lease value, fingerling costs for continuing the fish culture in the subsequent year. For the Beel Mail (case 1) floodplain, after deductions of the lease value and deposit the fingerling cost, out of total net income (100%) the fishers (N=68) received around 40% of money received and the landowners (N=34) received almost 38% of money, as they had to pay the lease money for the floodplain. According to the bilateral agreement with the Fisheries Cooperative 20% of their net income would be given to a cooperative fund. The fishers in the floodplain on their part considerably benefited by taking control of the fish harvest from the floodplain. They received 50% of the price of the harvest of un-stocked fish and 10-15% of the stocked fish.

Like in the public floodplain of case 1, also in the private floodplains of case 2 and case 3 the net income was determined by deducting the fingerling cost from the total

income. In the Kalmina floodplain (case 2) and Angrar floodplain (case 3) all classes of stakeholders deposited around 25% of their net income in a revolving fund. The fishers group got their income from the final harvesting of fish as they received 50% of the price of the harvest of un-stocked fish and 10-15% of the stocked fish. The landowners (N=97) received 50% of income according to their land. In the Angrar floodplain, the fishers (N=23) and land or ditch owners (N=110) 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 and received 5% of income. In all the three cases, the users of the floodplain contributed a small portion of their income to social work like, the development of the mosque or the Hindu temple.

Table 2.3 Benefit Sharing Arrangement of Case 1 (Beel Mail) floodplain, Case 2 (Kalmina) and Case 3 (Angrar) floodplain

Stakeholders	Net Income (%)		
	Case 1 (Beel Mail)	Case 2 (Kalmina)	Case 3(Angrar)
Landowner and ditch owners	38	50	45
Fishers	40	10	10
Landless Seasonal Fishers	-	5	5
Deposit fund for next year	20	25	25
Contribution to social work	2	10	15

Source: This research

In conclusion, the income increase for full-time fishers is higher in the public CPR (case 1) than in the privately owned floodplains of the cases 2 and 3. Landowners are better off in cases 1 and 3, while the poor, landless seasonal fishers profit more from accessing fish stocks in the privately owned floodplains of cases 2 and 3.

2.7 Conclusion

The DoF/WorldFish project on fish culture has shown that it is socially feasible to successfully integrate community based fish culture in large floodplains, and establish income increase and sharing mechanisms including all classes of beneficiaries, irrespective of whether they are subject to public or private ownership. Yet, the three cases of community based fish culture presented in this chapter show that the institutional differences of rules and regulations may also differ substantially between public and privately owned floodplains.

The institutional setting in case 1 of the public floodplain of Beel Mail markedly differs from the privately owned floodplains, due to the role of the fisheries cooperative and the Land Authority. Through the formal rule of taking a three years lease on the public lands of the floodplain from the Land Authority by the fishers' community, the fisheries cooperative created a platform to establish their access rights to the floodplain for fish culture. The CBO also have informal rules for those having land and those using the floodplain to harvest fish during the wet season, like landless seasonal fishers, to become members of the CBO in order to obtain access to the resources of the floodplain and the benefit sharing of fish culture. In order to enforce the formal rules, the Land Administration together with the Department of Fisheries were subject to much influence from different power groups, which made it sometimes difficult for those who were entitled to become involved in the auction to actually obtain the lease rights. The the CBO of the fisheries cooperative, the advocacy role played by DoF through the project, however, succeeded in strongly establishing their user rights, even for an extended period.

In the private floodplains of Kalmina (case 2) and Agrar (case 3) the rules set up were more informal, including the access rights of landowners. Their priority was to have the resource use shared with a range of users of the floodplains, including the landless seasonal fishers and the fool-time professional fishers. The CBOs designed and implemented most of the informal rules for establishment of an effective community based fish culture in the floodplains.

The institutional embedding of DoF through the Fishers Cooperatives as implementing institution appeared highly instrumental. The various classes, including landless poor seasonal fishers, professional full-time fishers, and non-fishing landowners, all benefited from the implementation of the CBFC activities in the floodplains, albeit in various ways. Landowners clearly profited most, but fishers, and especially poor landless fishers became clearly included in the benefit sharing arrangements. The outcomes of this research demonstrate a significant increase in income to all classes of beneficiaries through income sharing derived from their involvement in the fisheries cooperative and fish culture.

In conclusion, despite the difficulties encountered, an environment with a win-win situation was created for large numbers of people, with active and strategic participation of 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.,* 2005b) and demonstrate that community-based fish culture can be successfully implemented also in large publicly owned floodplains, if supported by effective institutional arrangements.

Chapter 3

Power and Decision-Making in Fish Culture Management in Public and Private Floodplains

3.1 Introduction

Administrative decentralization and increased pressure on coastal and marine resources have created the need for reflection and action on integrated coastal development (Visser, 2004). Increasingly social science studies have been carried out on fisheries co-management in coastal areas of South and Southeast Asia (Bavinck, 2001; Agrawal and Ribot, 1999; Larson and Ribot, 2004; Ribot, 2002a) but they remain mostly focused on the marine environment. Studies on natural resources management in floodplains are notoriously absent. In recent years the demand for floodplain fish production has largely increased due to decreasing trends in capture fish production from the floodplains (Dey *et al.,* 2005b, Haque *et al.,* 2008; Fazlur, 2010). Floodplains offer a high potential for increased production through fish culture, particularly during the monsoon. Recent initiatives are trying to bring privately owned floodplain areas under fish culture by establishing contracts between land owners and individual fish culture entrepreneurs (Mustafa *et al.,* 2009; Barman *et al.,* 2010; Toufique and Gregory, 2008). The empirical data in this chapter result from my involvement with a WorldFish project (2007-2010) to develop and implement a co-management model, focusing on institutional aspects of community based fish culture in the floodplains of Bangladesh.

A public floodplain surrounded with private land is an open access area throughout the year, during both the dry and the wet season. Its resource users may differ, but for community based fish culture (CBFC) management it is important that particularly during the wet season all kinds of stakeholders, ranging from landowning elites and fishers to landless poor fishers (Chapter 2) have access and rights to fish. A privately owned floodplain is owned by village elites, especially during the dry season, and used for crop cultivation. During the wet monsoon the plots are inundated and boundaries become more fluid, so private ownership claims are more difficult to sustain. A more inclusive community based fish culture during the wet season could then serve as a common pool resource area for a wider range of stakeholders, this time including fishers and landless poor fishers.

Equal access to and ownership of public floodplains is complex in cases where floodplains that are leased to groups of fishers are appropriated by a wealthy local elite, which results in the accruing of the benefits from fish culture only to a few members of these fishers' groups. Although this kind of community based fish culture may lead to

increased fish production, it also results in the loss of access rights of landless poor fishers (Barman *et al.,* 2010). Private lands in floodplains are increasingly being converted to land use systems integrating rice culture and fish production in different seasons. Although fishery productivity increases, it also adversely affects the landless poor fishers/farmers. The necessary investments of landowners to sustain this type of integrated land use have important implications for access arrangements to the water bodies in the floodplains as well as to their potential productivity. This concern is echoed by Haylor *et. al.,* (1997) who noted that the owners of rice fields suitable for fish production may fence off their fields. This intervention negatively affects access of the poor to fishing grounds by converting the floodplain from open access to private space.

While there are initiatives to bring privately owned floodplains under fish culture by establishing a contract between landowners and individual fish culture entrepreneurs, initiatives to bring public as well as privately owned floodplains under a community-based fish culture system with multiple beneficiaries are less common. It is particularly important to design an integrative resource use approach in which poor households can be included, and to optimize the overall seasonal floodplain productivity by using innovative technologies incorporating culture-based systems and/or conserving natural fish production (see Chapter 1 for technical aspects of the intervention). Such an approach faces institutional challenges and demands that institutions like community based organizations (CBO) are developed (Chapter 2) to balance the interests (Collis *et al.,* 2011) of land-owning fishers, landless, poor fishers, and non-fishing landowners in the floodplains. This chapter focuses on the power differentials and how these influence decision making concerning the development of community based fish culture implying more equal access to the floodplains, especially during the monsoon season.

An analysis of resource use and management practices is necessary to properly understand the real-life conditions and power relationships in public and privately owned floodplains. The more intensive and longer the period of engagement of a researcher with key actors, the better the social, technical, and institutional problems are understood, and the limitations of past developments acknowledged. In this case, I have been involved with the resource users, both landowners, professional fishers, and landless poor fishers as a WorldFish researcher in doing long-term fieldwork (2007-2010) in Mohanpur (Rajshahi district), Pirganj (Rangpur district) and Fulbaria (Mymensingh district), in collaboration with the Department of Fisheries and other local government institutions.

A major issue was the strong power position of the village leaders and elite, known in the literature (Fritzen, 2007; Platteau, 2004) as elite capture, dominating the social, economic and political networks. Initially it was difficult to reduce the effect of

elite capture on the project's efforts to include other classes of resource users in the decision making about access rules to community based fish culture. However, over time the village elites lost their interest in the project's involvement of the actual resource users, like landowning fishers and landless poor fishers who were able to empower themselves and establish their rights (see below). Also, at the beginning, lack of money was a major constraint of fishers, in the course of the WorldFish project intervention the improvement of the organization giving more responsibility to fishers, and establishing a representational structure of fishers, several comparatively better-off fishers even joined to invest their money in floodplains fish culture to support the CBO in covering their management costs, like the payment of the land lease to the owners, fencing, and stocking of fingerlings (see Chapter 2). As a result, even though the project formally ended in March 2010, the CBO has been able to still continue their activities with success.

This chapter addresses the research question (1.2) about the identification of the different resource users of the floodplains, their power relations, and how they became involved in the decision making about community based fish culture and a more equal access to floodplain resources. Field research aimed to first assess the power relations between the various stakeholders who were directly or indirectly involved in floodplain fisheries in the three sites of the Indo-Gangetic River Basin (Tab. 3.1). In section 3.3 their shifting power relations and decision making process in co-management practices were studied in the different institutional contexts. Section 3.4 describes the governance in the case of the three research sites, Beel Mail (case 1), Kalmina beel (case 2), and Angrar Beel (case 3). Results show that the co-management arrangements of both public and private floodplains as a unique community based fish culture model indeed achieved more equal representation of stakeholders, improved distribution of power, was instrumental in conflict resolution, and helped to develop a mechanism of accountability in collective decision making about the management of floodplains in Bangladesh.

3.2 Co-management and power practices

Co-management of natural resources is a form of political-administrative devolution that involves the formal transfer of power from a central government to actors and institutions at lower levels in a political-administrative and territorial hierarchy (Larson and Ribot, 2004; Agrawal, 2005). In this study the focus lies with the shifting of decision-making powers from centralized to more localized institutions within and beyond state structures, such as local government, civil society organizations, and local user groups (Meinzen-Dick and Knox, 2001; Nizami, 2013). Current thinking about community based fish culture in seasonal floodplains is promoting more democratic and

rights-based approaches (Larson and Ribot, 2004). Co-management as a form of decentralization is believed to lead to increased equity and efficiency in natural resource governance by bringing decision-making closer to primary stakeholders like the local users, and making the decision-making procedures more transparent, by enabling the participation of less powerful, often poorer stakeholders, and increasing downward accountability (Agrawal and Ribot 1999; Larson and Ribot 2004; Ribot 2002a). In this context, effective decentralization is defined by inclusive and accountable processes where local entities are empowered with meaningful discretionary authority over the management of natural resources that are relevant to local populations (Ribot 2002a, 2002b). In line with the literature, our action research and analysis focused on the power relations between the different classes of stakeholders and the changing relations as result of project intervention in fish culture in the floodplain of the Indo-Gangetic River Basin.

Table 3.1 summarizes the power positions in the co-management organization of the three research sites that were used as case studies of different institutional arrangements. Instead of merely listing the institutions involved, I studied the actual power practices and decisions making processes between the stakeholders in the three cases to gain insight in the different power positions in community based fish culture.

Tab. 3.1 Membership and decision making in public and private floodplains

Attributes	*Publicly owned floodplain*	*Privately owned floodplain*	
	Mail (case 1)	Kalmina (case 2)	Angrar (case 3)
Establishment of FMC	2006	2007	2007
Membership	Representatives of the fishermen's society, landowners, landless poor	Landowners, fishermen, landless poor	Landowners, fishermen, landless poor
Executive members	11 members; leader chosen by fishermen's society plus influential landowner	13 members; leader chosen democratically from among all stakeholders	17 members; leader chosen democratically from among all stakeholders
Decision making process	Monthly FMC meetings, validation/acceptance by fishermen's society and landowners	Monthly FMC meetings, Leader discusses with members and reports to FMC	Monthly FMC meetings, Members take decisions and implement them
Excludability	Determined by membership of the existing CBO, FMC	Determined by FMC membership and multiple use characteristics	Determined by FMC membership and multiple use characteristics

Subtractibility	By members of the fishermen's cooperative society, participating landowners and landless seasonal fishers of surrounding villages	By members representing the beneficiaries from surrounding villages	By members representing the beneficiaries from surrounding villages
Multiple use	Domestic purposes, irrigation for crop production, fishing and fish culture	Irrigation for crop production, fishing and fish culture; domestic purposes	Irrigation for crop production, fishing and fish culture, domestic purposes
Access rights during monsoon season	Floodplain as CPR and as open access resource, but in dry season the access right restricted by land owner	Floodplain as CPR and open access resource and dry season; the access right restricted by landowner	Floodplain as CPR and open access resource and in dry season; the access right restricted by landowner
Conflict resolution	Low cost, involvement of governmental and informal institutions	Low cost, involvement of governmental, informal institutions, and customary organization	Low cost, involvement of governmental, informal institutions, and customary organization.

Source: This research

3.3 Institutional arrangements and power practices

The co-management approach that was developed in the floodplain intended to support all stakeholders to become beneficiaries, especially poorer fishers, to enable them to be represented in the management of local water bodies, to cooperate and participate in taking collective decisions, and the development of local rules (Thompson *et al.,* 2003). In collaboration with WorldFish, the Department of Fisheries (DoF) took the initiative to establish management committees in order to increase the level of participation of resource users in decision making, setting the rules for the improvement of sustainable fisheries and aquaculture, and a more equitable distribution of income and consumption between all stakeholders. This meant that less profit would be going to fishers' leaders, land owners, middlemen, moneylenders and leaseholders (Haque et al 2008; Toufique and Gregory, 2008; Sultana and Thompson, 2011). In this section I examine different types of powers reflected and exercised by the various key actors in community based fish culture management. I identified two types of power in the management of floodplain aquaculture and stakeholder involvement, namely a) the power to create rules and decision making procedures, and b) the power to resolve disputes and ensure compliance (Agrawal *et al.,* 1999).

Creating rules and decision making procedures

Institutions can be defined in terms of formal rules and informal norms, which constrain or foster human behavior and are adopted by individuals operating within or across organizations (Ostrom, 1999). Both formal and informal rules can be classified into seven broad categories, like position, boundary, choice, aggregation, information, payoff, and scope rules (Ostrom and Crawford, 2005). Some community-based organizations which are managed by the government, set rules and regulations as they are changing and developing their own rules to address new responsibilities (Haque *et al.,* 2011). These rights and rules may be formal or informal. Institutional arrangement analysis of community-based fish culture describes what is occurring in real life and assesses the relationships between local community-based institutions and related organizations (Ostrom, 1994). The local management system and sets of contextual variables were explored using the IAD model (Chapter 2). Contextual variables include the biological, physical and technological attributes, market attributes, stakeholder and community characteristics, community institutional and decision-making arrangements, the external institutional arrangements, and exogenous attributes. Floodplain Management Committee (FMC) reviews the rules and regulations formulated by the government to complement the vision and roles of the institution, and if there is a need, modify them.

It is important to recognize who implements or enforces these rules. Rules and regulations governing access to the public and privately owned floodplain were developed by Department of Fisheries (DoF) and FMC. A similar set of rules and regulations was applied to the public and the privately owned floodplain for fish culture. Most of the rules were derived from the national fisheries law. The rules and regulations that were applied to the floodplain were written down in a Memorandum of Understanding between DoF and FMC. Examples are rules and regulations about membership, leadership, boundary and access, allocation, penalties, input, and conflict resolution that were enforced for the management of community based-fish culture (Table 3.2).

The Department of Fisheries (DoF) and FMCs have discretionary powers to create new rules and make decisions about how resources are to be used. However, the process and nature of legitimacy regarding these decisions varies between the different actors. The executive members of FMC have a role to settle disputes among fishers and other beneficiaries. The Government of Bangladesh devolved power to the local Department of Fisheries to manage fisheries resources, to implement the national fishery policy and to elicit the legal instruments guide the process through outlined strategies. These rules and regulations likewise aim at enhancing fish production by introducing fishing limitations in

Table 3.2: Evaluative framework and results for involvement in community based fish culture

Rules	Evaluative Criteria	Evaluation Results		
		Beel Mail(Public)	Kalmina(Private)	Angrar(Private)
Position	Participation is representative of and accountable to local populations and all relevant stakeholders	Representatives of the influential landowners and landowning fishers decided on the criteria formulating the positions rules; were accountable to local community and project management committee.	Representatives of the landowners, land owning fishers and landless poor fishers decided on the criteria formulating the positions rule; were accountable to local communities	Representatives of the landowners, land owning fishers and landless poor fishers decided on the criteria formulating the positions rule; were accountable to local communities
Boundary	Selection of participants allows for representative and accountable participation	Representatives of influential landowners and landowning fishers decided on the criteria formulating the boundary rules; were accountable to local community and project management committee.	Representatives of the landowners, landowning fishers and landless poor fishers decided on the criteria formulating the boundary rules; were accountable to local communities	Representatives of the landowners, landowning fishers and landless poor fishers decided on the criteria formulating the boundary rules; were accountable to local communities
Choice	Meaningful authority to affect resources management outcomes slowly transferred from government to community based institutions	Meaningful authority to affect floodplain management outcomes transferred from the government to Fishers group	Meaningful authority to affect floodplain management outcomes transferred from landowners and ditch-owners to FMC	Meaningful authority to affect floodplain management outcomes transferred from landowners and ditch-owners to FMC
Aggregation	Decision-making aggregates the preferences, values and needs of those who are mainly affected by the exercise of power	Decision-making aggregates the preferences, values and needs of FMC and fisher group who are mainly affected by the exercise of power	Decision-making aggregates the preferences, values and needs of local communities and FMC who are mainly affected by the exercise of power	Decision-making aggregates the preferences, values and needs of local communities and FMC who are mainly affected by the exercise of power
Information	Good communication and interaction with local population, stake holders and central government	Communication and interaction with local communities, stake holders and local government was low	Communication and interaction with local communities, stake holders and local government good and transparent	Communication and interaction with local communities, stake holders and local government good and transparent
Pay-off	Adequate resources transferred allowing the community based institutions to exercise their authority.	Government land transferred allowing the Fishers group to exercise their authority	Landowners, ditch-owners, local community and local government transferred land resource allowing the FMC to exercise their authority	Landowners, ditch-owners, local community and local government transferred land allowing the FMC to exercise their authority
Scope	Authority is transferred to a lower political-administrative and territory hierarchy	Authority transferred to district and sub-district administration/ local government; Fisher groups	Authority not transferred to administrative and territory hierarchy but transferred to local government and FMC	Authority not transferred to administrative and territory hierarchy but transferred to local government and FMC

Source: This research (adapted from Ostrom and Crawford, 2005)

for example fish shelter areas or gear and mesh size restrictions. FMCs in all cases were relatively powerful and endorsed the decision. This implies that user committees have *de jure* powers to formulate rules that govern exploitation of the fisheries resources within their jurisdiction.

In the case of a public floodplain (case 1) participation of the representative of influential land owners and landowning fishers plays a major role in formulating criteria for position rules of the members and their duties, as all members are accountable to local communities and the project management committee. The selection of members allows for representative and accountable participation and the meaningful authority is slowly transferred from the government to community based institutions to affect resource management outcomes. The decision-making process aggregates the preferences, values and needs of those who are mainly affected by the exercise of influential land power. Before project intervention, the exchange of information, communication and interaction with local communities, stakeholders and the local government were very little. The power of the Department of Fisheries was now being transferred to the lower political-administrative units of the sub-district administration: Union Parishad, together with local user groups, and floodplain management organizations (FMC).

In the case of a private floodplain (cases 2 and 3) the representatives of land owners, landowning fishers and landless poor fishers have a collective role in formulating criteria and rules about position and boundary. The management committee is accountable to local communities. The selection of members allows for representative and accountable participation and the meaningful authority is transferred from the CBO to affect resource management outcomes. The decision-making process aggregates the preferences, values and needs of those who are mainly affected by the exercise of power and information, communication and interaction with local communities, project management committee and the local government were present and transparent.

In the public floodplain the fisheries cooperative society was the lease holder formally using their institutional identity. However, in actual practice they were almost powerless, the influential powerful people taking over the control providing a very small token in terms of financial benefits to a few members of the fisheries society. Fish production, decision making etc. were all captured by the local elites. After the project started, a series of meetings with the communities surrounding the floodplains, the application of a Participatory Action and Development Plan (PAPD), and my own participatory action research activities led to gradual changes in the power dynamics between the elites and other classes of resource users, creating a more equity based institution.

In the case of the Kalmina floodplain (case 2) under private ownership, several younger people came forward and took over the major responsibilities in management of the CBO. They managed to establish of a system for effective use of the floodplains to get a higher fish production and increased benefits for the members. They also took initiatives to formalize their institution through registration with the Department of Social Welfare.

In the private floodplain of Angrar Beel (case 3) all initiatives were equally applied to establish a management system of the floodplain by the CBO. But this initiative failed due to the power game of the leader of the CBO and a few other members. Several other initiatives were undertaken which in most cases failed.

Resolving disputes and ensuring compliance

Magistrate courts at local level in Bangladesh have the power to decide on penalties for offenders in case of violation of the Government Fisheries Act of 2010 (DoF, 2013) in the management of fisheries and aquaculture including the floodplain; a range of penalties is stipulated in the Offences and Penalties paragraph of the Act. In addition, in the case of both public and private floodplains, leaders of local organizations have the authority and power to confiscate illegal nets and penalize offenders by charging monetary fines. This institutional context provides the power to implement fisheries regulations and ensure compliance to public and private actors, except the fishers (Thompson, 2007; Njaya *et al.,* 2011).

Conflicts of various types are common due to the complexity of inland fisheries, including in the public and privately owned floodplains in this research. The competition for control over these resources and their benefits is often strong (Thompson *et al.,* 1999). In the public floodplain, access to communal resources can result in various types of conflicts, normally due to problems with ownership (e.g. public lease versus private landownership, private landowners illegally occupying public lands), and social and political problems (e.g. local power conflicts due to caste based and social inequity). For example, in the Beel Mail floodplain conflict arose when outsiders, that is members of the communities surrounding the floodplain who were not involved in the project, tried to harvest fish in the floodplains from the project beneficiaries. I myself was involved in arranging meetings and engaging in a dialogue with the people in the surrounding communities to help clarify the objectives of the project and to solve the problem. In some instances solving the conflict also required the assistance of representatives of formal institutions, like the Upazila Nirbahi officer, the chairman of the Union Parishad, or the police. Also in the privately owned floodplains, conflicts over access rights for fishing in the floodplain, power struggles in the decision making process, and conflicts over leadership may occur.

In the Kalmina Beel floodplain (case 2) no significant conflict was observed. The active role of the FMC with support from DoF and the research team was instrumental in avoiding conflict. Evidently, conflicts related to dominant leadership and the motivation of becoming the leader in order to obtain illegal benefits from having that position would discourage other members. It is important to understand such complexities of human attitudes, behaviour, the variations in people's interest to work together to utilize common pool resources.

In the Angrar Beel (case 3) floodplain serious conflicts erose due to a leadership problem since one of the landowners had previously been the president; conflicts arose between the president of the FMC and the other members. This was largely related to the dominant attitude of the president. The local Department of Fisheries office, together with the research team, had a series of discussions at local level, held meetings with religious and village leaders, and the surrounding communities. They took the initiative of forming a new, more democratic FMC with involvement of all the beneficiaries of the floodplains, and by imposing strict rules and regulations.

Sub-leasing of fishing grounds is often a source of conflict. Public land is usually leased out from the Land authority by registering a fishers' group. The richer people among the fishers group or in the community would sublease the floodplain as they have a strong mode of control over the resources. I found how they explained the project to people surrounding the floodplains in a way as to favour their own elite position, in defense of their modus operandi. Their way of seeking administrative support from the local authorities became especially obvious during the production period. This caused many conflicts with the surrounding communities. Sometimes, tension arose in the floodplain due to the harvesting of fish by local elites from communities further away from the floodplain, or the illegal fishing by people from the surrounding communities, and the measures needed to control access to the fishing grounds.

In a public floodplain (case 1) the sub-lease was in practice completely taken over by influential elite (elite capture) who paid the lease value and token money to few of the leader of the formal lease holder exercised the full authority to use the floodplains among themselves. The fishers in this case worked as daily laborers. However, during project intervention, and together with the elites, the members of the Fishers Cooperative Society who were the formal lease holders, formed a CBO and cooperated as a functional group. The project initially provided support for the stocking of fingerlings and to set up *bana* fencing in the outlets which helped the group to carry out the fish culture activities. Although initially the members of the CBO encountered problems in managing the floodplain, over time their interactions improved and problems were resolved. This happened largely due the involvement of large numbers of fishers in the CBO as members and their active role in the activities regarding fish culture and the regular harvesting of fish from the floodplain. It was the CBO who paid all the leases of the floodplain from their account instead of taking it from the elites. Finally, I found that many of the powerful elites withdrew their membership from the CBO as they realized that it belonged mainly to the fishers who were formally the main stakeholders.

Outsiders to the villages surrounding the floodplains were also influenced by some local leaders, trying to take over control of the floodplains on the ground that many of them were land owners of the floodplains in the dry season. They would harvest fish by using their local gears which was not allowed and seen as an offense by the sub-lease arrangement. The project team took various measures to solve these conflicts by carefully communicating and explaining the purpose of the project and the ways it was managed to the local people in those communities. Most people in the surrounding villages felt very positive about the fishers using the resources of the floodplain and benefiting from the project, but they complained about the involvement and restrictions of the sub-lease arrangement. Their concern was addressed by allowing poor people to harvest non-stocked small fish, on the condition that they only used their local gears, like small traps or nets with a big mesh size.

The fishers group tried to become better organized to achieve greater benefits through the increase of their sharing in the investment and outcomes. The Project Implementation Committee (PIC) in close collaboration with the Upazila Fisheries Officer (UFO) were able to formally institute a payback system for the fishers group to deposit the revenues earned from fish harvesting in their PIC accounts.

In summary, powers have been legally provided to the FMCs to formulate and enforce regulations for resource management. However, such powers suffer from elite capture and are not fully or effectively exercised in some cases due to the strong influence that elite or village leaders still exercise on the fisheries through the executive committee.

3.4 Governance of community based fish culture

In the natural resource management discourse governance is mainly discussed along three dimensions: stakeholder representation, distribution of authority, and mechanisms of accountability (Ratner *et al.,* 2012; Agrawal and Ribot, 1999; Ribot, 2002a; WRI, 2003). Governance in the context of community-based fish culture (CBFC) management addresses the dominancy of the land-owning group, informal sets of norms and traditions, and the social network and power relationships between stakeholders (Ratner *et al.,* 2012).

Hardly any empirical study has been made to understand in the floodplains of Bangladesh to learn to understand the temporal and social-political changes over time regarding their use during the monsoon and dry seasons, and the relations between land owners, users, and surrounding communities of the floodplains. The actual situation and conditions of the resources governance of this particular environment demanded a more intensive and longer field research period. Therefore, as a WorldFish researcher I was engaged during

the last ten years with the relevant institutional stakeholders (DoF, local government institutions of the Upazila and the District), and local resources users (Barman *et al.,* 2010; Haque *et al.,* 2008). In this section I present the governance and the socio-political contexts of the individual cases of Beel Mail, Kalmina Beel, and Angrar Beel in more detail, showing important linkages between floodplain–dependent livelihoods and wider institutional developments.

3.4.1 Public floodplains – the case of Beel Mail

In the public floodplain of Beel Mail, governance processes resulting in the formation of a responsive, accountable leadership and representative membership appeared vital for the success of community-based fish culture (CBFC). The big challenges were to create transparency in investments, the income earned, and the saving and sharing of benefits to keep the project running over the years. The establishment of successful CBFCs in public floodplains demands continuous institutional support from agencies such as the Department of Fisheries, because an increase in production and income also increases the risk of elite capture, and the possibility of an exploitative leadership (Haque *et al.,* 2011; Rahman *et al.,* 2011).

Before project intervention by WorldFish there was a lack of accountability and law-accorded rights to local communities. The fishers group took a lease of the floodplain for a three years term by participating in an auction arranged by the local Land Authority. But in practice they were often prevented from using the floodplains for their own purpose by economically and politically influential elites from surrounding villages who claimed the public floodplains as their land. The members of the fishers group were not represented among the decision makers about production management, sharing of benefits, and conflict resolution. The source of such elite capture in the Beel Mail floodplains was mainly due to a serious lack of accountability, for a number of reasons. Firstly, the Beel Mail fishers group was institutionally weak as their leaders, like the president and cashier, felt little accountable to the members of their communities. They had little capacity to collaborate in a transparent way, and they were easily influenced by local elites who claimed the floodplains by providing the leading members with financial tokens in exchange for their access to the floodplain of which they claimed ownership. Secondly, the members of the fishers group were not united, showing little social-economic initiative to be actively involved in some kind of collective action. Finally, local institutions providing support, like DoF or local government authorities, usually complied more with the demands of local elites than feeling accountable to local communities. Consequently, the performance of the members of the fishers group in securing access and use of the public floodplains was weak; they were socially marginalized, lacking the social and economic capitals to deal with the problems faced, and they had little capacity

or self-confidence to take the initiative to bring the floodplain under a community-based form of fish culture.

WorldFish project intervention over a longer period of time (2005-2010) together with local institutional support, significantly improved the accountability and representation of the fishers group. Gradually the dominancy of village elites decreased. Initially in 2007 there were 40 wealthy and influential members, but later in the project their numbers dropped to six only. Those who remained became active members of the CBO; they facilitated activities in their function as extension agent for fish culture management, ensured security of access to the floodplains, and they used their political weight to influence formal institutions to provide the fishers with financial and technical support, whenever needed. Over the years most of the members of the fishers group involved in the CBO of the floodplain remained actively involved. The CBO leaders gradually became more accountable to its members by distributing functions among them, securing a more equitable distribution of benefits, and trying to maintain active linkages with local agencies to improve service delivery. Likewise, the formal institutions of DoF and local government became more accountable to the communities as a whole. As a result, an effective community-based co-management of the floodplains evolved. In Beel Mail the CBO continued to use the floodplains after the lease period was over, and the Land Authority stopped the public auctioning of the floodplains.

Interestingly, there was no more problem of invasions by outsiders who came fishing illegally. Also, the rights of landless fishers were secured, using local gears to harvest non-stocked surplus small fish during the wet season which earned them a good harvest. These positive outcomes were helpful to increase fish production and fishers' incomes, providing further incentives for improvements in increasing accountability and representation among the members. Better regulations and control were established over fish harvests during a specific period, and restrictions were established on the use of destructive gears, like gill net, trap, and small mesh sized net, by people within and outside the communities. There was an increased production of both stocked and non-stocked fish and income rise with minimum investment (Chapter 4).

3.4.2 Private floodplains – the cases of Kalmina Beel and Angrar Beel

Before project intervention, during the monsoon season when privately land is inundated, the Kalmina Beel and Angrar Beel floodplains were under an open access regime characterized by overexploitation of resources due to indiscriminate fishing and the use of destructive gears, like gill nets, traps, small mesh size nets, etc.. Also, there was no water control structure and the water level would drop drastically due to leakage into nearby canals. Finally, there was no specific governance system in place to manage access and use of the floodplains during the wet season, as opposed to the dry months

when the lands of the floodplain could be used by individual households for crop production.

In Kalmina, thanks to greater accountability of the leaders and more equal representation of the different stakeholders including active leadership and a supporting role of DOF, leadership problems were few and easily solved. However, immediately after the end of the project in 2010 outside elites tried to re-capture the floodplains to bring it under their own arrangement for fish culture by taking a lease from the landowners in the communities. Although they did not succeed, and although the CBO had a revolving fund available for the 2010 production season, production activities were not implemented. Fortunately, in 2011 activities continued by the CBOs with assistance from DoF.

In the Angarar Beel floodplain downward accountability was well established in addition to many efforts by the project. In the first project year there was little representation of the members in the CBO, but in the next year (2008) the leader was excluded from membership. Also, bad relations between the communities surrounding the floodplains and opportunistic behaviour of influential community leaders had a negative influence on floodplain management. There were significant increases in the levels of fish production, income and household fish consumption which in turn served to motivate the CBO members (Chapter 4). After creating good leadership with strong networking activities with the formal institutions (DoF, Land Department, Local Government) CBO members were able to establish their access rights through motivating them to continue to use the floodplains.

3.5 Conclusion

This chapter aimed to describe the various power positions of the main resource users of the three floodplains, the decision-making processes and changes in the implementation of community-based fish culture in public and privately owned floodplains. A major challenge was to reduce the elite capture of a rich landowning village elite, and to include representatives of the landless, poor fishers in CBO management and decision making. I have described how the project was instrumental in establishing more equal rights to all users through a more collaborative fishery management structure, at least during the wet season. This was the case not only in the public floodplain of Beel Mail, but particularly the private floodplains of Kalmina Beel and Angrar Beel, where ownership and access to resources had to be negotiated with local landowing elites, whose land is used for crop production during the dry season, but had to be re-allocated during the wet season.

More equal rights were decided upon both in public and private floodplains by CBOs with membership of representatives of professional fishers, poor seasonal fishers,

and landowners formulating formal and informal rules about access rights, membership rules, benefit sharing arrangements, transparency, and accountability. In some case rules had to be negotiated with landowning elites, like in the private floodplains of Kalmina and Angrar, though they received additional benefit as land rent from management committee. But in the public floodplain of Beel Mail, the landowning elite negotiated with the fishers group for the payment of the lease to the government. The establishment of access rights for landless people to harvest fish for their livelihood during the wet season, is a clear example of the institutionalization of more equal rights to the floodplains.

We know from the literature that robust mechanisms of accountability are important for establishing the access rights to the use of resources to both rich and poor, land holding and landless users, and to derive benefits from fishing and fish culture in the floodplains. This research has applied this knowledge to floodplains as an under-studied area. The strengthened representation of marginalized groups previously excluded from decision-making appeared to be critical, and the newly established CBOs played a key role in securing a more socially inclusive access to seasonal water bodies like the Bangladesh floodplains (Haque *et al.,* 2011; Sultana and Thompson, 2010; Thompson *et al.,* 2010) especially in favour of landless poor fishers. In both public and privately owned floodplains, community based organizations have become more active in advocating community rights, and more effective in communicating and negotiating with local government. Although they have become stronger in averting elite capture in practice rather than through any formal rules, this still remains a barrier to the implementation of community based resource management. In Beel Mail a series of awareness development activities, community meetings, and motivational meetings with local elites has gradually reduced the bias of elite capture in community based fish culture.

Chapter 4

Impacts of Community-Based Fish Culture on Income, Food Security and Employment[8]

4.1 Introduction

Fisheries is a key subsector and significant contributor to the national economy of Bangladesh; it contributes 4.37% to the national GDP and almost one-fourth (23.37%) to the agricultural GDP of Bangladesh (Bangladesh Economic Review, 2013). The country's export earnings from the fisheries sector was 2.01% in 2012-2013, and the total national fish production was 3.41 million tons (DoF, 2013). Of the total fish production, inland open waters, inland closed waters, and marine fisheries contributed respectively 28.19%, 54.54%, and 17.27% (DoF, 2013). Bangladesh is now the fourth largest aquaculture fish producer in the world (FAO, 2014). About 6.7 million people receive direct benefits to their food security and livelihoods from the floodplains in Bangladesh, of which 2.7 million are classified as poor and extremely poor categories (WorldFish Center, 2005; Dey and Prein, 2005; Dey and Prein, 2006; DoF, 2013).

The Indo-Gangetic Basin of Bangladesh has a large number of seasonal floodplains that offer great opportunities for the promotion of fish culture to benefit the poor. Bangladesh has rich freshwater resources, and therefore has a huge potential for fisheries development. There are 4.69 million ha of inland waters, 58% of which are floodplains (FRSS, 2014). During monsoons, almost half of the country is inundated, and these areas are reported as floodplains. Around 27 million beneficiaries directly rely on these floodplains for their food security and household nutrition. In most cases, these floodplains are used for the production of fish and other aquatic animals and plants; which has a large impact on the livelihoods of many people, including poor fishermen. However, open access to these resources and their indiscriminate use, have led to over-exploitation and reduced productivity; making the system very unreliable in its ability to generate benefits for the people. If properly managed, these water resources could play a pivotal role in boosting fish production, generating income, and creating employment opportunities.

Culture of fish in the seasonal floodplains can be an important tool for strengthening the rural economy of the country (Rahman *et al.,* 1999; Dey and Prein, 2006). Historically floodplains were the major source of natural fish production, but currently, fish yields are declining. Yield of typical capture fisheries activity usually ranges from 150 to 350 kg/ha

[8] This chapter is in preparation of being submitted to an international peer reviewed journal.

(WorldFish, 2007). There are opportunities to use these floodplains for fish culture by building enclosures in parts of this floodwater, and stocking fingerlings in addition to the non-stocked fish. Daudkandi in Comilla District, where floodplains under private ownerships were transformed to fish culture using semi-intensive management, resulting in very high fish production levels (up to 3000kg.ha^{-1}) and income; but with limited potential for expansion in large areas and the risk of excluding the poor as direct beneficiaries (Toufique and Gregory, 2008).

This chapter[9] examines the overall impact on households involved in community based fish culture in seasonal floodplains, particularly with respect to fish production, consumption, and income generation.

4.2 Methods

This chapter introduces the comparison between the three research sites described in the previous chapters, and three control sites outside the project intervention area. In total, six floodplains from three river basis were selected for this PhD study, of which three were CBFC project areas and three were control sites. From each river basin one floodplain was selected as a treatment/project area, and another floodplain from the same river basin, near to the project site, was chosen as a control group. It is important to mention that these control floodplains were chosen in such a way so that the socioeconomic and environmental conditions were similar to the CBFC project floodplains. DoF officials and researchers who were involved in this project visited the proposed sites several times in order to identify the target populations. In order to do that, several meetings were organized with the local people. Subsequently, households who mainly depended on floodplains for their income, were selected as project members and included into the community management project. The control household group was selected in the same way. Sixty (60) samples from each floodplain were selected randomly for this study: 180 samples from project floodplains and 180 samples from control floodplains were selected every year. Three years (2007, 2008 and 2009) worth of panel data were used for this analysis. Household as well as community level data were collected using qualitative as well as quantitative methods in examining the impact of Community Based Fish Culture (CBFC) in seasonal floodplains on food security, income, and employment of the participants; starting with a conceptual framework on how positive impacts take effect (see Chapter 5 for additional analysis). Descriptive statistics and the cost and return analysis, such as mean, standard deviation, and mean difference test of the selected floodplains following participation in the project were

[9] This chapter is in preparation for submission to an international peer reviewed journal.

made. At the level of the beneficiaries, descriptive analysis was also conducted for the consumption data. However, for the income level data of the beneficiaries, a random effect model of panel data was run. Having established that the random effects model is a better fit, a quantitative random effects model was developed to estimate the impact of participating in the program on fish production and household income. Before the model estimation, a propensity score matching (PSM) method was employed to make comparisons between program participants and the control group.

4.2.1 Conceptual framework

Many studies have failed to establish a counterfactual when conducting before-and-after analysis to assess the impact of a new technology on income, food security, etc. In order to avoid the counterfactual situation, we have considered introducing community based fish culture technology with a baseline and panel data; and also compared before-and-after scenarios in the selected sites and households, both with and without the technology adoption (Adato and Meinzen-Dick, 2007). It has been revealed that the adoption of fish culture technology in pond or floodplain systems can contribute to improved food security and nutrition for poor households in several ways; i) generating income from fish culture, ii) creating alternative employment generating activities and increasing labour productivity, and iii) increasing available food supply and fish consumption (Edwards 1999; Ahmed & Lorica, 2002; Jahan *et al.,* 2010). This chapter focuses on disaggregated multi-dimensional impact of CBCF in seasonal floodplains on both the household level and community level, accounting for the counterfactual situation. An analytical framework is presented below, showing management strategies of community based fish culture in seasonal floodplains, and identifying direct and indirect effects on the household and community levels.

The study critically looked at the WorldFish project's hypothesis that CBFC leads to improved floodplain productivity. It was expected that, firstly, CBFC management would directly improve the natural resource capital (soil and water), increase fish production, make possible multiple uses of the floodplain waters, increase household income and fish consumption. Secondly, CBFC management would create employment, ensure property rights, market access, strengthen local level institutions, and improve human and social capital, for example trust and cooperation.

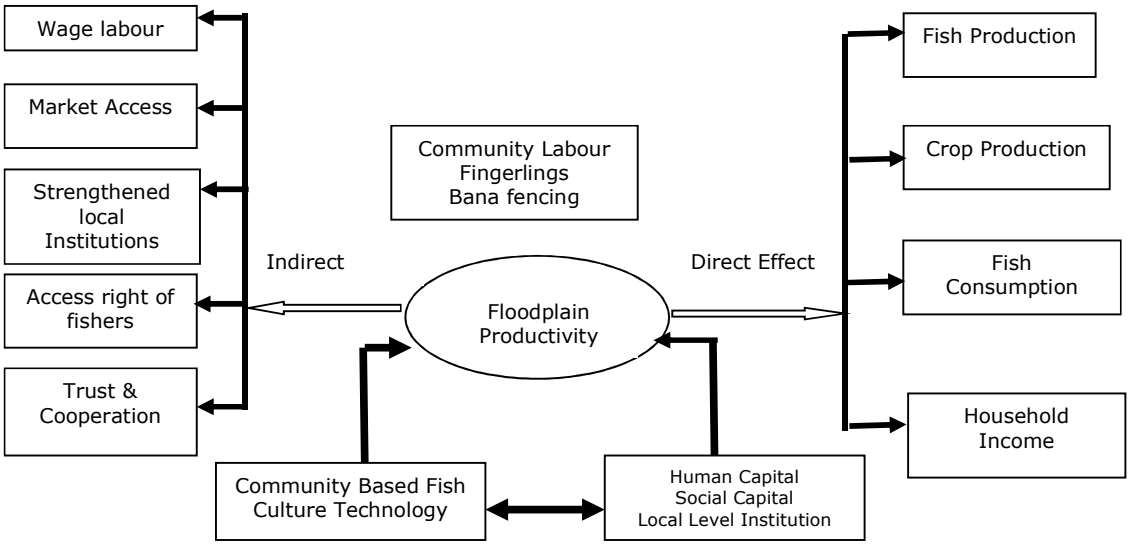

Fig 4.1 Conceptual model for impact assessment
Adapted from Dey *et al.,* (2007) and Ahmed and Lorica (2002)

4.2.2 Data collection

Data collection in the DoF/WorldFish project entitled 'Community based Fish Culture in Seasonal Floodplains' used for this chapter is discussed in Chapter 1. The project officially started in 2005 and the floodplains were selected in 2006. Project staff conducted a baseline survey in 2006 in project and control areas, which covered the floodplains used for fishing, rice production, and some additional household socio-economic data. A range of qualitative and quantitative techniques coupled with community profiles, participatory resource mapping, field observations, semi-structured interviews with key informants, and Focus Group Discussions were applied for collecting baseline information.

Building on the baseline study, for the PhD research (2007 - 2009) I followed a stratified random sampling procedure to select the households for the monitoring of various parameters. The strata identified were professional or full-time fishers, landless seasonal fishers, and landowners. Out of the total population of 778 households in six project and control areas, about 46 percent of the households were randomly selected. Data were collected using longitudinal surveys on a quarterly, seasonal (six monthly) and monthly basis. Information on earnings and expenditures were collected on a quarterly basis, data on crop production and input use were collected at six months interval, while fish consumption data were collected on a monthly basis. The details of these surveys are presented in section 1.5.2 and Table 1.5.

This chapter aims to describe a before-and-after analysis on the intervention and without an intervention design, but this appeared not possible for all indicators. Before-and-after

and project-control were simultaneously done depending on the availability and of data. Before and after analysis was used when the data were available and compatible, while a with-and-without intervention analysis was made to monitor the changes and to analyze the impact of CBFC. All surveys were designed and managed using a relational access database. Data collected were tabulated and analyzed in accordance with the objectives of the study.

4.2.3 Model for estimation

I employed a random effects model of panel data to estimate the impact of participation in the CBFC program on fish income as well as household income. However, I first tested whether the fixed or random effects model was more appropriate for this dataset using the Hausman test[10] indicating that the random effects model provided a better fit. This is possibly because some of the variables, such as education level of the head of the household, farm size, ditch area, etc., were time invariant; which indicates that the household-level independent variables (X_{it}) are uncorrelated with the individual effects (α_i). Therefore, in this case, the random effects model is better. It is important to mention, that propensity score matching (PSM) method was employed initially to make comparisons between program participants and the control group (see Tab. 1.1). Afterwards the random effects model was estimated with common support. This ensures the exclusion of control observations that are not "nearby" to the propensity score distribution of the project observations.

The specification is as follows:

$$y_{it} = \beta_0 + \beta x'_{it} + \alpha_i + \varepsilon_{it}, \text{ where } \varepsilon_{it} \sim \text{IID}(0, \sigma^2_\varepsilon) \text{ and } \alpha_i \sim \text{IID}(0, \sigma^2_\alpha). \quad (4.1)$$

The empirical model is then:

$$y_{it} = \beta_0 + \beta_1 \text{participation}_{it} + \beta_2 \text{age}_{it} + \beta_3 \text{education}_{it} + \beta_4 \text{religion}_{it} + \beta_5 \text{familysize}_{it} + \beta_6 \text{rice land}_{it} + \beta_7 \text{household pond}_{it} + \beta_8 \text{boat}_{it} + \beta_9 \text{ditch area}_{it} + \sum \gamma_t \text{year}_t + \alpha_i + \varepsilon_{it} \quad (4.2)$$

Where, $\alpha_i + \varepsilon_{it}$ is treated as an error term consisting of two components: an individual-specific component, which does not vary over time, and a remainder component, which is assumed to be uncorrelated over time.

[10] In the Hausman test, H0 (the difference in coefficients) was not systematic: χ^2 (7) = 2.44 and prob > χ^2 = 0.9314.

4.3 Direct Impact of Community Based Fish Culture

4.3.1 Impact on fish production

The main purpose of the CBCF project was to improve water productivity through the use of fish culture technology in a floodplain environment. The three control sites of Chandur Beel (public-private floodplain), Andola Beel (private floodplain), and Paingler Beel (private floodplain) were outside the project area and thus did not have fish culture , as opposed to the three sites included in the project, a before-and-after analysis was only employed for the analysis of the impact of CBFC on fish production.

Results reveal that from 2006 to 2009 the average fish production in the three sites included in the project area increased from 124kg/ha to 464 kg/ha, including stocked and non-stocked fish (Fig. 4.2). The overall fish production in the project floodplains was 274% higher than the baseline fish production. It was observed that amongst the three floodplains, fish production most significantly increased in the public floodplain of Beel Mail (from 282 Kg/ha to 729Kg/ha) when compared to the private floodplains of Kalmina and Angrar. Due to the implementation of the fish culture technology in the private floodplains, between 2007 and 2009 fish production here increased from 46kg/ha to 458kg/ha in Kalmina, and from 43kg/ha to 206kg/ha in Angrar floodplains, respectively.

The presence of a connecting channel between the Beel Mail floodplains and the nearby river where natural sanctuaries are established, also facilitated the entrance of non-stocked fish into the floodplains during the flooding period. The production of fish in Beel Mail after implementation of the project was significantly higher than the year before (2006), even though fish culture was initiated in the Beel under the community's own initiative in 2005. The highest level of fish production achieved per hectare was 729kg in 2009 at Beel Mail, which was 142% higher than the baseline fish production per hectare.

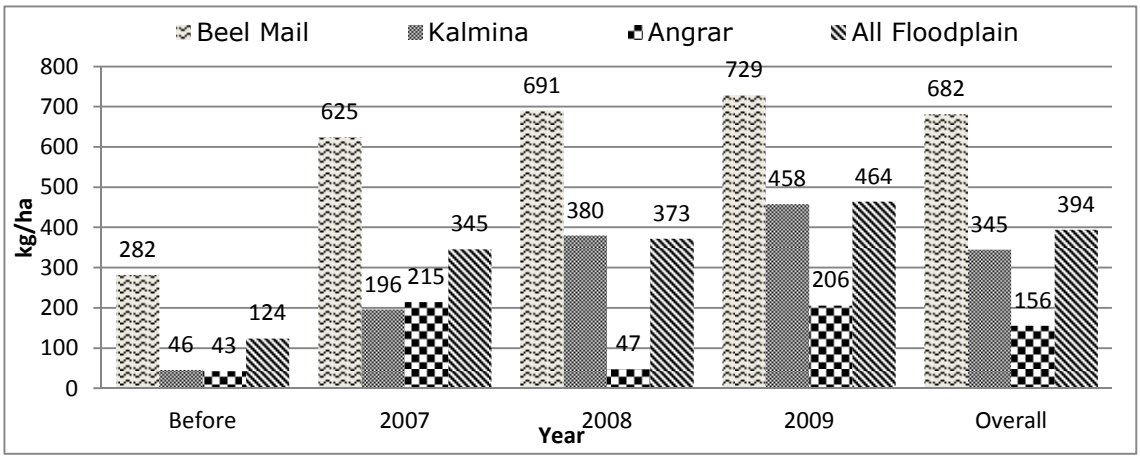

Fig 4.2 Fish production in the three sites within the project area before and after implementation of CBFC system

In the floodplain at Kalmina Beel, the total fish production reached 458 kg/ha in 2009, which was 652% higher than the baseline fish yield. Similarly, fish yield per hectare increased to 206 kg in Angrar floodplain, which was 391% higher than the baseline fish yield. Before project implementation, the Kalmina and Angrar floodplains were completely open although they were private land, and no fisheries enhancement program had been launched. The surrounding community, pond owners, fishermen and landless people, used to harvest fish in the ditches or traps pond. The physical nature of the floodplain, larger size of fingerlings, facilities to allow for wild fish to enter the system from outside, techniques of multiple harvests, regulation of harvest, and environmental factors contributed to the increased productivity of both stocked and non-stocked fish. These data indicate that the implementation of the technical approach (see Chapter 1) was helpful in increasing fish production in the floodplains under the community based fish culture.

Table 4.1 Cost and Return Analysis of CBFC (USD/ha/year)

Items	Beel Mail				Angrar				Kalmina				All flood plains
	2007	2008	2009	2007 - 2009	2007	2008	2009	2007 - 2009	2007	2008	2009	2007-2009	2007 - 2009
Input Costs	75	114	145	112	87	86	93	90	161	186	203	183	128
Fixed costs	19	14	36	23	36	34	22	29	73	73	86	77	43
Total Costs	94	128	182	135	123	115	116	120	234	259	290	261	172
Total Income	199	307	449	318	162	140	167	164	432	492	501	475	319
Net Income	105	179	267	183	38	54	51	45	198	237	212	214	147
Net Income/ Variable Cost	1.40	1.57	1.84	1.64	0.44	0.62	0.55	0.50	1.23	1.27	1.04	1.17	1.15
Net Income/ Total Cost	1.12	1.40	1.47	1.36	0.31	0.46	0.44	0.38	0.85	0.92	0.73	0.82	0.86

Source: This research

Table 4.1 shows the cost and return analysis of the CBFC project areas. Since no cost and return data was collected by the project staff in the baseline survey, data on cost and return of CNBC are now only available for the three project sites included in my research for the period of 2007 to 2009.

Results show that the ratio of net income to variable cost (BCR) was greater than 1 in Beel Mail and Kalmina floodplains for all the three study years; the ratios averaged 1.64 for Beel Mail and 1.17 for Kalmina. However, it was less than 1 during the study period in Angrar Beel, with an average ratio of 0.50. Overall, for the three floodplains, the ratio stood at 1.15 for the three years combined. The net income figures were also high for

Beel Mail and Kalmina, ranging from 105 USD to 267 USD per hectare per year; averaging 183 USD for Beel Mail and 214 USD for Kalmina for the 2007-2009 period. On the other hand, the net income for Angrar for the 2007-2009 period was only 45 USD per hectare per year.

4.3.2 Supplementary impact on crop production

Floodplain fisheries and fish culture dominate livelihood activities during flood season, from May to November (De Graf 2003, Nagabhatla *et. al.,* 2012). In Bangladesh the Boro rice crop is grown from November to May, which is transplanted mainly in low lying areas or rain-fed flood prone areas. The Aman rice crop that can survive a longer duration of inundation is planted from June to November in certain areas. Floodplain water is used for irrigating rice plots in the floodplains, water in these plots gradually trickles down to lower plots. In the upper plots of the floodplain rice production starts earlier by making use of the available surface water in nearby plots, and to some extent using water from the canals connecting the lower part (deeper areas or ditches) of the basin of the floodplain. The ditches within the floodplain serve a dual purpose; used as supplementary sources of surface water and also as traps and ponds to grow more naturally occurring fish.

In April, at the end of the dry season, heavy rainfall and flash flooding from the river sometimes damages the rice during its flowering stage. Adjacent low lying areas cultivating wet-season (Aman) rice make use of this floodplain water. Boro rice cultivation needed a total of 13-15 (STW) irrigation cycles and Aman rice cultivation needed 1-2 irrigation cycles for a good harvest. Due to this management during the dry season, at least 4-5 irrigation cycles are saved for rice production. Prior to project implementation, farmers used 26% and 74% of floodplain water and ground water, respectively, for irrigation purposes during the Boro season. After project implementation, 43% of farmers used floodplain water to meet their irrigation needs, whereas 57% of farmers used ground water before. The use of floodplain water reduced water usage from ground water sources by 17%. This result shows that CBFC provides an opportunity to utilize rain water and minimize the use of expensive ground water, which reduces overall cost of rice cultivation. In the wet-season (Aman) crops mainly depend on rain water, when only 1-2 irrigations are needed at most. Use of floodplain water by beneficiaries increased from between 13% and 18% pre-project implementation to 31% post-implementation.

Use of floodplain water for supplementary irrigation in wet-season (Aman) rice fields, located on the periphery of the floodplains, helped in increasing rice production. Water

levels in the floodplains are maintained during the period when wet-season (Aman) rice is grown in the surrounding uplands, through the management of the outlets (putting small concrete culverts). Rice production in dry season (Boro) and wet-season (Aman) seasons was significantly increased (Table 4.2). Due to implementation of the community based fish culture, rice production increased by 18.9% for Boro and 28.90% for Aman.

Table 4.2: Uses of Floodplain water for supplementary irrigation and Rice Production

Intervention	Crop Seasons	Before (n=90)		After (n=90)/Project period		Cost of production (USD/ha)		Cost of production Decreased (%)	Rice Production (Ton/ha)		Rice production Increased (%)
		% of farmer response		% of farmer response							
		Floodplain Water use	Ground Water and rain fed water	Floodplain Water use	Ground Water and rain fed water	Before	After/ Project period		Before	After/ Project period	
Project	Boro	26	74	43	57	570	522	9.11	4.96	5.58	12.5
	Aman	18	82	31	69	369	325	13.55	3.79	4.48	18.20
Control	Boro	20	80	18	78	566	568	0.35	4.96	5.01	1.00
	Aman	5	95	10	90	340	336	1.17	3.79	3.80	0.26

Source: Baseline survey conducted in 2006 and Impact survey conducted in 2007, 2008 and 2009

4.3.3 Income effect on household level

Given that detailed data on income was not collected in the baseline survey, a comparison of the income of households in project sites and and control sites is presented in this section. The average fish income, non-fish income and total income of the fishermen, landless non-fishermen, and landowner's households in the project sites significantly increased as compared to households in the control sites (Tab. 4.3 and Tab. 4.4). I analyzed the income of CBFC project households and control households according to income source, based on the mean values of three years of income.[11] Table 4.3 shows that the household's fish income was higher for the households in the project sites. This implies that overall household income was higher for the CBFC project participants during the project period from 2007 to 2009.

In 2007, fish income for project beneficiaries increased to USD 211/hh, which was 297% higher than the control group. The increased fish income for project households was almost the same in 2008 (USD 231/hh) and 2009 (USD 277/hh); which was 175% and 274% higher than control households, respectively. The percentages of fish income for the project and control farmers were 22% and 8%, respectively. Over the three project years, the average fish income increased to USD 240/hh for those included in the project which is 237% higher than the control group.

[11]I deflated the incomes for 2008 and 2009 using the 2007 consumer price index.

Table 4.3: Annual fish income from the waterbody to the total income in project and control sites

Source	2007		2008		2009		Average	
	Amount (USD/hh)	% of income	Amount (USD/hh)	% of income	Amount (USD/hh)	% of income	Amount (USD/hh)	% of income
Project (n=180)								
Fish income	211	21	231	21	277	23	240	22
Non-fish income(other farm)*	483	48	538	49	565	48	529	48
Non-farm Income**	312	31	329	30	343	29	328	30
Total Income	1006	100	1098	100	1185	100	1097	100
Control (n=180)								
Fish income	56	7	84	8	74	9	71	8
Non-fish income(other farm)*	479	56	444	51	500	52	475	53
Non-farm Income**	296	37	365	41	371	39	350	39
Fish income	849	100	893	100	945	100	896	100
Change								
Fish income	155	14	147	13	203	14	169	14
Non-fish income(other farm)*	4	-8	94	-2	65	-4	54	-5
Non-farm Income**	16	-6	-36	-11	-28	-10	-22	-9
Fish income	157		205		240		201	

*Non-fish income includes other farm income like crop, livestock and poultry

** Non-farm income includes labour service, business

A water body includes the project floodplain and other sources, like rivers or floodplains

Source: Surveys conducted in 2007, 2008 and 2009

Table 4.4: Share of fish income (USD/hh/year) from the floodplain to the total income in project and control sites

Sample Category	Project n=180			Control n=180			Changes	
	Fish income	Total Income	% of income	Fish income	Total Income	% of income	Fish income	Total Income
Fisher	224	698	32	120	538	22	103	160
Landless non-fisher	185	705	26	83	533	15	102	172
Landowner	311	1889	16	11	1617	1	300	271
All	240	1097	22	71	896	8	169	201

Source: Surveys conducted in 2007, 2008 and 2009

Table 4.5 displays the impact of the CBFC system on income determined by the random effects model. Results show that the project households significantly increased their fish income compared to the control (non-CBFC project) households. The results also reveal that fish income of the project households remained significantly higher than that of the control households for every year in the data sample. In addition, during 2009, the magnitude of increase in fish income exceeded those of the previous two years. This suggests that fish income increased significantly due to the introduction of the CBFC

management system. Results also reveal that there was no significant impact on non-fish income after project implementation. Furthermore, total household income increased to about USD 175 for those who participated in the program. Therefore, it can be concluded that the CBFC management system increased the overall household income in the floodplain areas.

Table 4.5 Impact on income using random effects model (with common support)

Variable	Impact on fish income	Impact on non-fish income	Impact on total household income
Participation (dummy)	154.00*	21.12	174.93*
	(9.71)	(18.84)	(319.38)
Age of the household head	42.61	–99.80	–57.35
	(30.75)	(129.16)	(131.50)
Education of the household head (years of schooling)	– 147.13***	2572.54*	2425.01*
	(83.50)	(466.17)	(480.23)
Religion	-1888.23**	644.43*	4523.11
	(928.65)	(2678.73)	(2932.23)
Family size	573.82**	2866.44*	3448.95***
	(249.35)	(1384.02)	(1442.53)
Pond area	12.20**	275.93*	850.86**
	(5.51)	(68.89)	(282.53)
Rice land in the floodplain	15.32***	341.11*	356.35*
	(9.04)	(53.06)	(55.89)
Ditch area	21.39*	231.43*	252.94*
	(7.86)	(26.88)	(27.29)
Number of fishing boats	45.54	–2649.18	–2559.77
	(517.72)	(2487.68)	(2615.83)
Year 2008	23.57*	40.82*	64.30**
	(4.63)	(21.01)	(21.66)
Year 2009	41.695*	101.124*	142.823*
	(4.984)	(24.723)	(25.308)
Constant	1814.19	10587.08	12404.39
	(1337.90)	(6564.93)	(6816.53)
Wald $\chi 2$ (12)	475.78	452.80	550.12
Prob. $>\chi 2$	0.000	0.000	0.000
R2	0.484	0.513	0.518
Number of observations	1,080	1,080	1,080

Notes: *, **, and *** indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. Figures in parentheses are robust standard errors.

4.3.4 Employment effect

Table 4.6 shows that employment generation took place in the floodplain areas as a result of fish culture activities. Before project implementation, floodplains were not properly utilized for fish culture. One site (Beel Mail) had some fish culture before the project started, but fish yield was low. Furthermore, data on labour use were not collected for the baseline year (2006). Consequently, my research is the first to measure employment opportunity in the project intervention sites.

After project implementation, the opportunity was created for employment in the different fish culture activities. The fish culture in seasonal floodplains is an extensive method of fish production, characterized by low cost and high labour intensity. Community members willingly participated in the different fish culture activities. In every site, the landless non-fishermen and fishermen from surrounding floodplains were involved in fish culture activities as sources of labour. The setting of *bana* fencing, installed in different places throughout the floodplain, was performed by landless non-fishermen and fishermen. Two or three landless non-fishermen were engaged as guards for a period of 3 to 4 months. The Floodplain Management Committee (FMC) allowed the previous fishermen to catch fish in the floodplain. It was observed that a large number of labourers were engaged in fishing at every site. Over the project period, partial harvest of fish started from mid-October to January which allowed for longer periods of employment. From 2007 to 2009, 2495 labourers were engaged in fish culture activities; indicating that there is a large requirement for labour involvement. The average numbers of labourers per hectare engaged in culture activities were 19, 19, and 34 in 2007, 2008, and 2009, respectively.

Table 4.6: Employment generated in the Community Based Fish Culture project from 2007 to 2009

Year	Employment generated in three floodplain (Person-days)				Person-days/ha	Labour productivity (kg/ha/labour)	Return to labour (USD/ha/labour)
	Setting of Bana Fencing	Guarding	Fish Harvesting	Total			
2007	276	630	1055	1961	19	18	5
2008	271	445	1222	1938	19	20	2
2009	252	666	2668	3586	34	14	6
Average	266	580	1648	2495	24	16	4

Source: This research

The adoption of fish culture practices has the potential to increase the total labour requirement to some extent (Ahmed *et al.,* 1995; Dey, 2000; Ahmed & Lorica, 2002). Another direct way in which the poor floodplain community stands to benefit from adoption of fish culture is by improving returns to labour in terms of physical and monetary units. This study shows that the performance of the CBFC project in terms of labour productivity and returns to labour improved significantly after project implementation; and it was significantly higher in post-implementation periods. The highest labour productivity was estimated in 2008 (20 kg man-days^{-1}), and the lowest in 2009 (14 Kg man-days^{-1}). The return to labour was also found to be higher in 2009 (USD

6 labour ha^{-1}) and lower in 2008 (USD 2 labour ha^{-1}). Another important impact of fish culture in floodplains on employment is a series of backward linkage effects like hatcheries, nurseries, seed production, feed, and input deliveries; there are also forward linkage effects, like post-harvest handling, processing, and marketing of fish (Jahan *et al.,* 2010, Lewis *et.al.,* 1996).

4.3.5 Consumption effect on household level

According to FAO, food security is the physical and economic access to the basic food needed by all human beings; and it implies availability, stability, and access to this food (1996). Fish plays a very vital role in providing food security and good nutrition to billons of people in both developed and developing countries (Bene *et al.,* 2015; Toufique and Belton, 2014). Several studies have investigated food security in Bangladesh; in terms of per capita food availability, pattern of household food consumption and causes of food insecurity, the access to and utilization of food and causes of nutritional food security (Begum, 2002; RDRS, 2005; Mishra and Hossain, 2005). Our study provides descriptive statistics of food security; with food security and nutritional intake having improved significantly among the project beneficiaries.

A before-and-after analysis with intervention and without intervention design was followed for analyzing the impact of CBFC on food security and fish consumption. The results for consumption of nutritional food (Table 4.7) show that the per capita fish consumption of project households increased from 1.26 kg $capita^{-1}month^{-1}$ in the baseline year to 2.31 kg $capita^{-1}month^{-1}$ in 2009 (Table 4.8); which is higher than the national average per capita fish consumption of 0.95 $capita^{-1}month^{-1}$ (Bangladesh Economic Review,2005). It was observed that over the course of the project the per capita fish consumption increased significantly compared to baseline year (2006); an increase of 34%, 58% and 83% for 2007, 2008, and 2009, respectively. During the same period, the per capita monthly consumption of fish in control households increased from 1.23 kg $capita^{-1}month^{-1}$ in the baseline year, to 1.63 kg $capita^{-1}month^{-1}$ in 2009; which was also higher than the average per capita national consumption. It is assumed that the actual per capita fish consumption in Bangladesh is higher than the national average reported in official databases (FAO, 1999 and 2002; Welcome, 2001; Ahmed *et al.,* 1996, Dey *et al.,* 2005a). Due to implementation of the CBFC project, the average per capita fish consumption per month in project areas increased by 59% in comparison to the baseline year; which was 29% higher than in control sites.

The average monthly fish consumption, considering all species, was higher for project beneficiaries (2.00 kg/person) than for their control counterparts (1.55 kg/person) during the 2007 to 2009 period. Initially, the monthly fish consumption was lower for the project

beneficiaries during 2007. This shows that the growth rate of monthly fish consumption was higher for project beneficiaries.

Table 4.7 Trend in per capita fish consumption (Kg Capita $^{-1}$month^{-1}) among project and control households

Project / Control	Baseline (Mean±SD)	2007 (Mean±SD)	2008 (Mean±SD)	2009 (Mean±SD)	2007-2009 (Mean±SD)	Average Growth
Project households	1.26±0.57	1.69±0.80	2.00±0.53	2.31±0.47	2.00±0.61	22.65
Control households	1.23±0.5	1.48±0.48	1.54±0.38	1.63±0.42	1.55±0.42	10.07

Table 4.8 Per capita fish consumption (Kg capita-1month -1) by different project and control households over the period 2006-2009

Beneficiaries	Project households n= 180					Control households n=180					Mean difference test * between project and control households		
	Baseline	2007	2008	2009	Average growth (%)	Baseline	2007	2008	2009	Average growth (%)	2007	2008	2009
Fisher n=60	1.19 (0.38)	1.69 (0.81)	2.06 (0.66)	2.23 (0.54)	27.11	1.16 (0.35)	1.53 (0.50)	1.57 (0.40)	1.66 (0.34)	13.69	0.16	0.48	0.56
Landless non-fisher n=60	1.03 (0.61)	1.60 (0.82)	1.94 (0.51)	2.16 (0.62)	33.22	1.04 (0.61)	1.50 (0.60)	1.52 (0.27)	1.51 (0.39)	15.16	0.34	0.41	0.64
Landowner n=60	1.52 (0.56)	1.72 (0.74)	1.99 (0.61)	2.51 (0.71)	19.01	1.49 (0.52)	1.48 (0.50)	1.41 (0.37)	1.85 (0.56)	8.62	0.09	0.57	0.65
All	1.26 (0.57)	1.68 (0.79)	2.00 (0.53)	2.31 (0.47)	24.75	1.23 (0.5)	1.47 (0.51)	1.54 (0.38)	1.63 (0.42)	10.34	0.20	0.46	0.67

* Significance at α =0.05 level and parentheses figure indicate SD

The per capita fish consumption for all groups, both the project beneficiaries and control group, increased over the years; however, the rate of that increase was not same for all year (Table 4.8). Among the project beneficiaries, landless non-fishermen went through the fastest average growth in per capita fish consumption per month at 33.22%, followed by fishermen (27.11%), and landowners (19.01%). Overall, the per capita fish consumption for the project beneficiaries increased from 1.26 kg per capita per month to 2.31 kg per capita per month, an increase of 24.75%. On the other hand, the control group witnessed an average increase of only 10.34% (from 1.23 kg/capita/month to 1.63 kg/capita/month) over the project years. It was signifying that the control group saw less growth in fish consumption in comparison to project beneficiaries. In this case the landless non-fishermen also witnessed the fastest growth in fish consumption at 15.16%, followed by fishermen (13.69%), and landowners (8.62%).

The differences in fish consumption between project beneficiaries and control group members over the years are further highlighted by the last three columns of Table 4.8. The difference in fish consumption for all the groups increased over the years and overall. The difference between project beneficiaries and the control group was 0.20 kg per capita per month in 2007, which went up to 0.46 kg per capita per month in 2008, and then further upwards to 0.67 kg per capita per month in 2009.

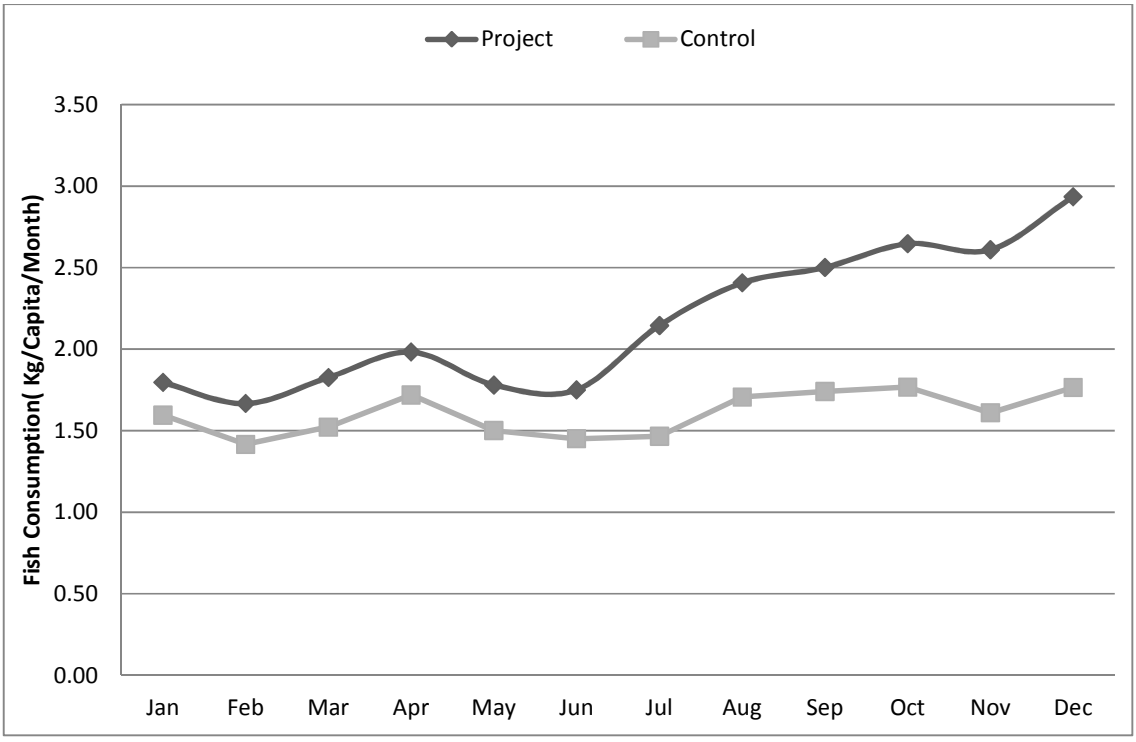

Figure 4.3: Seasonality of fish consumption (2007-2009) in project and control areas presents the trends in fish consumption in both project and control households from 2007 to 2009.

The monthly fish consumption of project beneficiaries varied in different months (Fig. 4.3). Due to project implementation, fish availability was increased in the project area during the period from July to December. It was observed that fish consumption of the project beneficiaries increased when compared to control farmers in the months of November and December. This was possible only due to changing production technology from capture to culture fisheries. Approximately 68% to 75% of the total fish consumption requirements of the project beneficiaries were fulfilled by fish culture in the floodplains in the months of July through December. It may therefore be concluded that the availability of fish at the community level will increasingly fulfil the consumption needs of the community as fish production in the floodplains increases.

4.4 Indirect effects

4.4.1 Access rights to fishers and other beneficiaries

Floodplain fish culture is a 'privatization of the commons' and changes a seasonal, open access common property resource into a year round, closed, private property resource. As a result of this, a large number of people can lose the source of their livelihoods (Toufique and Gregory, 2008). The restriction on fishing in the floodplains disproportionately affects poorer groups, who are most dependent on floodplains for their livelihoods. In this study it was found that some fishermen and landless poorer households had suffered from these restrictions, particularly pertaining to the use of destructive fishing gear. But use of local fishing gear was allowed under the CBFC project, which ensured the property rights of fishermen and landless people in the floodplain areas. The local decision-making typically excluded the interests of the poor and marginalized. Poorer groups' experiences have generally been that they have had a low level of influence on committee decision-making, and have often had their interests neglected. Community based fish culture management included fishermen and landless individuals as members of FMC and therefore allowed them to participate in the decision making process (see Chapter 3).

The share of net profit for fish production from the floodplains, agreed to at the start of project activities, varied by the types of beneficiaries and across floodplains. Benefit sharing was decided and agreed upon by the beneficiaries and finally by the FMC. At Beel floodplain, the fishermen received a large share of the benefit, as they paid the lease money for the floodplain. The fishermen in the floodplain, however, received considerable benefits by taking control of fish harvested from the floodplain. They received 50% of the value of the harvest of non-stocked fish and 10-15% of the stocked fish. Furthermore, access of landless and seasonal fishermen from communities surrounding the floodplain using local gear was allowed throughout the season. As in Beel Mail, the landless non-fishermen were allowed to harvest fish for their subsistence throughout the season. In the private floodplains (Kalmina and Angar) land owners and ditch owners received the major share of the benefits compared to other stakeholders; but fishermen did get 50% percent share of non-stocked fish and 10-15% of the stocked fish. The present study indicates that the involvement of all stakeholders ensured that property right of secure access to fishing in the floodplain was retained, which contributed to increasing household incomes for up to 6 months of the year.

4.4.2 Impact on access to markets

The supplies of fish from the implementation sites had significant impact on fish consumption in the community level and also the local market. The results of the study

show that about 20-30% of non-stocked fish were sold at farm gate to the community people as well as to local middlemen or *paikers*, who had the opportunity to purchase fish at a cheaper price. The remainder, i.e. 80-70%, was sold to adjacent local markets on a wholesale basis. The fish price per kilogram varied from site to site and also from village level to market level. The prices of non-stocked fish at the village level in the different sites were Tk.58/kg for Beel Mail, Tk.45/kg for Kalmina Beel, and Tk.47/kg for Angrar Beel. But at the market level the prices were Tk.64/kg, Tk.55/kg, and Tk.58/kg in the local markets of Beel Mail, Kalmina Beel, and Angrar Beel, respectively.

It was observed that the quantity of stocked fish marketed at village and market levels also varied from site to site. In the case of Beel Mail, the local fish traders who sell fish from door to door purchased the stocked fish at farm gate prices. Local community people also bought fish from the landing sites. The largest portion of stocked fish (70%) went to the local wholesale markets. The beneficiaries were involved in the marketing process of the harvested fish. In the case of the Kalmina floodplain, the total harvested fish were partially (25%) dispersed to the local consumers and largely to the *paikers* (75%); who transported it to the nearest and distant market places. The fish harvested from Angrar floodplain were sold locally to a small extent (12%) and the majority (88%) were sold to distant local markets. The local fishermen were involved in the marketing of fish. The average prices of stocked fish at the village level in different sites were Tk.60/kg for Beel Mail, Tk.55/kg for Angrar, and Tk.58/kg for Kalmina; but at the market level, the prices were Tk.65/kg, Tk.66/kg and Tk.60/kg in the local markets of the Beel mail, Angrar, and Kalmina, respectively. The species wise price of fish varied from Tk.65 to Tk.80 per kg at the village and market levels.

The major constraint at the market level faced in the project sites was a lack of bargaining power. The results from the present study show that fishermen who sold their fish at the farm gate received 25% of the consumer-paid price; those who sold directly in the market received an average of about 60% of the consumer-paid price. During the focus group discussion with FMC, it was reported that fishermen were always in a weak position when marketing fish due to a lack of information on patterns of supply, demand, and prices. So there is potential in promoting institutional development for dissemination of market information, and encouragement of co-operative group action and participation by small-scale producers to strengthen their bargaining position (Jahan *et al.,* 2010). The local markets are dominated by a few large-scale traders who control the market. Ahmed and Lorica (2002) noted that if fish farmers depend only on local village markets to sell their products without knowing the demand for fish, there will be a tendency to oversupply fish in rural markets.

4.4.3 Effect on trust and cooperation

Solidarity, trust and cooperation are important social factors which play vital roles in a well-managed fishery. Local institutions should be respected, with stakeholders having the confidence to trust their opinions. Increase in solidarity, trust, and cooperation (individually and collectively) among fishermen and other stakeholder resolves conflicts and improve management outcomes. In the study area, respondents were asked regarding their perception about improvements in solidarity, trust, and cooperation amongst themselves and also with other stakeholders compared to three years ago. Table 4.9 shows that this level has increased by 99% in the project sites; whereas no respondent from control sites expressed views of increased solidarity, trust, and cooperation. So fishermen tended to have more trust in CBOs.

Table 4.9 Respondents' opinion on trust, cooperation and solidarity by floodplain

Statement	Floodplain							
	Project (%)				Control (%)			
	Beel Mail (n=60	Kalmina (n=60)	Angrar (n=60)	Total (n=180)	Chandpur (n=60)	Andola (n=60)	Painglar (n=60)	Total (n=180)
Gotten worse	-	-	-	-	21.9	-	10.0	9.8
Stayed same	1.1	-	1.4	0.9	78.1	100.0	90.0	90.2
Gotten better	98.9	100.0	98.6	99.1	-	-	-	-
All	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

It is amazing that 90% of the participants in the control sites reported that levels of solidarity, trust, and cooperation remained the same; but there were also some reports of decreasing trust-solidarity levels in the floodplains of control sites. High levels of solidarity, trust, and cooperation of participants in project sites indicates that all stakeholders, especially fishermen communities, have more participation in decision making and democracy; which is a focus of better institutional arrangement. Promotion of sharing fisheries knowledge and information also took place. Besides, stronger solidarity, trust, and cooperation with local institutions tend to protect property rights more effectively and tend to be less exploitative in economic transactions.

Table 4.10. Opinion of respondents on solidarity, trust and cooperation by floodplain

Opinion	Floodplain									
	Project (n=180)					Control (n=180)				
	D (%)	NAD (%)	A (%)	Mean	STD	D (%)	NAD (%)	A (%)	Mean	STD
Most people can be trusted	-	-	100.0	4.2	0.4	-	4.3	95.7	3.8	0.3
People always like to take advantage	95.5	3.2	1.3	1.5	0.6	95.6	2.2	2.2	1.6	0.7
Most people are willing to help if needed	-	0.5	99.5	4.0	0.2	4.4	35.9	59.7	3.5	0.7
Most people trust local management committee	0.5	0.8	98.7	4.3	0.5	85.8	12.0	2.2	2.1	0.6
Maximum participants cooperate/participate to fish culture management	-	0.5	99.5	4.1	0.3	14.1	57.6	28.3	3.1	0.6

D-Disagree, NAD-Neither agree nor disagree, A-agree, STD-Standard deviation.

Opinions from the respondents about solidarity, trust, and cooperation were obtained based on 5-point Likert scales. Table 4.10 indicates that over 95% of the respondents in project sites agreed that most people within the community can be trusted, they don't like to take advantage of others, they are helpful, they trust the local management committee (CBO), and they usually cooperate and participate in fisheries management. In addition, respect within heterogeneous communities of different ethnic and religious groups, and differing social values have improved so as to foster harmony.

4.4.4 Strengthening local level institutions

Formal and informal training builds up the capacity of the members of the FMC, as well as that of the beneficiaries within the communities. Training workshops, focus group training, and exchange visits in other project sites enhanced the knowledge of the fish culture technology, financial, and institutional aspects of FMC. These efforts also build up the visions, rules, and regulations of the FMC as a group. Activities carried out as Participatory Action Research over 3-4 years through involvement of these actors proved useful for changes in practices, knowledge, and attitudes. It is important to recognize the process of group formation, to avoid dominion by a leader over group members, or the creation of dependence by the members to their leader; particularly if the leader has multiple responsibilities. Institutions can be developed through affinity based on mutual trust. Kinship, religion, economic status, livelihood activities, etc. are some factors that motivate individuals to work together. In every FMC, the group structure was well defined and the titles of the different positions were: President, Vice-president, Treasurer and Member. In Beel Mail, the existing fisheries society and participating landowner, who paid a larger amount of the lease value, represented the FMC. In contrast, the Kalmina

and Angrar floodplain management committees represented the fishermen, landowners and landless non-fishermen from the surrounding villages.

The incentive from WorldFish worked as a start up fund for continuing the practice of fish culture. Every year the FMCs deposited the funds into the bank, for use as a revolving fund. Comparing the three financial managements of the FMCs, Kalamina and Beel Mail maintained their accounts updated properly. These two FMCs kept all records of accounts and reports, and were better about being transparent. In the Angrar floodplain some mismanagement occurred by the president of FMC and his followers. A bank account was opened in the name of the FMC, and jointly operated by the local level DoF officer and the Secretary or President of the FMC. All expenditures made for fish culture were approved in FMC meetings. FMC members remained informed for all the expenditures and income from fish culture activities. Treasurers kept all vouchers for the FMC file, and additional copy was kept in the Upazilla Fisheries office. It was found that in the general meetings the FMCs explained their expenditure plan to their community of people.

The capability and skills of the FMC leader, are the main criteria for assessing the organizational strength of the FMC. Regular changes in leadership are important and healthy for an organization; as it brings fresh ideas to the forefront and gives others a chance to lead (Fernandez, 2000). In addition, leadership relates to transparency, particularly on the feedback or outcomes of any assessment report. Each FMC is responsible for reporting to the Project Implementation Committee (PIC) for approval, before submitting to the government and other organizations. Over the CBCF project period, the decision making capacity of the leaders, including the fishermen and poor non-fishermen, improved; they are now able to make decisions together with land owners about the activities and share the benefits amongst themselves.

The linkages with formal and informal institutions and organizations within the villages and outside of the villages are critical for the sustainability of the organizations; as well as for institutional capacity building or strengthening strategy. These linkages provide information on the perceptions of each FMC with regards to other CBOs in the village, and the synergy on how FMCs can work together to achieve a common goal for the village or community level. The PRA exercise of the Venn Diagram was used to ascertain relative importance of CBOs and the relationships between them. It was found that a number of NGO groups, village groups, religious committees, and farmer cooperative societies were working at the village level in all floodplain sites. FMCs tried to establish linkages with these organizations and share their experiences to cope new things.

4.5 Conclusions and policy implications

The impacts of community based fish culture in seasonal floodplains have been diverse across, and within, the FMCs. The results presented in this chapter clearly show that there is potential to introduce fish culture systems in the place of capture fisheries activity in floodplain areas; which can increase fish production, supply vital nutrition to poor households, contribute to poverty reduction, and improve the overall welfare of the low-income and resource-poor households. Introduction of this approach has had a significant and positive impact on income, employment, and household nutrition for adopters; along with additional benefits, such as the accumulation of social capital through gifting of fish to community members. This chapter also demonstrates that income of labourers and fish consumption were significantly higher among the project beneficiary households than control households. Since there were no major differences between the two groups (project beneficiaries and control) in terms of socio-economic parameters, such as household size, floodplain size, experience in collective action, and there were no other projects that took place during this time period; it can be concluded that the achievement of all benefits, in terms of fish production, consumption, employment generation, and overall food security during the project period was mainly due to project implementation. It will be difficult to reduce the level of exploitation experienced by beneficiaries when marketing fish to the organized marketing agents.

The innovations of the community based approach to fisheries management have been widely used in Bangladesh by different institutions, as well as in other countries of Asia. The innovative outcomes of the community based approach have encouraged the government of Bangladesh (DoF) by revealing the potential for a scale-out of ideas and broader impacts to spread over Asia; and the potential for promotion in other parts of the world. The reason why the CBFC system is a useful and effective method of achieving scale-out are: it is innovative, holistic, poverty focused, and results in nutritional improvement; supplying of a large amount and variety of micro-nutrients through small indigenous fish locally on a regular basis in addition to increasing production and supply of other fish. The CBFC system has huge potential benefits, as a large number of people depend on the 2.8 million hectares of floodplains for their livelihoods. Improvement in water productivity and ecosystem services are important, as are addressing issues of governance for how to manage floodplains and make the system. The promotion of the community based fish culture in seasonal floodplains may thus be a useful tool to bring about dramatic positive changes in trends of overall productivity and livelihood gains for poor people in Bangladesh.

Chapter 5

Impact of the Community Based Fish Culture System on Expenditure and Inequality[12]

5.1. Introduction

In the United Nations Millennium Development Goals (MDGs), eight development dimensions were specified; including the eradication of poverty and hunger, improvements in education, reducing gender inequality and improving healthcare, environmental sustainability and promotion of global cooperation in development (UNDP, 2003). Equity and growth are the prerequisites to reducing poverty and achieving food security in developing countries. Most of the people in developing countries, like Bangladesh, depend on natural resources to meet their basic needs; but unequal distribution and improper management of these natural resources create inequality and increase poverty in rural areas. In recent years, increasing income and poverty reduction through proper natural resource management has become an important issue for both development organizations and government agencies. Together, WorldFish and the government of Bangladesh have undertaken several initiatives to reduce inequality and poverty through proper water resource management.

The fisheries sector contributes significantly to the national economy and helps to reduce poverty and inequality in rural areas of Bangladesh. Floodplains are one of the main sources of fish production, responsible for 82.73% of fisheries production from inland opens waters in Bangladesh (FRSS, 2014). Approximately 6.7 million people are getting direct benefits to their food security and livelihoods from the floodplains in Bangladesh; 2.7 million of which are classified as poor and extremely poor categories (Ahmed, 2005; Dey and Prein, 2005; Dey and Prein, 2006; WorldFish Center, 2005). However, during the monsoon season these floodplains remain submerged, limiting local people or land owners from using the land for any productive purpose (Ahmed, 2005; DoF, 2014). During this period, these floodplains are used as areas for capture fisheries activity, translating into low cropping intensity and water productivity of the floodplain area. As a result, household incomes as well as expenditure are both low in these floodplains in comparison to other rural areas (see Chapter 4). In addition to this, local elites exercise their power to harvest a major portion of the fish during monsoon season, using local poor people as day labourers (see Chapter 3). Consequently, landless and poor

[12] This chapter is in preparation of being submitted to an international peer reviewed journal.

people/fishermen earn very little from floodplains, which contributes to income inequality as well as expenditure inequality. However, if properly managed, these water resources can play a pivotal role in boosting fish production, generating income, creating employment opportunities, and strengthening the rural economy of the country (Barr *et al.,* 2004; Rahman *et al.,* 2010a).

In Bangladesh, the community-based fisheries management (CBFM) approach to inland fisheries started in 1995, but the CBFC is different from other community based approaches where technology has been converted from capture to culture. Most of the previous studies conducted on the CBFM system focused only on production and income, but there are very few empirical studies on CBFC. Many of the CBFC studies show that production and income have increased due to involvement in the CBFM system (Ahmed and Luong-Van, 2009; De Graaf, 2003; Dey and Prein, 2005; Dey and Prein, 2006; Dey *et al.,* 2005a; Hossain *et al.,* 2010; Mustafa and Brooks 2009; Nagabhatla *et al.,* 2012; Sheriff et al., 2010). Khan *et al.* (2012) studied the impact of the CBFM system on household income, expenditure, expenditure inequality and poverty. Khan *et al.* (2012) found that the CBFM system has significant positive impacts on household income, expenditure and has an equalizing effect on household expenditure. Singh and Dey (2010) conducted studies on different sources of family income for fish farmers, and examined the effects of these sources on family income and expenditure in Tripura, India. They found that increasing the share of government jobs available to lower income groups could play dual roles of alleviating poverty among relatively poor fish farmers, and reducing income inequality among fish farming households in the study area. Mussa R. (2011) investigated household expenditure components, and the poverty and inequality relationship in Malawi; the results of the study indicate the exemption and zero rating of some food, health, and education related goods and services under the value added tax system. Food security and nutritional security in Bangladesh were estimated by Bose and Dey (2007) using household income, expenditure, and food consumption survey data. They concluded that fish, livestock, horticulture, and pulses sectors should be accorded high priority to diversify the dietary pattern towards high food and improve the nutritional food security of Bangladesh.

This chapter evaluates the impact of the CBFC system on household expenditure and expenditure inequality by employing Propensity Score Matching (PSM) method and Gini decomposition. The results of this impact and decomposition analysis will help to guide decision making by policy makers, and support the reduction of inequality and poverty through community based natural resource management.

5.2 Methodology

5.2.1 Impact analysis

This study has made use of the CBFC project sites and control sites floodplain data to evaluate the impact of the CBFC project. According to Ravallion (2007) there is no single statistical method which is rigorous and policy relevant for evaluating the impact of any program or project. It is very difficult to obtain a good counterfactual when using treatment and control data. Selection bias and unobserved heterogeneity are the main problems when we compare between the two groups. If selection bias is not a problem, then we can use simple OLS for impact evaluation (Maddala, 1983). In that case, the outcome of the individual households who participate in the CBFC-project is:

$$(y_{1i}|I_i=1)=\alpha+\beta X_i+\gamma+\varepsilon_i \qquad (5.1)$$

and the outcome for households who do not participate in the program is:

$$(y_{0i}|I_i=0)=\alpha+\beta X_i+\varepsilon_i \qquad (5.2)$$

where Yi is the variable of interest (in this paper variables of interest are food expenditure, non-food expenditure, and total expenditure), X_i is the vector of exogenous explanatory variables (household characteristics), I_i is the treatment indicator (I=1 if the individual household are participants of the CBFC project, and I=0 otherwise), α, β, γ are the unknown parameters of the variable, and ε_i is the error term that captures unobservable factors and potential measurement errors that affect Y. The difference between equation (5.1) and (5.2) is γ, which indicates the project benefits or impact due to participation in the CBFC project. In this case, simple OLS estimation gives unbiased estimates of β, if there is no sample selection bias. We can develop a combined equation from equations (5.1) and (5.2) as follows:

$$Y_i = \alpha + X_i\beta + I_i\gamma + \varepsilon_i \qquad (5.3)$$

In equation (5.3), I can be used as an independent variable if I is an exogenous variable, but if I is self-selected then it becomes endogenous. In that case, where I is endogenous OLS gives biased estimates of β. This biasness may arise from two sources, first differences in unobservable characteristics and second differences in observable characteristics; which is because of a lack of appropriate comparison groups (Ravallion, 2001). In this study, two types of households are used to evaluate the CBFC-project impacts which are: CBFC-participant (target) and non-participant households (control). Household participation in the program may be endogenous; in that case selection bias may be a problem.

To overcome the problem of bias, we used the propensity score matching method to estimate the impact on expenditure. First introduced by Rosenbaum and Rabin in 1983, it

has been used widely since then to estimate treatment effects when all treatment confounders are measured (Abadie and Imbens, 2009; Cobb-Clark and Crossley, 2003; Heckman *et al.,* 1998; Ravallion 2005). The propensity score can be defined as "the conditional probability of assignment to a treatment given a vector of covariates including the values of all treatment confounders" (Rosenbaum and Rubin 1983). Simply put, the propensity score is the probability of being in the treatment group given a vector of observed variables. In cases of impact evaluation, it is not possible to observe individual treatment effects since we do not know the outcomes for untreated observations under treatment scenarios, and for treated scenarios under non-treatment scenarios; this is known as "counterfactual". Matching methods aid in creating a counterfactual from the control group. The basic assumption when using a counterfactual is that the untreated samples approximate the treated samples, if they had not been treated (Heckman et al. 1998). From the propensity score matching we get an average treatment effect on treated (ATT) which can be written as follows:

$$ATT = E(Y_1 - Y_0|X, I = 1) = E(Y_1|X, I = 1) - E(Y_0|X, I = 1) \quad (5.4)$$

To fulfill the propensity score matching, three assumptions need to be satisfied: the assumption of Conditional Independence (CIA), balancing property, and common support. The CIA assumption implies that the selection is solely based on observable characteristics, and all variables that influence assignment and potential outcomes are simultaneously observed by the researcher. The CIA assumption also implies that the counterfactual outcome for the treated group is the same as the observed outcomes for the non-treated group, given the control variables(X).

The balancing properties assumption implies that two households with the same probability of participating in the program will be placed in the treated (participant) and untreated (non-participant) samples in equal proportions. "The idea behind balancing tests is to check whether the propensity score is an adequate balancing score, that is, to check to see if at each value of the propensity score, X has the same distribution for the treatment and control groups" (Lee, 2006). The final assumption required for the propensity score method, is the common support or overlap condition; it implies that persons with the same *X* values have a positive probability of being both a participant and a non-participant (Heckman *et al.,* 1999).

The propensity score is estimated by a binary choice model, which in this paper, is represented by a binary probit model. There are many ways (methods) to estimate ATT. In the present study, households with and without participation in the CBFC program were matched based on their propensity scores (pscore) using the Nearest Neighbor (NN), Kernel, and Radius matching methods. Although each matching method has its

own strengths and limitations, one may consider any of them alone for impact evaluation; but their utilization in combination has an advantage of testing the robustness of impact estimates (Becker and Ichino, 2002).

5.2.2 Estimation of inequality and marginal effects

Another main objective of the CBFC project was to distribute the floodplain benefits equally among the participating beneficiaries. Therefore, this study has also examined the effects of the CBFC project on expenditure inequality, i.e., how community based aquaculture management systems can reduce expenditure inequality; especially with regards to expenditure on basic necessities. The main intent of this section is to compare expenditure inequality between CBFC project households and control households, after project implementation. There are many procedures to determine the economic inequality. Six criteria namely *mean independence, population size independence, symmetry, Pigou-Dalton transfer sensitivity, decomposability and statistical testability* must be full-filled to get a good measure of inequality (World Bank, 2005). In the arena of inequality measurement, the Gini coefficient is the most popular and widely used method; but it does not satisfy all the above six criteria, only the first four criteria are satisfied and it is mainly based on the Lorenz curve. The Gini coefficient is probably the most intuitive measure of inequality, and also the easiest to interpret. Therefore, this is the measure that was used in the present study to measure inequality. The Lorenz curve is a cumulative frequency curve that represents equality by comparing the distribution of a specific variable (e.g. income, expenditure etc.) with a uniform distribution. Gini coefficient can be defined as:

$$G = 1 - \sum_{i=0}^{N} (\alpha Y_{i-1} + \alpha Y_i)(\alpha X_{i-1} - \alpha X_i) \qquad (5.5)$$

Where αY and αX represents the cumulative percentage of Xs (population) and Ys (income) and N is the total number of observations.

In this research project, the interest lies more on household expenditure and thus the effort is to investigate the effect of the CBFC project on basic necessities and total expenditure inequality. The household expenditure is decomposed according to expenditure sources and this helps to understand whether the CBFC management system can increase or decrease inequality of particular groups of households. This decomposition also allows for understanding the amount of basic necessities expenditure that contributes to the total expenditure inequality in the project group, which can be compared with the control group. Shorrocks (1982), Lerman and Yitzhaki (1985) show that the Gini decomposition can be represented as:

$$G = \sum_{f=1}^{F} S_f \, R_f G_f \qquad (5.6)$$

Where S_f denotes the share of sources *f* of the total expenditure, R_f[13] indicates the Gini correlation coefficient between expenditure sources *f* and total expenditure; which implies how expenditure source *f* and the distribution of total expenditure are correlated. G_f is the relative Gini index of the f^{th} source of expenditure, and finally G is the Gini coefficient of total expenditure. When a particular expenditure source is an increasing (or decreasing) function of total expenditure, then R (Gini correlation) will equal 1(or -1) and R will equal zero (0); when expenditure source is a constant which implies that the source's share of the Gini is zero (0).

From the above Gini decomposition method, we evaluate a particular or specific source of expenditure effects on overall inequality. In addition, we can estimate marginal effect of a particular expenditure source on overall inequality when other expenditure sources are held constant, using a partial derivative of the overall Gini with respect to a percentage change in specific expenditure source; specified as (Stark *et al.,* 1986):

$$\frac{\partial G}{\partial y_f} = S_f(R_f G_f - G) \qquad (5.7)$$

Dividing equation (5.7) by G, which yields the marginal effect of a particular expenditure source relative to the overall Gini and can be written as (López-Feldman, 2006):

$$\frac{\partial G/\partial y_f}{G} = \frac{S_f R_f G_f}{G} - S_f \qquad (5.8)$$

5.3 Further comparison between project sites and control sites

Continuing up on the comparison between households around the floodplains where project intervention took place and sites outside the project area, Table 5.1 presents the summary statistics of the CBFC project and control households for the selected samples.

Table 5.1 Summary statistics of the CBFC project and control floodplain areas

Variable	CBFC Project		Control	
	Mean	S.D.	Mean	S.D.
Age of the household head (year)	41.99	10.34	39.86	11.86
Family size (number)	5.44	2.06	4.72	1.93
Education of the household head (year of schooling)	3.68	3.63	3.53	4.02
Occupation (Dummy, 1 if fishermen, 0 otherwise)	66	-	66	-
Ditch area (decimal)	3.52	23.84	2.36	21.58
Total number of gear	2.261	1.79	2.20	1.34
Own gear (1 if have own gear, 0 otherwise) (%)	91.11	-	85.00	-
Fish boat (number)	0.27	0.50	0.20	0.39
Food expenditure (US$/household/year)	747	525	671	502
Non-food expenditure (US$/household/year)	298	285	168	131
Total household expenditure (US$/household/year)	1045	761	869	645

[13] Here $R_f = Cov\{Y_f, F(Y)\}/Cov\{Y_f, F(Y_f)\}$ where $F(Y)\ and\ F(Y_f)$ represents the cumulative distribution of total expenditure and expenditure for source *f*.

I have also drawn a graphical representation of food expenditure, non-food expenditure and total expenditure to compare between project and control households. Figure 5.1 clearly shows that households in the CBFC system have greater food, non-food and total expenditure compared to control households.

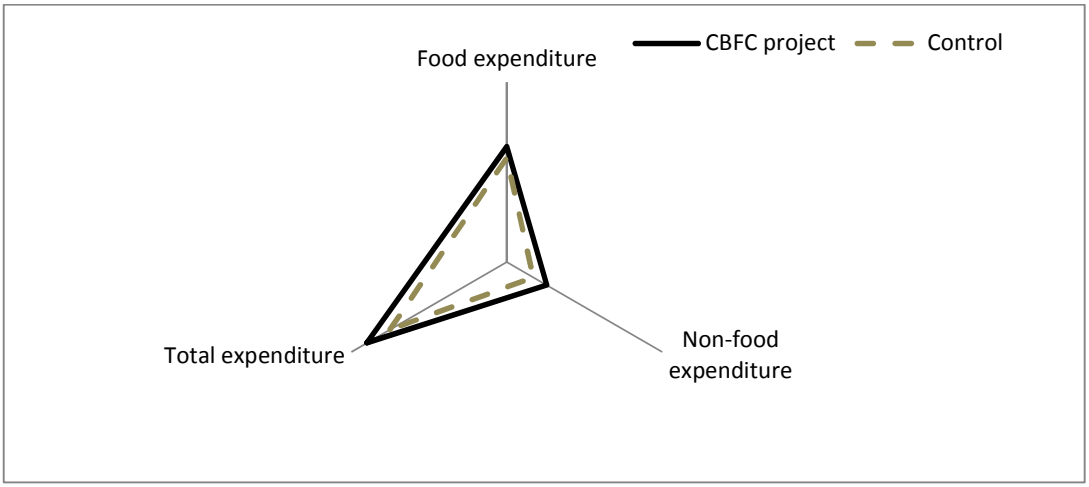

Figure 5.1: Expenditure portfolios of the CBFC project and control households

5.4 Impact on expenditure and inequality

5.4.1 Impact on expenditure

This section discusses the welfare impact of the CBFC system, which is based on household expenditure. I used expenditure data instead of income, because expenditure is a better indicator of welfare than income. People who are living under the poverty line mainly struggle for basic necessities like food, clothing, healthcare, etc. In this study area, the majority of the people are poor as the result of an unequal distribution of land, and lack of proper management of natural resources. Therefore, expenditure is the best indicator to evaluate the welfare impact on any individual or household.

Total expenditure is the summation of food, and non-food expenditure; non-food expenditure includes expenditure on clothing, housing, education, healthcare and other expenditures. Propensity score matching method with three matching algorithms have been used to evaluate the welfare impact of the CBFC project. Probit estimates of propensity score (pscore) are presented from a STATA program output. The common support region and the balancing property were satisfied with this data set, which is a necessary condition for the validity of propensity score matching method. First, the model is run with respect to the expenditure on clothing, housing, education, healthcare

and other expenditures, but the results do not reflect reality because propensity score matching method only considers those households who have the same pscore (propensity score); other households are left out. Consequently, sample size is reduced, which is the drawback of this method. Therefore, data are summarized on expenditure for clothing, housing, education, healthcare and other expenditures as non-food expenditures.

Table 5.2 presents the non-parametric matching estimates for the average treatment effect of participation in the CBFC program on the treated (ATT) for the panel dataset by year. Three matching algorithms, namely nearest neighbor matching method, Kernel matching method, and Radius matching method have been used to assess the robustness of the estimated results. Results revealed that the overall average food expenditure per household per year (for panel estimation) increased due to participation in the CBFC-project; ranging between USD 93 to USD 141 and that the increase was statistically significant at 5%, 5%, and 1% levels based on the nearest neighbor, Kernel, and Radius matching methods, respectively. Each and every year, project participants were able to spend more on food in comparison to non-participants, which was also statistically significant; in addition, household expenditure on food also increased year by year.

This result implies that because of proper management systems in the floodplain areas, households who participated in the CBFC project were able to spend more on food. Khan *et al.* (2012) also found a similar result, where food expenditure was increased due to participation in a CBFM project in Bangladesh. Results also reveal that participant households were capable of paying more in comparison to non-participant households for non-food items like clothing, healthcare, education, housing, transport etc.; the increase ranging from USD 45 to USD 74 considering the three matching algorithms (which were all statistically significant at the 1% level). This non-food expenditure has increased gradually year by year and was statistically significant. This result is also supported by Khan *et al*. (ibid.), where they found expenditure on healthcare and housing increased significantly due to participation in a CBFM project.

Total household expenditure of the CBFC project participants appeared to be higher by USD 134 to USD 215, than that of the control households; statistically significant at 5%, 1%, and 1% levels in Nearest Neighbor, Kernel, and Radius matching methods, respectively. Table 5.2 thus implies better livelihoods for the CBFC participant households.

Table 5.2: CBFC project impact on expenditure (US$/household/year)

Matching method and outcome	For panel		2007		2008		2009	
	Average Treatment on treated (ATT)	t-value*	Average Treatment on treated (ATT)	t-value	Average Treatment on treated (ATT)	t-value	Average Treatment on treated (ATT)	t-value
Food expenditure								
Nearest neighbor matching	93	2.03	145	1.88	150	1.96	141	2.20
Kernel matching	99	2.51	95	2.11	109	1.91	133	2.14
Radius marching	141	4.85	101	2.09	133	2.67	166	3.16
Non-food expenditure								
Nearest neighbor matching	45	3.25	65	3.12	72	3.26	68	3.02
Kernel matching	59	4.27	50	2.80	63	3.83	71	4.48
Radius marching	74	8.14	65	4.37	68	4.50	86	4.94
Total household expenditure								
Nearest neighbor matching	138	2.59	210	2.20	222	2.33	168	1.67
Kernel matching	157	3.31	146	2.34	172	1.97	204	2.55
Radius marching	215	5.89	165	2.71	201	3.22	252	3.82

Source: Own calculation from field survey

5.4.2 Impact on inequality

In the previous section, I have demonstrated that the CBFC management system has significant positive impact on food expenditure, non-food expenditure and overall household expenditure for its participants. That does not necessarily mean, however, that the CBFC management system distributes the floodplain benefits equally among the floodplain communities.

This section shows how CBFC project implementation has affected expenditure distribution equality. Total expenditure, food expenditure, clothing expenditure, and healthcare expenditure depend mainly on family size, and expenditure on education depends on how many children are going to school. The results of Gini index and Gini decomposition analysis are presented in Table 5.3. Gini index of total expenditure is found to be 0.344 and 0.400 for the CBFC-project and control households, respectively. This indicates that expenditure is, in general terms, equally distributed among the sample households; but more equally distributed among the CBFC households as compared to the control households. This result is comparable with the national Gini

index for Bangladesh, which was 0.39 in 2000 and 0.43 in 2010 at rural level (Titumir and Rahman, 2011). The expenditure inequality difference between the CBFC-project and control areas of 0.06 implies that the CBFC management system helps to distribute total expenditure 15% more equally among the surrounding communities. This results is also supported by Khan *et al.* (2012) and Islam and Kazal (2007), where they found that expenditure and income inequality decreased after involvement in the CBFC project.

In the seasonal floodplain area, expenditure varies from household to household due to unequal distribution of land and lack of proper floodplain management. Results show that the share of food expenditure out of total expenditure is comparatively lower for CBFC-project areas than for control areas; but food expenditure is more equally distributed (Gini index 0.346) in the CBFC-project areas compared to (Gini index 0.410) control floodplain areas[14]. This indicates that the CBFC management system helps to distribute food expenditure more equally among the communities; which was one of the main objectives of this project.

Clothing expenditure accounted for 9.5% and 3.8% of total household expenditure, for the CBFC project group and the control group, respectively. Expenditure on clothing is equally distributed (Gini index 0.48) in the CBFC project areas, but is unequally distributed (Gini index 0.66) in the control floodplain areas. This result implies that the CBFC management system helps to distribute clothing expenditure 27% more equally among the floodplain communities. The unequal distribution of clothing expenditure for the control group, implies that a substantial number of individuals were only able to spend a very small amount of money on clothing. The percentage share of education expenditure out of total expenditure is more or less the same for both project and control areas; although the distribution of education expenditure is high in both areas, it is distributed more equally (Gini index 0.55) in CBFC project areas compared to control areas (Gini index 0.66).

Expenditure on healthcare is another important cost item at the village level. Most of the target populations are unable to visit healthcare centers or private doctors due to financial limitations, outside of cases of serious illness. Results shows that expenditure on healthcare is distributed 12% more equally after the CBFC-project implementation (Gini index from 0.53 to 0.44), which implies that poor people were able to spend more on healthcare. In addition to this, the CBFC project also had equalizing effects on other expenditures (other expenditure includes transportation, fuel, cultural occasions, etc.).

[14] Less share on food expenditure for CBFC –project area does not mean that CBFC individual spend less on food compared to control area. In previous section we have shown that CBFC household spends significantly more on food compared to control.

The Gini correlation coefficient (R_f) between total expenditure and food expenditure is 0.97 and 0.99 for the CBFC project and control areas, respectively; which is greater than that between total expenditure and other household expenditure items like clothing, education, and healthcare expenditure. This result indicates that expenditure on food is more important when compared to other expenditure items to reduce the inequality in both the CBFC project and control areas. A positive correlation between the expenditure on different items is observed, which is consistent with the findings of Singh and Dey (2010) and Singh (2007) where they used income data.

Table 5.3 Gini decomposition by expenditure items for CBFC project and control area.

Category		*Share in total exp.* S_f	*Gini of exp. sources* G_f	*Gini correlation with total exp.* R_f	*Share in total exp. inequality*	*Marginal effect*
CBFC project area	Food expenditure	0.716	0.346	0.976	0.701	-0.015
	Cloth expenditure	0.094	0.480	0.745	0.097	0.004
	Education expenditure	0.045	0.557	0.710	0.052	0.007
	Health expenditure	0.036	0.435	0.560	0.025	-0.011
	Other expenditure	0.110	0.422	0.848	0.125	0.015
	Total expenditure inequality			0.344 (0.331, 0.362)		
	N=			980		
Control area	Food expenditure	0.773	0.410	0.992	0.789	0.017
	Cloth expenditure	0.038	0.659	0.465	0.029	-0.009
	Education expenditure	0.043	0.621	0.679	0.045	0.003
	Health expenditure	0.052	0.527	0.717	0.049	-0.003
	Other expenditure	0.096	0.463	0.865	0.088	-0.008
	Total expenditure inequality			0.400 (0.380, 0.412)		
	N			852		

The marginal change in inequality due to 1 percent change in total expenditure for individual expenditure sources has also been estimated. Results reveal that, all else being equal, if expenditure on food is increased by 1 percent, the Gini index of total expenditure decreased by 0.015 percent for the CBFC-project households; for the control households it increased by 0.017 percent under the same conditions. This indicates that individuals in the CBFC project area are spending more on food (Table 5.2), which has a positive contribution to equalizing total expenditure distribution; this was the opposite for control floodplain areas.

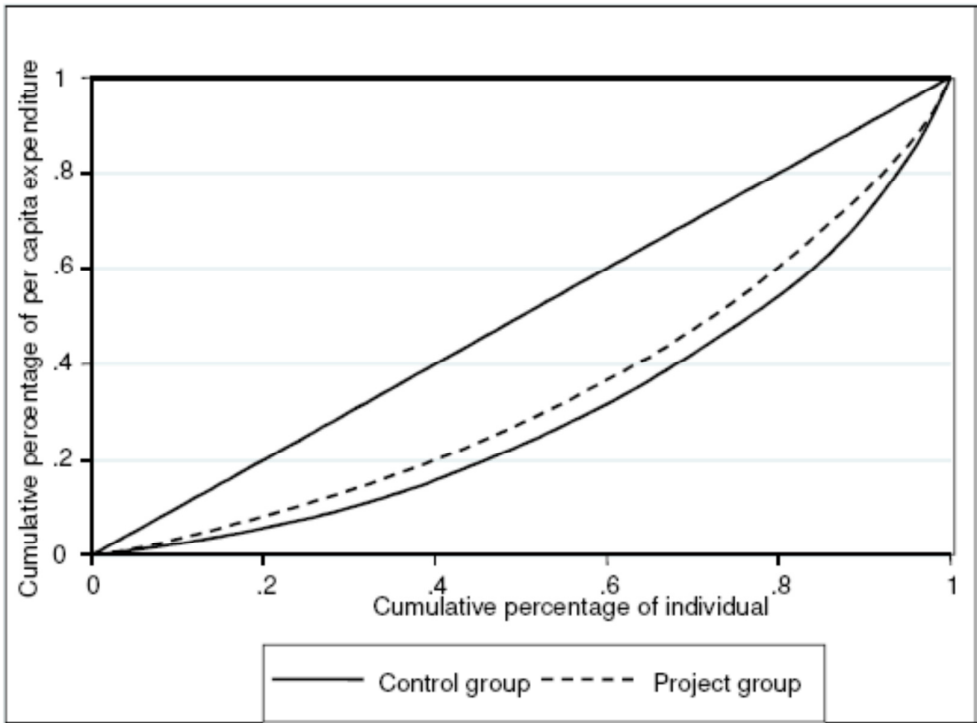

Fig. 5.2 Expenditure inequality Lorenz Curve

Lorenz curve shows the graphical representation of project impact on expenditure inequality. Before project implementation, some people were earned more money from the water resource and some people earned less which leaded to expenditure inequality among the people. This was happened due to social structure and political power of the local people. But after intervention of the project, access to land resource was distributed properly and return from floodplain land resource were distributed properly in the project compared control site. As a result income as well as expenditure was equality distributed among the project beneficiaries.

5.5 Conclusion

In this chapter I have analyzed the impact of the CBFC project on expenditure/consumption and expenditure inequality. A non-parametric propensity score matching method with three algorithms (Nearest Neighbor, Kernel and Radius matching) was used to evaluate the impact of the CBFC program and a Gini coefficient measure was used to evaluate inequality in this study.

Expenditure is a better measurement of welfare than income, in cases where most of the people are poor and struggle for food; because of this, we used expenditure data instead of income. Results show that the CBFC project has a significant positive impact on food expenditure, non-food (other basic needs like clothing, healthcare, education, etc.) and

overall total expenditure. Results reveal that the CBFC management system was able to distribute total expenditure more equally in the floodplain areas in the study. Specifically, expenditure on food, clothing, housing, and education were distributed more equally among the fisher communities in the CBFC project floodplain areas compared to control floodplain areas. Based on these results, it can be concluded that to improve the livelihoods of poor fishermen, the community based fish culture system should be emphasized in the floodplain resource areas of Bangladesh.

Chapter 6

Conclusion and Discussion

6.1 Introduction

Due to rapid population growth, the importance of floodplain productivity is increasing day by day. Lack of proper management in floodplain areas means that they remain unused at least six months out of the year; during that time, capture fisheries are the only source of income from these floodplains. As a result, income as well as expenditure of the people inhabiting these areas is low in comparison to other rural areas in Bangladesh. In addition to this, local elites exercise their power and harvest the major part of naturally occurring fish during the monsoon season; which leads to higher inequality. Culture of fish in the seasonal floodplains can be an important tool for strengthening the rural economy of the country (Rahman *et al.,* 1999; Dey and Prein, 2006). Historically floodplains were the major source of natural fish production, but currently, fish yields are declining.

The Bangladesh and South Asia Office of the WorldFish Center in collaboration with the Department of Fisheries (DoF) and the Bangladesh Agricultural Research Council (BARC) implemented therefore undertook a five-year interdisciplinary action research project (2005-2010) with the overall aim of enhancing the productivity of seasonally occurring floodwaters for the improved and sustained benefit of the livelihoods of the people of the surrounding villages, including the different classes of resource users, especially poor, landless fishers. The main activities of the project were carried out in seasonal floodplains in order to develop appropriate technical and institutional options for increased water productivity at basin level through the establishment of community based fish production in the floodplains under equitable and sustainable sharing arrangements.

6.2 Organization of the research

The WorldFish project provided for three PhD research positions, one each on floodplain productivity, technological intervention and institutional aspects. The present research is organised around the institutional aspect of community based fish culture in the floodplains. The project officially started in 2005 and in 2006 six floodplains in three different river basins of Bangladesh were selected. These floodplains are located in the Brahamaputra, Padma and Teesta river basins in Mymensingh, Rajshahi and Rangpur districts, respectively. The selected floodplains were under two types of land ownership category: public-private and private. Public floodplains are open access areas during the

monsoon season when all land is inundated. Access to private floodplains, on the other hand, remains in control of the landowners also during the monsoon season. In each floodplain one site was selected to be included in the establishment of community based fish culture, and one site became a control site outside the project intervention area. The sites included in the overall project, hence in this research, are: Beel Mail (public floodplain), and the private floodplains of Kalmina Beel and Angrar Beel. The control site in the respective river basins are: Chandur Beel, Andola Beel, and Paingler Beel.

Project staff from WorldFish, DoF and BARC conducted a baseline survey in 2006 in project and control areas. A total of 778 households were selected, comprising 469 households in the project floodplains and 309 in control floodplains outside the project area. Baseline information of all households was gathered, including their demographic situation and socio-economic conditions, ecological conditions, land use, and the floodplain water management system.

I was selected to carry out PhD field research (2007-2009) on the institutional aspects of the introduction of community based fish culture in the three floodplains, focusing on the social and economic characteristics of the research sites. To this purpose, 46.27% of all households from the baseline study of the three project sites and the three control sites were randomly selected for the present study, including fishers, landless seasonal fishers, and landowners (Tab. 1.4).

Although I have been involved with the WorldFish project from its start, this thesis focuses on my involvement as PhD researcher I consider this research an action research in the sense that I also coordinated different institutional stakeholders, and collaborated with the Department of Fisheries and other institutional stakeholders to effectively implement the project. But I have kept a critical distance from project policy decisions, and was mainly involved in the field in communication with local organizations and other stakeholders.

In 2007 I was formally granted admission to the PhD programme of Wageningen University. As a PhD candidate I remained an external candidate to Wageningen University, and WorldFish has generously supported my research.
The overall objective was to carry out long term close monitoring of collective mechanisms, activities and operations so that an effective institutional organization could be arrived at which would be replicable elsewhere in Bangladesh and beyond.

This set of objectives generated the following overall research question:

What institutional arrangements can be identified, and how do they influence power relations in order to adequately manage community based fish culture activities? What is the impact of the project on communities and households involved in the project as compared to those not involved?

Although the sociological and the economic parts of the study are closely related, I have divided this thesis into a sociological and an economic part, mainly because of methodological differences. But, the institutional organization of community based fish culture evidently influences the social and economic conditions of the households involved in the project, as compared to those in the control group outside the project. Therefore, data presented in Chapter 2 and Chapter 3 (sociological part) and data presented in the economic analyses of Chapter 4 and Chapter 5 are clearly interrelated. Given the focus on institutional arrangements related to CBFC intervention, Chapters 2 and 3 only deal with the three project sites and not with the control sites; whereas the results of my economic surveys (2007-2009) in Chapter 4 and Chapter 5 are compared with data from the project's baseline study in 2006 (if available), and with the control group.

The specific research questions have been addressed in the different chapters.

Chapter 2 discusses the floodplains as a common property resource, and the establishment of new institutional arrangements to facilitate better stakeholder participation in community based aquaculture, like the Floodplain Management Committee (FMC), and answers the question to what extend and how public floodplains differ from privately owned floodplains.

Chapter 3 continues with the discussion of the formal and informal rules on access rights in fish culture, and how they are enforced, particularly in relation to the strong power position of local elites. An important question here is whether and how fishers, particularly poor landless fishers, are represented in the decision-making process, and power differences are dealt with in the decision-making process of community-based fish culture management.

Chapter 4 addresses the overall economic impact of technical and institutional arrangements of fish culture at both floodplain and household levels. The question is answered how community based institutions improve economic the livelihood, food and health conditions, and equity of the households participating in the project, as compared to those outside the project in the seasonal floodplains.

Finally, in Chapter 5 the direct and indirect effects of participation in community based fish culture, at household level and per project and control site, and expenditure inequality between the different classes of fishers and landowners were measured.

6.3 Summary and discussion of the main research findings

6.3.1 Institutional arrangements and community based fish culture

Formal institutional linkages between DoF, WorldFish Center and the Bangladesh Agricultural Research Council (BARC) appeared to play a key role in ensuring success. DoF is a government institution with establishments at different administrative levels and played a major role in the selection of floodplains, beneficiaries, and the formation of Fischers Management Committees (FMC) and Project Implementation Committees (PIC). In the public floodplain of Beel Mail it also took the necessary measures to protect fish from uncontrolled harvest and to ensure a five years lease from the Department of Lands (DoL).

The main difference among the stakeholders in the two types of floodplains is found among the classes of beneficiaries. Professional, full time fishers are members of a formal institution, namely the fisheries cooperative society. They are born in a fisher's family and the members of Hindu community. The livelihoods of fishers of this community largely depend on income obtained from fishing. The fishers of the Kalmina and Angrar Beel floodplains are members of a Muslim community. They are not born into fishers families, and have no formal institution to support them. The livelihoods of these fishers depend on fishing and agricultural activities.

In all floodplain sites there are landless poor people living in the same communities. Most of them are dependent of the floodplain for their livelihood, but they can only fish during the monsoon season when the floodplains become more or less open access areas. The percentages of landless fishers in the three floodplains are comparable, despite the different ownership regimes. As members of the Community Based Organizations instituted by the project, they can now benefit from fish culture in the floodplains, like the other classes of members. Interestingly, also in the private floodplains, their participation was negotiated with the landowners who in the end consented to sharing mechanisms with the poor. Seasonal fishers are thus given the opportunity to harvest fish, but on the condition of using local gears for household consumption. Actually, only few of them sell the fish they harvest. The land owners own plots of land located in the floodplains. During the dry season they grow rice but during the monsoon season their inundated land is used as an integral part of the floodplain.

6.3.2 Institutional arrangements and rules

In constructing the overall conceptual framework for the thesis the IAD model and Community Based Fish Culture model were used because they are key complementary approaches to understand the structural and practical aspects of floodplain resource

management. They were developed to understand how technical and institutional intervention changes fish production and create new institutional arrangements.

Generally, the rules and regulations that apply to public and privately owned floodplains are written down in a Memorandum of Understanding between DoF and the individual FMC's in a non-judicial construction. Importantly, in their regular meetings the FMC documents the everyday practices of the implementation and compliance with the rules related to fish culture and management, and these minutes are distributed among its members. Some rules are derived from the national fisheries law. It appears that in the three cases of public (Beel Mail) and private floodplains (Kalmina and Angrar), comparable rules and regulations for fish culture are applied irrespective of their status of public or private floodplains.

Operational Rules apply when during the monsoon fish culture period public land or private land is inundated and the floodplains become a semi-open access space for the surrounding villages, and particularly for the fulltime fishers and the seasonal landless fishers. After the stocking of fingerlings access to the floodplain is restricted for all fishing during the period of one week to avoid stocked fish mortality.

The composition of Floodplain Management Committees in principle regarded all beneficiaries, (non-fishing) landowners, landowning fishers, and landless seasonal fishers. But in the public floodplain of Beel Mail the landless held no position in the FMC. Collective choice rules for the formulation and enforcement of operational rules may also differ between private and public floodplains. 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 the three research sites of the project the FMCs made additional rules and regulations according to the MoU between the FMC and DoF, and they also developed additional rules, for example fishing rules and membership criteria. Leaders were selected considering criteria like capability to speak well in public and be a good organizer, their acceptance by all beneficiaries, transparency and accountability.

6.3.3 Power and decision making

The power relations between the various stakeholders who were directly or indirectly involved in the floodplain and the decision-making process in co-management practices were also studied at different institutional levels. A range of qualitative and quantitative Participatory Rural Appraisal techniques was applied including community profiles, participatory resource mapping, and field observations. 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 Floodplain Management Committees (FMC), villagers and institutional stakeholders to investigate the use of the floodplain as a common property resource (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 analysed.

Management committees were established to increase the level of participation of (non-fishing) landowners, landowning fishers, and landless seasonal fishers as beneficiaries of fish culture, and to involve them in the decision making at setting of rules for a more equitable distribution of income and consumption between all stakeholders. This meant that less profit would be going to fishers' leaders, landowners, middlemen, moneylenders and leaseholders. I have identified two types of power in the management of floodplain aquaculture and stakeholder involvement, namely the power to create rules and decision making procedures, and the power to resolve disputes and ensure compliance. Examples are rules and regulations about membership, leadership, boundary and access, allocation, penalties, input, and conflict resolution that were enforced for the management of community based fish culture. The Government of Bangladesh devolved power to the local Department of Fisheries to manage fisheries resources, to implement the national fishery policy, and to elicit the legal instruments guide the process through outlined strategies. These rules and regulations likewise aim at enhancing fish production by introducing fishing limitations in such as fish shelter areas or gear and mesh size restrictions. FMCs in all cases were relatively powerful and endorsed the decision. This implies that user committees have *de jure* powers to formulate rules that govern exploitation of the fisheries resources within their jurisdiction.

In the case of the public floodplain (case 1) participation of the representative of influential land owners and landowning fishers plays a major role in formulating criteria for position rules of the members and their duties, as all members are accountable to local communities and the project management committee. The selection of members allows for representative and accountable participation and the meaningful authority was seen to slowly become transferred from the government to the community level. In the case of a private floodplain (cases 2 and 3) the representatives of land owners, landowning fishers and landless poor fishers did have a collective power in formulating criteria and rules about position and boundary. However, such power suffers from elite

capture and it remains problematic that in some cases they cannot be fully or effectively exercised due to elite capture of the fisheries through the executive committee.

Therefore, it remained a major challenge to reduce elite capture of rich landowning villagers, and to effectively include representatives of the landless, poor fishers in the FMCs. In the private floodplains there was no specific governance system in place to manage access and use of the floodplains during the wet season, as opposed to the dry months when the private plots of the floodplain were used by individual households for crop production. In Kalmina (case 2), thanks to greater accountability of the leaders and more equal representation of the different stakeholders including active leadership and a supporting role of DoF, leadership problems were few and easily solved. But in the Angrar Beel floodplain (case 3) downward accountability could only be established through many efforts by the project.

Before the intervention of this action research project it was not clear how the institutional changes would work in floodplains under public and under private ownership regimes. In my study many of these issues were explored. Especially in the case of a public floodplain, I tried to show the success of CBO management so that the members of CBO can be assigned ownership of the public floodplain through the FMC. However, as this is a complex and lengthy political-administrative process which goes up to the Ministry of Land, it has not resulted in a positive outcome yet. In the floodplain under public ownership, the fisher's community formally obtains the lease of the floodplain, but in practice it was captured by the local elite. At the initial stages of project intervention these were the main power holders and the fishers were quite powerless due to less equity in the distribution of benefits. Over the project period, and due to technological and institutional changes the scenario improved. Fishers became more involved, employment increased; likewise their voice increased with more equity in the sharing of benefits from the high increase in fish production from the floodplains. DoF played a major role by providing the necessary technological and institutional support to bring this process to a success.

A floodplain under private ownership shows a better performance of community based fish culture in terms of sustainability as it faced less problems in ensuring ownership and access rights, as compared to a public floodplain. For a public floodplain in order to ensure ownership after three years the CBO needs to obtain a land lease from the local land authority of the Government through participation in an open auctioning process. Although there is a preference for fisheries communities to take part in auctions, in most

cases these their chances to obtain the lease are thwarted by social and political forces beyond their control, therefore they are unable to sustain ownership.

Although showing a better overall performance, CBFC in the private floodplains was not without conflicts. But the strong participation of younger members of the community in one case managed to overcome the problems and CBFC management continued with success. As the ownership of the private floodplain was based on negotiation with the land owners, membership of the CBO, hence of the FMC received the necessary support from the Department of Fisheries who arranged for their registration from the Social Welfare Department of the government which provided them with a comparatively stronger position than in the case of the public floodplain.

6.3.4 Impacts of community based fish culture on income, food security and employment

I have examined the overall impact on households involved through the WorldFish project in community based fish culture in seasonal floodplains, particularly with respect to fish production, consumption, and income generation. The overall fish production in the floodplains at the project sites appeared to have increased 274%. Interestingly, from 2007 to 2009 and among the three sites, fish production increased most in the privately owned floodplains: in Kalmina (case 2) from 46kg/ha to 458kg/ha (895%) and in Angrar (case 3) from 43kg/ha to 206kg/ha (279%). In the public floodplain of Beel Mail (case 1) fish production increased over the surveyed three years from 282 kg/ha to 729 kg/ha (159%).

Differential impact of community based fish culture in three sites reflects, among other things, the varying degree of project implementation between project and control sites. Income from fish production increased significantly for project beneficiaries as compared to the control group. Over the period 2007-2009, average income from fish production increased to USD 240 for all beneficiaries involved in the project, which is 237% higher than the income of beneficiaries in the control group. Results of the random effects model show that project-involved households significantly increased their fish income compared to the households of the control sites. Furthermore, total household income increased to about USD 175 per household for those who participated in the WorldFish project.

Due to project intervention introducing fish culture, 43% of the farmers used floodplain water to meet up irrigation needs instead of ground water. The use of floodplain water reduced pressure on ground water by 17%. In wet-season (Aman) rice, the use of

floodplain water by beneficiaries increased by 13% point from 18% before project intervention to 31% after project intervention. Due to the implementation of community based fish culture, rice production increased by 18.9% for dry-season (Boro) rice and 28.9% for wet-season (Aman) rice in the project floodplain areas.

Fish availability has increased in the project area from July to December. The consumption of nutritional food shows that per capita fish consumption of households in the project sites has increased from 1.26 kg per capita per month in the baseline year (2006) to 2.31 kg per capita per month in 2009 (Tab. 4.9) which is higher than the national average per capita fish consumption of 0.95 kg per month (Bangladesh Economic Review, 2005). Due to project intervention the average per capita fish consumption per month increased by 59% compared to the baseline year, which is 29% higher than in the control sites. Among the project beneficiaries, landless seasonal fishers showed the fastest average growth (33.22%) in per capita fish consumption per month, followed by professional fishers (27.11%) and landowners (19.01%). In other words, food security has considerably increased, particularly for the poorest households.

Apart from the direct effect on household income and food consumption, CBFC intervention also created the opportunity for employment in the different fish culture activities. Labour productivity and returns to labour significantly improved after project intervention through a series of backward linkages like hatcheries, nurseries and seed, feed, and input deliveries, and forward linkages like post-harvest handling, processing and marketing. Access to markets to sell the harvested fishes had the indirect effect of supplying fish from the project sites to surrounding communities and local markets. This study shows that about 20-30% non-stocked fish are sold at farm gate to the communities surrounding the floodplains as well as to local middlemen who got a chance to purchase fish at a cheaper price.

Respondents were also asked about their experience of solidarity, trust and cooperation among themselves and with other stakeholders over the last three project years. Social cohesion in terms of solidarity, trust and cooperation was perceived to have improved, which is critical for the sustainability of the FMC and its linkage to other CBOs within the village and outside of the village, as well as for institutional capacity building.

6.3.5 Impact on expenditures and inequality

My data show that the CBFC management system has significant positive impact on food expenditure, non-food expenditure and overall household expenditure. Gini index of total expenditure is found to be 0.34 and 0.40 for the CBFC-project and control households

respectively, which indicates that expenditure is equally distributed among the households, but that it is more equally distributed among the CBFC households as compared to the control households. Expenditure inequality difference between the CBFC-project and the control area is 0.06 which implies that the CBFC management system helps to distribute total expenditure more equally among the surrounding communities.

The impact of CBFC on household expenditure and expenditure inequality was measured by using Propensity Score Matching (PSM) method and Gini decomposition. Propensity score matching method with three matching algorithms was used to evaluate the welfare impact of CBFC project. Probit estimates of propensity score (pscore) were presented with STATA program output. Results revealed that the overall average food expenditure per year per household (for panel estimation) increased due to participation in the CBFC project from USD 93 to USD 141. Project participants were able to spend significantly more on food compared to non-participants. In addition, expenditure on food was increasing year by year. Moreover, participant households were capable to spend more compared to non-participant on non-food items like cloth, health, education, housing, transport etc. (from USD 45 to USD 74)per year. This non-food expenditure also gradually increased per year. Finally, total household expenditure of CBFC project participants was between USD 134 to USD 215 per year higher than the total expenditure of control households, which implies a better livelihood of the households involved in the project (Table 5.2). These results are consistent with Khan *et al.* (2012).

At the start of the WorldFish project in the seasonal floodplains expenditure considerably varied from household to household due to unequal distribution of land and lack of proper floodplain management. Project results show that the share on food expenditure of the total expenditure is comparatively less for CBFC project involved communities than for the control area, but that food expenditure itself is more equally distributed (Gini index 0.35) within the project area compared to the control floodplain area (Gini index 0.41). This data indicates that community-based fish culture management system helps to equally distribute expenditure on food among the communities, which was one of the main objectives of this project.

Gini correlation coefficient (R_f) between food expenditure and total expenditure is 0.97 and 0.99 for the CBFC project and the control area, respectively, which is greater than other household expenditure items like cloth, education and health expenditure. This indicates that expenditure on food is regarded more important than other expenditures to reduce household inequality in both the CBFC project and control areas. At household

level, the research shows (Tab. 5.3) that household members within the CBFC project area are spending more on food, which positively contributes to equalizing total expenditure distribution, as opposed to the control group.

Expenditure is a better measurement of welfare than income where most of the people are poor and struggle for food. In this study we therefore used data on expenditure instead of income. Results show that the CBFC project has a positive and significant impact on food expenditure, as well as on non-food (other basic needs) and overall total expenditure. Results reveal that CBFC management system was able to distribute total expenditure more equally in the floodplain areas. More specifically, expenditure on food, cloth, housing and education were distributed more equally among the fisher communities in the CBFC project floodplain area as compared to the control group. Based on the above results it can be concluded that community-based fish culture in the floodplain resource areas of Bangladesh is instrumental in improving the livelihoods of all classes of stakeholders, but particularly of the poor and landless fishers.

6.4 Reflection on scientific and policy relevance of the research findings and recommendations

6.4.1 Scientific relevance of the research

The present study is concerned with community based fish culture in the floodplains. The two key words here are the 'community' and 'floodplain'. Seasonal floodplains have a different physical hence social appearance depending on the season. The monsoon when all land is inundated may be an open access area, but the same area may turn into privately owned land of fishers and non-fishing landowners, excluding the landless poor fishers, from surrounding communities. All people living around the floodplain have an interest on floodplain fishery or fish culture as it provides economic opportunities to increase their incomes, but social dynamics like culture, religion, class hierarchy and many other aspects of life need to be understood to understand and mitigate the process of resource extraction from the floodplain. Therefore, society must be understood so that no misunderstanding or conflicts arise, no one deprives the benefits of others, and conservation of the floodplains is maintained. Social rules need to be strengthened or established to ensure better management of the floodplain, develop institutions of user groups and establish equity in the distribution of benefit. To arrive at these ends, a project that aims at the introduction of fish culture for the benefit of the surrounding communities needs to understand and seriously integrate social and political conditions in order to develop appropriate institutions to sustainably govern the floodplains.

However, knowing the social dynamics of the floodplain is not enough. The study also has to include an economic component because maximum benefit needs to be extracted from the floodplain management. Therefore, the best technology and management structure need to be selected so that the benefit derived from the resources is maximized and equally shared among all stakeholders. Moreover, the floodplain use should be(come) environment friendly. Not only the production of fish is prime objective in the floodplains, the methods of production, procurement of inputs and marketing of the products etc. are all economic activities with which the members of the surrounding communities are involved. The social, institutional, and the economic are not isolated entities. Therefore, action research aiming at the introduction of community-based fish culture should involve interdisciplinary social and economic research to complete the scenario.

6.4.2 Policy relevance

The individuals of the village or community have become benefitted in many ways, which otherwise would not have been possible. This result is a lesson for other floodplain or *beel* management. For better management of the public and private floodplains in Bangladesh, the government together with WorldFish can take the present project as an example and a lesson learnt for the purpose of developing a policy to better utilize fish resources and improve the fish-based livelihoods of the people living in and around the floodplains of Bangladesh. The following points are important:

a. The formation of CBOs and their management units (FMC) in order to establish upward and downward accountability of resource use, ensure the sustainable management of the floodplains, arrange proper marketing of the products, and establish equity in the distribution of benefits of the floodplain resources;
b. A CBO-based approach can also generate more revenues for the government. Moreover, exhaustive use of resources can be checked, and productivity of the floodplains can be increased;
c. A CBO-based approach may control elite capture and create conditions for a more equal income distribution among all classes of society by securing access to the floodplain to poor and landless farmers.
d. Community-based fish culture not only increases fish consumption, but also expenditures on food, clothing, and housing.

6.4.3 Recommendations

Community based fish culture has proven to be effective in private floodplains, but it also worked well in a public floodplain management to realize an increase in fish production, income, and employment generation of fishers, landless, and land owners surrounding the public lands of the floodplain. However, in most cases the fishers – who are the ones

taking the lease of the public area of the floodplain - lost their ownership rights of the public areas of the floodplain when political powers frustrated their endeavours to renew their lease rights.

In order to guarantee the rights of the community organizations led by the fishers there is a need to modify the policy of leasing out public floodplains. Learning from this project's lessons, the government can support livelihood improvement around the floodplains by developing a policy to structurally lease floodplain areas to the fishers' organizations, and to accommodate the landless and poor.

Policy issues to be included under private and public floodplain management are:

- To bring all floodplains with a potential for fish culture under CBO management;
- To give CBOs long term lease of the public areas of the floodplains, with a minimum of 10-15 years;
- To provide government support for the registration of CBOs and their members, and take the necessary measures to strengthen the institution through technical training, and training in leadership and financial management;
- To improve or reconstruct ditches - even in private floodplains - to hold water for longer periods to be used for fish culture as well as for crop irrigation;
- To provide government support for the construction of small infrastructures at the outlets and inlets of the floodplains in order to better contain the water for fish culture as well as irrigation;
- To improve and develop general infrastructure (access roads to the floodplains, canals connected to the floodplains, fish landing, and grading facilities);
- To facilitate provision of quality fish fingerlings, supply of brood of natural fish species, boats, nets and fish transportation related supports in order to improve the quality of the fish supply and receive a premium price.
- To continue the research support for scaling out the CBFC approach by WorldFish, BFRI and universities, including their role in influencing policy through the formulation and implementation of action-research;
- To allow and facilitate regular participation, sharing of experiences and observations by a variety of stakeholders, including the less powerful, to create greater accountability as well transparency of action-projects and acknowledging success locally and nationally to scale-up and scale-out the community-based fish culture approach in Bangladesh.

6.5 Areas for future research

During the last two decades of research we have gained concrete understanding about the technological and institutional issues of the use of floodplains for fish culture. Now it is important to know how these lessons can be disseminated so that CBFC can be adopted in most of the floodplains with potential for fish culture. Therefore, the development of a scaling-up model of the CBFC approach is useful. Future research may include an assessment of the effectiveness of scaling up of CBFC innovation in floodplains using a CBO to CBO approach, and receiving facilitation support from formal institutions. The outcome of such a 'scaling model of CBFC in the floodplains' would have a wider impact on fish production, biodiversity, income rise, nutrition and employment of the poor, including the women of Bangladesh. Finally, there is scope for the incorporation of a land-based agro-ecosystem approach covering the integral landscape of the floodplain area to create greater sustainability.

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Annex 1: Institutional Checklist/Questionnaire at Floodplain Level

Self-assessment Questions

Name of Floodplain: Upazila: District:

Name of FMC/Fisheries Society:
Respondent: Member of the Floodplain Management Committee (FMC)

1. Vision

   a) Why did the members join the institution or group;

   b) Why do they continue to be members?

   c) Describe one achievement of the group and how was this achieved;

   d) How do they envision the institution say, five years from now – this is not a listing of activities but more of an action one, i.e., what is their plan and how to implement;

   e) How do they see the village 5 years from now – this describes what the people would like to happen to the community and not a list of activities?

   f) Enumerate the present activities of the group that paves the way to achieve its vision as well as their vision for the village;

   g) List the future activities of the group that will assist in realizing their dream for the group and village;

   h) What do members expect from non-members in terms of their impression about the institution – obtain information on the core values of the group from an outsider's perspective; and

   i) Self-assessment in terms of community based organization and village vision – need to rank three indicators on how vision influenced their thinking.

2. Group formation

   a) When was the group formed and by whose initiative, that is government, NGO, local people, self-organized;

   b) How did the initiator formed the group;

   c) How are members chosen and what selection criterion was employed;

   d) Given the selection criteria, how did they actually become members?

   e) Why did they join the group – list and categorize the responses;

   f) How many members do the groups have and why is membership changing – can be increasing or decreasing in number of members;

   g) Group assessment of member participation during group formation – rate according to excellent, good, less good, weak. The group should identify and agree on three indicators as basis of their assessment; and

h) Group assessment on sense of ownership and belongingness of CBO – rate and select indicators as above.

3. Rules

a) Does CBO has written rules and regulations – who made them; when were these developed;

b) Are all members aware of these rules and regulations – have they seen them;

c) How often should rules and regulations be reviewed and discussed;

d) Have they conducted any training sessions for members or only for office-bearers;

e) Can the group remember three rules and regulations in detail;

f) Do regulations include sanctions – should these be included; to their knowledge, has any sanction been enforced; by whom;

g) Has there been any revision on the rules and regulations;

h) List three major problems experienced by CBO – how did they arise; were the rules and regulations the cause of any of them;

i) Group self-assessment on rules and regulations – are they sufficient; require any changes; who will change these; what is the process; do the rules create more conflict, confusion or reduce it; and

j) Group self-assessment on observance of the rules – what is the consequence if one does not follow the rules; are sanctions effective or generally respected.

4. Group meetings

a) Who calls for the meeting – decides on the date, time and place; is it fixed or subject to change;

b) Frequency of the meeting;

c) Registration of attendance required and maintained – who maintains it;

d) What is the average attendance in a group meeting;

e) Is there minutes of the meeting – who does it; who maintains it;

f) Is there a bank account – operated by whom; who physically holds these records; where are they kept;

g) Is there a written agenda every meeting- who sets the agenda; list three important items regularly on the agenda?

h) How does the group ensure decisions have approval from the majority and are known to all?

i) List all office-bearers and the roles they perform; and

j) Group assessment on level of participation during meetings using the scale of good, not so good, weak; why and give three indicators.

5. Capacity building

a) Any training provided to all members as a group – where conducted;

b) What are the training modules – how long did each module last;

c) Usefulness of the training – name two examples why this is useful;

d) Members as a group visited any other group or projects – which group or project;

e) Group made any changes (added or deleted) rules and regulations;

f) Any policy to train members to take over responsibilities in the group;

g) When were office-bearers change – how often since inception;

h) Audits/reports

- conducted and reported in group meetings
- recommendations from audits discussed in the meetings
- any follow-up actions on the recommendations
- reports/feedback and assessments made by Project Management (project officers) or consultants shared by CBO
- group followed any recommendations made; provide three recommendations

i) List official responsibilities performed by group officers; how does group ensure rotation of responsibilities among different members; and

j) Describe three major lessons or innovations learned or implemented over the last three months.

6. Financial management

a) Books and accounts properly maintained and updated – where is the cash kept;

b) Members knowledge of common fund – do they care; who are the defaulters; any penalty imposed to defaulters;

c) What are the sources of income of CBO – what are the purposes; all members clear on finances;

d) How are decisions on expenditures made – what are the required supporting documents; group maintain regular expenditure vouchers;

e) Describe any problems or conflicts over the last six months regarding cash or input management; any sanctions for mismanagement – who will enforce;

f) List three major rules related to financial management; and

g) Group self-assessment on the process of financial management – rank as excellent, good, not so good, weak; list three reasons for this assessment.

7. Organizational accountability

a) When was the last time the leader was changed – how was the leader appointed (elected by members, chosen by the former leader);

b) Criteria for selecting a leader – list them; were they observed or if not, why?;

c) Any regular compliance audits, that is, yearly;

d) Are there any rules that state leader should present reports and compliance audits to members;

e) Are office bearers or members of any committees or sub-committees related?

f) How often do reports (e.g. financial) submitted to higher authorities like government or even to members; if not, are there any plans to submit them;

g) Any situation where sanctions were applied; who enforces them;

h) What are the benefits of the office bearers given their investment in time, effort, etc;

i) Is there any positive attempt to involve the weakest members in decision-making or get a fair share of resources – provide two examples where weaker members progress to hold positions in the organization; and

j) Group self-assessment on the process of organizational management; rank as excellent, good, not so good, weak; list three reasons for this assessment.

8. Power and Decisions Making Process

a) What are the main characteristics of the leader (President/Secretary/Executive member)?
b) How does the FMC usually make decisions?
c) How the processes of decisions making in operations rules are?
d) How the processes of decisions making in Collective Choice rules are?
e) How the processes of decisions making in Constitutional rules are?
f) How you participated in decisions making in fish culture related activities and which activities?
g) How you participated in decisions making in management related activities and which activities?
h) What are your attitudes/values towards rule-breaking?
i) What types of sanctions/penalty are used in last 12 months?
j) How many times rule break in last 12 month?

9. Governance to Fisher Community

a) How fisher's raise their voice?
b) How the leaders do the effective role for raising voice?
c) How effective is the FMC leadership for fish culture management?
d) How fisher/you are obeying the rules and regulation?
e) Do you think that formed committee (FMC) is accountable and transparent to community?
f) How the committee showed their activities as they are accountable and transparent?

10. Conflict Management in Community Based Fish Culture

a) In last year, what types of conflict have occurred any conflict related fish culture management in the community level?
b) How it is solved and what is your opinion occurring the reasons for conflict?
c) What rules on fishing in the floodplain are there? Who set them? Do you know that it was broken during last year ?

11. Solidarity, Trust and Cooperation

a) Do you think that over the last three years, the level of trust, cooperation and solidarity in this village has been better, worse, or stayed about the same?
b) Which activities show that levels of trust, cooperation and solidarity in this village?
c) What are the three most important sources (instruments) of information about fish culture management activities?
d) In general, compared to three years ago, access to the information has increased, declined or remained as same
e) How often you or your family members visited the Upazila Fisheries office in the last 12 months?
f) How often the Upazila Fisheries office visited in your village to give management support in the last 12 months?

Interviewer signature_____ Date _____

Annex-2: Fish Production and Other Information at Floodplain Level

Questionnaire for Community Based Fish Culture in the Seasonal Floodplain

Respondent: Member of the Floodplain Management Committee (FMC):

A. General Information

1. Name of the Floodplain or Beel:……Sub-district: …… District:……..
2. Name of the Community Based Fish Culture Project:……..
3. What is the distance of the Floodplain from Upazilla Headquarter? …….. km
4. Type of the Floodplain/site : (Public / Private/ Public and private)
5. Area of the floodplain/beel (ha): Public: ..... private:.....
6. Please provide us detail information on the beneficiaries involved of community based fish culture:

Name of the beneficiaries	Number

7. Stocking Information: Year-2007/2008/2009

Species of fish stocked	Who made the decision about the stocking?	Quantity of fingerlings stocked (kg)	Maximum size of fingerlings stocked (gram)	Minimum size of fingerlings stocked (gram)	Unit price/ kg	Source of fingerling
Rui						
Catla						
Mrigal						
Silver carp						
Bighead						
Common Carp						

Decision Making Code:

Decision made by the consensus of all shareholder and FMC member (Consensus)- 1
Decisions made by the some influential FMC leader without DoF concern (Autocratically)-2
Decisions made by the FMC members (Representative of all shareholders) with DoF concern(Majority)-3

Source of fingerling Code:

Supplier from local market - 1
Supplier from own floodplain-2
Private hatchery- 3
Govt. hatchery-4

8. Harvesting Information (Stocked and Non-stocked fish) in Year-2007/2008/2009

Species of fish harvested	Who made the decision about the harvesting	Quantity of fish harvested (kg)	Maximum size of fish harvested (gram)	Minimum size of fish harvested (gram)	Fish Sold
Stocked Fish					
Rui					

Catla					
Mrigal					
Silver carp					
Bighead					
Common Carp					
Non-stocked fish					

Decision Making Code:

Decision made by the consensus of all shareholder and FMC member (Consensus) - 1;

Decisions made by the some influential FMC leader without DoF concern (Autocratically)-2;

Decisions made by the FMC members (Representative of all shareholders) with DoF concern (Majority)-3

Decision Making Code:

Fish Sold Code:

Sold from farm gate-1
Sold to village market-2
Sold to sub-district market-3
Sold to district market-4

9. Operational cost of fish production

Sl. No.	Items	Unit (Person-days/quantity (kg))	(Tk.)
1.	Dyke repair and earth work		
2.	Labor cost for setting fence		
3.	Sluice get and culvert repairing		
4.	Guarding		
5.	Fingerlings (Last year and new year		

	fingerlings)		
6.	Feed (Rice bran, oilcake, pillet, etc.)		
7.	Organic fertilizer: -Cowdung, litter, etc;		
8.	Inorganic fertilizer-Urea, TSP, MP)		
9.	Fuel cost for irrigation		
10.	Marketing cost (toll, load, unload, etc.)		
11.	Transportation cost for fingerling purchase		
12.	Harvesting cost for stocked fish		
13.	Harvesting cost for non-stocked fish		
14.	Transportation cost for fish marketing		
15.	Lease money for govt. floodplain		
16.	Lease money for private landowner		

10. Return from fish culture

Fish	Quantity of Fish (Kg)	Average price (kg)	Total Return (Tk)	Quantity (Kg/ha)	Return (Tk/kg)
Stocked Fish					
Non-Stocked Fish					

11. Marketing

i. What marketing channel being followed in fish selling? Draw a flow chart:

ii. Proportion of fish sold in the last year Production (percentage):
Farm gate: Whole sale: Retail:

12. Quantity of fish sold in different level:

a. At Farm gate level

Species	Farmgate Fish Sold			
	Fish sold local wholesaler who comes District or Upazilla		Fish sold to the local people who comes from surrounding the floodplain	
	Quantity(Kg)	Tk\Kg	Quantity(Kg)	Tk\Kg
Rui				
Catla				
Mrigal				
Silver carp				
Bighead				
Common Carp				

b. At Wholesale level and Retail market

Species	Wholesale Market (Fish sold to the trader)		Retail Market (Fish sold to local buyer/consumer)	
	At Upazilla/ Union Market (kg)	Tk\kg	At Upazilla/ Union Market (kg)	Tk\kg
Rui				
Catla				
Mrigal				
Silver carp				
Bighead				
Common Carp				

13. What are the major problems of Community Based fish Culture?

14. Probable solutions for Community Based fish Culture

Name of the enumerator
Signature and date

Annex 3: Irrigation and Rice Production Information at Floodplain Level

COMMUNITY BASED FISH CULTURE IN IRRIGATION SYSTEMS & SEASONAL FLOODPLAINS
BARC – DOF – WorldFish Center
Information of Boro/Other Rice Cultivation in the Floodplain

Name of the Floodplain:
Project/Control:
Village: Upazilla: District:
Season: Boro/ Aman
Name of the Land Owner:
Father's/ Husband's Name

A. Before Intervention (in 2006)-Information collected by the project staff:

a. Cultivated Area (deci) Boro /Aman Rice in the Floodplain:

b. Name Rice Variety: Cost of seed/seelimg:

c. Cultivation Period (days):

d. Quantity of fertilizer used (kg) : Cost of fertilizer(Tk.):

e. % of Water used in the Floodplain for irrigation: STW/DTW (%)-

Cost of Irrigation for using floodplain (Tk.)

f. Labor used for rice production(no) Cost of labor:

g. Rice produced (Kg) : Value of Rice(Tk.):

B. After Project Intervention: 2007/2008/2009 –Information collected by the Researcher

a. Cultivated Area (deci) Boro /Aman Rice in the Floodplain:

b. Name Rice Variety: Cost of seed/seelimg:

c. Cultivation Period (days):

d. Quantity of fertilizer used (kg) : Cost of fertilizer(Tk.):

e. % of Water used in the Floodplain for irrigation: STW/DTW (%)-

Cost of Irrigation for using floodplain (Tk.)

f. Labor used for rice production(no) Cost of labor:

g. Rice produced (Kg) : Value of Rice(Tk.):

Annex 4: Quarterly Fish, Non-Fish and Other related Income at Household Level

Household Details	Interview Details
A1 Household Details (following details for data-checking purposes only) A1.1 Household Code**| __ __ __ | __ __ |** 1.5 Country _____ |__| A1.2 Village _____ | __ __ __| A1.3 Household N° |__ __| A1.10 Head of household name _____(Pers) _____(Fam)	AB1: Questionnaire Code | __ __ | __ __ __ | __ __ | (Visit N° and Household Code) AB Interview Details (begin data entry from here) AB2 Visit N°. | __ | AB3 Date (*dd/mm/yy*) ___ ___/___ ___/___ ___ AB4 Name of interviewer(s) _____ _____ AB5 Full name of respondent _____(Pers) AB6 _____(Fam) AB7 Sex 1. Male 2. Female AB8 Relation to household head _____ |__ __| AB9 Data checked by? _____ _____ AB10 Database entry date? (*dd/mm/yy*) ___ ___/___ ___/___ ___

Section 1: Household Labour (non-fisheries related)

B2 Records all **non-fisheries** related household labour activities. Fisheries related activities should be recorded in Section 3.

Enumerator: I would like to ask you about the activities that you and members of your household have done during **the last month**.

1. What activities have members of your household done during the last month? (Note - Refer to code sheet for guidance)
2. How many days did they spend doing each activity during the last month?
3. On average, how many hours in a day would they do these activities?
4. How much were they paid for their labour (per hour, per day, or other unit)

B2.1 Relation to head of household	B2.2 Sex M=1 F=2	B2.3 Age (yrs)	B2.4 Type of activity (Code: _Type of activity/ Occupation)	B2.5 1 = Off-farm 2= On-farm	B2.6 Average number of hours worked per day	B2.7 Wage received per hour	B2.8 Total days

* On- farm- any salaried or non-salaried labor activities done by respondent and his / her family members on their own land or homestead.

* Off- farm- labor means any salaried or non-salaried labor activity by respondent and his/her family members in other people's land or homestead or they work in other job besides agricultural, e.g: Van or richaw driver or restaurant owner.

Section 2: Fisheries Production

Table A7aB4 *Fisheries Production*

To fill in the table, the enumerator should ask the following questions:

1. What type of fish have you caught/ harvested during the last month?
2. Where did you caught/ harvest the fish?
3. What did you do with the fish you caught/ harvest? (i.e home consumption, sale, processing then sale, gifts)
4. Where did you sell the fish?
5. Did you purchase fish to sell? How much was the price?
6. How many of each type of fish did you sold?
7. If you sold the fish, what price did you get for the fish?
8. If the respondent sold the fish fresh and also processed, please record the same species of fish in two rows.

B4.1 Count	AB4.2 Species/ varieties)	AB4.3 Aquatic Production Source	AB4.5 Market Processing	AB4.6 Market Outlet	AB4.7 Quantity processed (kg)	AB4.8 Quantity Sold (kg)	AB4.9 Purchase price (& currency)	AB4.10 Selling Price (& currency)	AB4.13 Comments
1									
2									
3									
4									
5									
6									
7									

Section 3: Aquatic Production Related Activities

Table A7bB5

List down the details of all aquatic production, harvesting, marketing and processing activities which you and your household members undertook **over the last month**? Use one row per activity.

1. Which members of the household involved in aquatic production activity during the last month? (Please see code sheet for examples of aquatic production activities- fishing, collection of aquatic plants, making fishing gear, feeding living aquatic produce, etc)
2. How much time did each person spend for the activity in the last month?
3. Has anyone in the household sold fish during the last month?
4. How many days did they spend doing these activities?
5. On average, how many hours in a day would they do these activities?
6. How much they could earn per hour if they worked with others for the same activity and time?

AB.5.1 Relation to household head	AB5.2 Sex M=1 F=2	AB5.3 Age (yrs)	AB5.4 Aquatic production activity	AB5.5 Total days in the last month	AB5.6 Average hours in a day	AB5.7 Wage per hour	Comments

Section-4 Other household information

a. Give details about whole farm cost and return last three month

Sl. No	Livestock, poultry and other farm income	Production costs (Tk.) (a)	Total production (Kg)	Total production (No.)	Total production value (Tk) (b)	Total income (Tk)* (b-a)
1						
2						
3						
4						
5						

* In case of sharing arrangements, please mention the real income after deducting land owner's income

b. Give particulars about all household income from off-farm and non-farm income sources

Source of income	Last Three Months income (Tk)

Section 5: Remittances, Savings and Credits

AB16.1 How many people living away/ working away from the main household sent income home since **last visit**? _____

AB16.2 Total income sent home since last visit _____ A16.3 Currency_____

What proportion of your net household cash income were you able to AB16.4 save (%) _____ A16.5 required to borrow (%) _____
What were your household's credit requirements since the last visit?

AB16.6 Credit purpose	AB16.7 Credit Source	AB16.8 Amount	AB16.9 Currency	AB16.10 Terms: Interest (%)	AB16.11 Unit Time (Interest period)

Section 6: Household Income and Expenditure

B17a Source of household net income for the last month

1. What percentage of the household income came from activities involving aquatic resources? Example: Fishing, fish culture, fish processing and marketing, aquatic plants and animals marketing, etc.
2. What percentage of the household income came from activities involving non-aquatic resources? Example: Business, labouring, factory worker, government staff, etc.

* Aquatic resources include water bodies such as river, lakes, streams, ponds, rice fields and canal and all plants, animals and tree species that live in it.

Household net income source	Percentage (%)
B17.1 Aquatic resources related activities	
B17.2 Non- aquatic resources related activities	
Total	100 %

B17b Luxury and inferior goods

1. For question B17.3-17.6 we would like to capture indicators that can describe luxury and inferior goods from the point of the respondent.
2. Luxury good is a good at the highest end of the market in terms of quality and price; as people become wealthier, they will buy more and more of the luxury good.
3. Inferior good is one for which demand decreases when income rises; people tend to buy less when income increase. Usually, small income household will buy more of inferior goods.

On your opinion, what is considered as luxury good for a household in the village? Please give example for food and non-food item.
B17.3 Food item _____ B17.4 Non-Food item _____
In your opinion, what is considered as inferior good for a household in the village? Please give example for food and non-food item.
B17.5 Food item _____ B17.6 Non-Food item _____

B17c How much amount of the household income was spent on items below for the last month?

***Enumerator:** Before starting this question, please ask the respondent to think what had the household spent for the last month. Please ask if the respondent has spent for items listed in question B17.3 to B17.6. If yes, please fill in B17.15-17.17

Item	Tk
B17.3 Basic daily food	
B17.4 Sumptuous Food	
B17.5 Clothing and footwear	
B17.6 Education/ schooling	
B17.7 Electricity, gas and other fuels	
B17.8 Health and medication	
B17.9 Recreation, festival, gift	
B17.10 Transportation/ vehicle	
B17.11 Installment/ insurance/ loan	
B17.12 House repair/ building	
B17.13 Miscellaneous goods and services	
B17.15 Others, _____	
Total	

Section 7: fish culture preferences		
	1. Yes 2. No	Comments:
B18.1 Do you think the collective fish production in rice field in your village has brought significant benefits to villagers?		B18.2
B18.3 Would you like to continue with the collective fish culture activity?		B18.4
B18.5 Does your household face any problem on land use, water management and property rights during the implementation of community based rice fish culture period?		B18.6
B18.7 Does your household face any problem on fish culture and crop production during the implementation of community based rice fish culture period?		B18.8

Enumerator to respondent: Thank you very much for your time. Do you have any questions you would like to ask?
Questions from respondent

Annex 5: Seasonal Crop Production and Income at Household Level

Household Details	**Interview Details**
A1 Household Details (following details for data-checking purposes only) A1.1 Household Code**| __ __ __	__ __ |** A1.2 Village _____| __ __ __| A1.3 Household N° |__ __| A1.10 Head of household name _____(Pers) _____(Fam)	AB Interview Details (begin data entry from here) AB1: Questionnaire Code | __ __ | __ __ __ | __ __ | (Visit N° and Household Code) AB2 Visit N°. | 3 __ | AB3 Date (*dd/mm/yy*) ___ ___/___ ___/___ ___ AB4 Name of interviewer(s) _____ _____ AB5 Full name of respondent _____(Pers) AB6 _____(Fam) AB7 Sex 1. Male 2. Female AB8 Relation to household head _____ |__ __| AB9 Data checked by? _____ _____ AB10 Database entry date? (*dd/mm/yy*) ___ ___/___ ___/___ ___ AB12 This survey was conducted for 1. Dry season 2. Wet/ raining season?

Section 1: Crop input and production

B7 Crop inputs

Table B7 Inputs for all crop systems (include paid/ unpaid external labor)

1. What kind of inputs did you put into crop production during the **last season**? (i.e seeds, fertilizer, see code list)
2. Where did you get the input from?
3. How much did you use for each type of crop?
4. How much did it cost if you purchased the input?

B7.1 Count	B7.2 Farming System / Type of land held	B7.3 Crop	B7.4 Area of land held (ha)	B7.5 Unit	B7.6 Agri-Input type	A7.7 Source	B7.8 Total Quantity	B7.9 Unit	B7.10 Price / unit	B7.11 Currency	Comments

B8 Crop outputs

Table B8 List down all types of crops cultivated by you and your household members. Also record information related to each crop yield **in the last season. (as identified from seasonal calendars)**

1. What type of crops does your household grow?
2. What type of land do you have to grow crops?
3. How much land do you have for each crop?
4. What was the yield (a measure of the output per unit area of land under cultivation) for each crop?
5. How much of each crop did you produce during the last season?
6. How much of the crop did you keep for household consumption?
7. What percentage did you sell?
8. What percentage did you give to other people?

B8.1 Count	B8.2 Farming System (Type of land holding)	B8.3 Area of land held (ha)	B8.4 Crop	B8.5 Crop yield last season	B8.6 Quantity of crop sold	B8.7 Unit	B8.8 Price/ unit	B8.9 House-hold consumption (%)	B8.10 Given to others (%)	Comments

Enumerator to respondent: Do you have any questions you would like to ask?
Questions from respondent

Annex 6: Fish Consumption and Food Security at Household Level

Household Details

A1 Household Details (following details for data-checking purposes only)
A1.1 Household Code**| __ __ __ | __ __ |**
A1.2 Village _____ | __ __ __|
A1.3 Household N° |__ __|

A1.10 Head of household name _____(Pers) _____(Fam)

Section 1: Interview Details

AB Interview Details (begin data entry from here)

AB1: Questionnaire Code | __ __ | __ __ __ | __ __ | (Visit N° and Household Code)

AB3 Date (*dd/mm/yy*) ___ ___/___ ___/___ ___

AB4 Name of interviewer(s) _____

AB5 Full name of respondent _____(Pers) AB6 _____(Fam)

AB7 Sex 1. Male 2. Female

AB8 Relation to household head _____ |__ __|

AB9 Data checked by? _____ _____
AB10 Database entry date? (*dd/mm/yy*) ___ ___/___ ___/___ ___

Relation to HH

1 Head of HH
2 Wife or husband
3 Son or Daughter
4 Grandchild
5 Brother or sister
6 Father or mother
7 Father or mother in-law
8 Brother/ sister in-law
9 Son or daughter in-law
10 Tennant
11 Aunt or Uncle
12 Whole family
13 Rest of family
14 Male children
15 Female children
16 All children
17 Son
18 Daughter

Visit no.

01 Baseline survey
2_ Three month monitoring survey
3_ Seasonal survey
4_ Consumption survey

Table A8B3 Household expenditure on fish consumed over the **last seven days**? (Specify weight– use kg where possible)

AB3.1 Fish/ meat category	AB3.2 Species/ Variety	AB3.4 1= Bought 2= Wild catch 3= Self-cultured 4= Gift	AB3.5 Total Quantity Consumed	AB3.6 Quantity Units	AB3.7 Unit Price	AB3.9 No. Meals/ served	AB3.10 N° persons fed/ meal
1 Fresh Fish							

Note: If the food was produced by the household, please estimate market price.

	Aquatic Species	7	Chinese carps	14	Mud carp
1	Tilapias	8	Common carp	15	Black carp
2	Tilapia	9	Silver carp	16	Grass carp
3	Tilapia niloticus	10	Catla	17	Mirror carp
4	Tilapia zillii	11	Rohu	18	Prawns
5	Climbing perch	12	Mrigal		
6	Indian carps	13	Bighead carp		

*Please see more codes in the database

AB3.11 Have the consumption of food below increased compared to the last survey?

	1. Increased 2. Decreased 3. Similar	Reasons:
Fresh cultured fish		1. 2.
Fresh wild fish		1. 2.
Processed cultured fish		1. 2.
Processed wild fish		1. 2.

AB3.12 Any change in the nutrition intake after the implementation of the project?

Improved	1	Decreased	2	Similar	3

AB3.13 For the last xx days, did your household purchase any extraordinary food?

1	Yes	2	No

Summary

Seasonal floodplains are water bodies that retain water for 5-6 months during which they are suitable to grow fish and other aquatic animals. Out of 2.8 million ha of medium and deep-flooded areas, about 1.5 million ha are estimated to be suitable for Community-Based Fish Culture (CBFC). WorldFish had undertaken a five-year interdisciplinary action research project from 2005-2010 with the overall aim of enhancing the productivity of seasonally occurring floodwaters for the improved and sustained benefit of the livelihoods of the poor. My involvement in this project was as PhD Scholar from 2007-2009 for understanding the different and complex institutional arrangements and its overall impact of governing Community-Based Fish Culture in seasonal floodplains for the sustainable use and maximization of benefits to the targeted people of Bangladesh.

Six seasonal floodplains in different areas of Bangladesh were selected under the action research project implemented by the Department of Fisheries in collaboration with the Bangladesh Agricultural Research Council and the Bangladesh Fisheries Research Institute. For the action research which is the subject of this thesis, three seasonal floodplains were selected in the Brahamaputra, the Padma and the Teesta River Basins located at Mymensingh, Rajshahi and Rangpur districts, respectively. Another three floodplains were selected as control sites in the same river basins located near to the projects sites. The control sites were included in the economic study (Chapters 4 and 5) only. All the six floodplains belong to two types of ownership categories: public floodplains surrounded by private lands.

My thesis is broadly divided into a sociological and an economic part, mainly because of methodological differences. Chapter 2 and Chapter 3 discuss the institutional arrangements and the power and decision-making process of Community-Based Fish Culture management. Chapter 4 addresses the overall economic impact of technical and institutional arrangements of fish culture at both floodplain and household levels. We here employed a random effects model to estimate the impact of participation on fish income. Finally, in Chapter 5 the economic impact of community-based fish culture on expenditure inequality was measured at household level.

In the sociological part, three project floodplains covered the different institutional arrangements for managing the floodplains and maximizing their benefits to different classes of beneficiaries. Power relations between the various key actors or stakeholders were assessed who were directly or indirectly involved in the floodplain, and decision making processes in co-management practices were also studied at different institutional levels. 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 Floodplain Management Committees, villagers and institutional stakeholders to investigate the use of the

floodplain as a common property resource (CPR) and the processes of the formation of local institutions and organizations.

For the economic analysis of Chapter 4 and Chapter 5, three project floodplains and three control floodplains were selected for comparing the impact of the intervention at beneficiary level and also community level. Household survey data includes a baseline survey on socioeconomic information, three months monitoring on seasonal and monthly basis at community and household levels, as well as an assessment of the floodplains' natural resource systems. The seasonal survey covered the changes in input use for crop production, changes in quality of output from the agricultural land and the effects of the intervention on crop production. A monthly survey on the 1st and 15th day of the month was conducted to capture the household consumption pattern, especially the frequency and quantity of fish and meat consumption.

Chapter 2 improves our understanding of the complex institutional relationships governing Community-Based Fish Culture in seasonal floodplains in Bangladesh. 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. Institutional embedding of DoF through the Fishers Cooperatives (FMC) 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 to all classes of beneficiaries through income sharing derived from their involvement in the fisheries cooperatives and fish culture.

In case 2 and case 3 the floodplains under private ownership privately owned land is inundated during the monsoon season; these floodplains 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. FMCs normally allow these non-members to access the floodplains, but only to harvest un-stocked fish using local gears, considering the importance of fishing to their livelihood. 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 un-stocked 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 un-stocked fish as they can 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.

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

Generally, the rules and regulations that apply to public and privately owned floodplains are written down in a Memorandum of Understanding between DoF and the individual FMC's in a non-judicial construction. In their regular meetings the FMCs also document the everyday practices of the rules related to fish culture and management in the minutes that are distributed among its members. It appears that in the three cases, comparable rules and regulations for fish culture are applied to the public and to the private floodplains in operational rules, collective choice rule and constitutional rule.

Benefit sharing of the fish production from the floodplains was agreed at the start of project activities by all stakeholders, but their commitment varied between the classes of beneficiaries and across the cases. A significant increase of income for different stakeholders was derived from their involvement in fish culture. In the public floodplain fishers received around 40% of net income increase and the landowners received almost 38% of net income increase, as they had to pay the lease money for the floodplain. But in private floodplain all classes of stakeholders deposited around 25% of their net income in a revolving fund. The fishers group got their income from the final harvesting of fish as they received 50% of the price of the harvest of un-stocked fish and 10-15% of the stocked fish. The landowners received 45-50% of income according to their land. The landless seasonal fishers had open access to the non-stocked fish during the monsoon. Finally, the users of the public as well as the private floodplains contributed a small portion of their income to social work, like the building of a mosque or a Hindu temple.

Chapter 3 firstly assessed the power relations between the various key actors or stakeholders who were directly or indirectly involved in floodplain fisheries in the three sites. Secondly, their shifting power relations and decision making process in co-management practices were studied in the different institutional contexts of the three research sites during WorldFish project intervention. Instead of merely listing the institutions involved, we studied the actual power practices and decisions making processes between the stakeholders in the three cases to gain insight in the different governance models used in CBFC in Bangladesh. Existing co-management arrangements are characterized by unequal power distribution among the different actors, often

resulting in the marginalization of the professional fishers and the landless poor fishers. I differentiated between two types of power in the management of floodplain aquaculture and stakeholder involvement, namely a) the power to create rules and decision making procedures, and b) the power to resolve disputes and ensure compliance. The Floodplain Management Committee (FMC) reviews the rules and regulations formulated by the government to complement the vision and roles of the institution, and if there is a need, modify them. Rules and regulations governing access to the public and privately owned floodplains were developed by the Department of Fisheries (DoF) and the FMC. A similar set of rules and regulations was applied to the public and the privately owned floodplains for fish culture. Most of the rules were derived from the national fisheries law. The rules and regulations that were applied to the floodplain were written down in a Memorandum of Understanding between DoF and FMC. Examples are rules and regulations about membership, leadership, boundary and access, allocation, penalties, input, and conflict resolution that were enforced for the management of community based-fish culture.

Magistrate courts at local level in Bangladesh have the power to decide on penalties for offenders in case of violation of the Government Fisheries Act of 2010 (DoF 2013) in the management of fisheries and aquaculture including the floodplain; a range of penalties is stipulated in the Offences and Penalties paragraph of the Act. In addition, in the case of both public and private floodplains, leaders of customary organizations have the authority and power to confiscate illegal nets and penalize offenders by charging monetary fines.

Governance in the context of Community-Based Fish Culture (CBFC) management addresses the dominancy of the land-owning group, informal sets of norms and traditions, and the social network and power relationships between stakeholders. In the public floodplain governance processes resulting in the formation of a responsive, accountable leadership and representative membership appeared vital for the success of CBFC. But, the establishment of successful CBFCs in public floodplains demands continuous institutional support from agencies such as the Department of Fisheries, because an increase in production and income also increases the risk of elite capture, and the possibility of an exploitative. In the private floodplain, there was no specific governance system in place to manage access and use of the floodplains during the wet season, as opposed to the dry months when the lands of the floodplain could be used by individual households for crop production. Thanks to greater accountability of the leaders, and more equal representation of the different stakeholders including active leadership and a supporting role of DOF, leadership problems were few and easily solved. Downward accountability was well established in addition to many efforts by the project.

Chapter 4 examined the overall impact on households involved through the WorldFish project in community-based fish culture in seasonal floodplains, particularly with respect to fish production, consumption, and income generation. Qualitative as well as quantitative methods were deployed to examine the impact of Community-Based Fish Culture starting with a conceptual framework as to how positive impacts take effect. The overall fish production in the floodplains of the project appeared to have increased 274%. Due to project intervention introducing fish culture, 43% of the farmers used floodplain water to meet up irrigation needs instead of ground water and rice production increased by 18.9% for dry-season (Boro) rice and 28.9% for wet-season (Aman) rice in the project floodplain areas.

Increased income is an important economic incentive for the expansion of community-based fish culture in Bangladesh. Over that period, average income from fish production increased to USD 240 for all beneficiaries involved in the project, which is 237% higher than the income of beneficiaries in the control group. Results of the random effects model show that project-involved households significantly increased their fish income compared to the households of the control sites. Furthermore, total household income increased to about USD 175 per household for those who participated in the WorldFish project.

Fish availability increased in the project area from July to December. During these months approximately 68%-75% of the total fish consumption needs of the project beneficiaries could be fulfilled by the newly introduced fish culture in the floodplains. The consumption of nutritional food shows that per capita fish consumption of households in the project sites increased from 1.26 kg per capita per month in the baseline year to 2.31 kg per capita per month in 2009.

Apart from the direct effect on household income and food consumption, CBFC intervention also created the opportunity for employment, backward linkage, and access to market to sell harvested fish. Indirect benefits of the community based fish culture include reduced conflict; improved social capital and greater cooperation in the community.

Expenditure is a better measurement of welfare than income where most of the people are poor and struggle for food. In this study I therefore used data on expenditure instead of income. The results in Chapter 5 show that the CBFC project had a positive and significant impact on food expenditure, as well as on non-food (other basic needs) and overall total expenditure. The impact of CBFC on household expenditure and expenditure inequality was measured by using Propensity Score Matching (PSM) method and Gini decomposition. Results revealed that the overall average food expenditure per year per household (for panel estimation) increased due to participation in the CBFC project from USD 93 to USD 141. Project participants were able to spend significantly

more on food compared to non-participants. In addition, expenditure on food was increasing year by year. Moreover, participant households were capable to spend more compared to non-participants on non-food items like cloth, health, education, housing, transport etc. (from USD 45 to USD 74 per year). This non-food expenditure also gradually increased per year. Finally, total household expenditure of CBFC project participants was between USD 134 and USD 215 per year higher than the total expenditure of control households, which implies a better livelihood of the households involved in the project.

Gini index of total expenditure was found to be 0.34 and 0.40 for the CBFC project and control households respectively, which indicate that expenditure was equally distributed among households, but that it is more equally distributed among the CBFC households as compared to the control households. The expenditure inequality difference between the CBFC project and the control sites was 0.06, which implies that the CBFC management system helped to distribute total expenditure more equally among the surrounding communities.

Policy advice

For better management of the floodplain *beels*, the government may apply a similar policy for better utilization of the resources and for the economic benefits of the beneficiaries. Accountability, sustainable management of the floodplains, proper marketing of fish and equity in the distribution of benefits of the floodplains have proven to increase the productivity and ensure the accessibility of the poor and landless farmers, as long as elite capture is controlled.

Taking all CBFC project lessons into consideration, the Bangladesh government could indeed make some changes to their floodplain /wetland policy in order to accommodate the poor fishers and the landless poor. Policy (re)formulation may be needed for the dissemination of the CBO-based fish culture approach to scale-up its impact. In order to establish the rights of the CBOs (under the leadership of fishers) there is a need for modification of the policy of leasing of public floodplains. The major issues to be included are to bring private and public floodplains under CBO management; to secure government support for the registration of the CBOs and the strengthening of the institution; to guarantee that CBOs obtain long term (10-15 years or more) lease of the public areas of the floodplains as priority; to support small infrastructure constructions in the outlet and inlets of the floodplains; and to develop a functional model for the scaling-up (influencing policy) and scaling-out of the CBO fish culture approach in Bangladesh.

Future research

To assess the effectiveness of the scaling-up of the innovation in Community-Based Fish Culture in public and private floodplains, using a CBO to CBO approach will have to be developed with the support and facilitation from formal institutions. This will be considered as the subject of future research.

বাংলা সারসংক্ষেপ

মৌসূমী প্লাবনভূমি সেই সমস্ত জলাশয় যেখানে ৫-৬ মাস পানি থাকে যা মাছ ও অন্যান্য জলজপ্রাণী উৎপাদনের জন্য অত্যন্ত উপযোগী। এ ধরণের ২.৮ মিলিয়ন হেক্টর আয়তনের জলাশয়ের মধ্যম ও গভীরভাবে প্লাবিত জলাশয়ের মধ্যে ১.৫ মিলিয়ন হেক্টর জলাশয় সমাজভিত্তিক মৎস্য চাষের জন্য উপযোগী। ওয়ার্ল্ডফিশ ২০০৫-২০১০ সাল পযর্ন্ত পাঁচ বছর মেয়াদি একটি বহুমাত্রিক গবেষণা প্রকল্প পরিচালনা করেছিল যার সামগ্রিক উদ্দেশ্য ছিল মৌসূমী প্লাবনভূমির উৎপাদনশীলতা বৃদ্ধির মাধ্যমে দরিদ্র জনগোষ্ঠির জীবনমানের স্থায়িত্বশীল উন্নয়ন। একজন পিএইচডি স্কলার হিসেবে এ প্রকল্পে আমি ২০০৭-২০০৯ সাল পর্যন্ত সম্পৃক্ত থেকে এসব জলাশয়ের স্থায়িত্বশীল ব্যবহার নিশ্চিত করার মাধ্যমে সর্বোচ্চ ফলাফল প্রাপ্তির লক্ষ্যে সমাজভিত্তিক মৎস্যচাষ পরিচালনায় সংশ্লিষ্ট বিভিন্ন সংগঠনের ভূমিকা ও সামগ্রিক প্রভাব পর্যবেক্ষণ করি ।

কার্যকরী গবেষণা কার্যক্রম পরিচালনার জন্য মৎস্য অধিদপ্তর, বাংলাদেশ কৃষি গবেষণা কাউন্সিল ও মাৎস্য গবেষণা ইনষ্টিটিউটের যৌথ উদ্যোগে বাংলাদেশের বিভিন্ন এলাকায় ছয়টি প্লাবনভূমি নির্বাচন করা হয় । এ থিসিসের বিষয়বস্তু হলো নির্বাচিত তিনটি প্লাবনভূমি যথা ব্রক্ষ্মপুত্র, পদ্মা, ও তিস্তায় অ্যাকশন রিসার্চ পরিচালনা করা যেগুলো যথাক্রমে ময়মনসিংহ, রাজশাহী ও রংপুর জেলায় অবস্থিত। এক্ষেত্রে প্রকল্প এলাকায় অন্য আরো তিনটি প্লাবনভূমিকে কন্ট্রোল প্লাবনভূমি হিসেবে বিবেচনা করা হয়েছে। এ সকল প্লাবনভূমিগুলোর মালিকানা দুধরণের যথা- ব্যক্তিমালিকানাধীন এবং সরকারি প্লাবনভুমি যা ব্যক্তিগত জমি দ্বারা পরিবেষ্টিত।

পদ্ধতিগত কারণে আমার গবেষণা পত্রটির মূল দুটি অংশ রয়েছে যথা সামাজিক এবং অর্থনৈতিক। ২ এবং ৩ নং অধ্যায়ে সাংগঠনিক আয়োজন ও সমাজভিত্তিক মৎস্য চাষ ব্যবস্থাপনার সিদ্ধান্ত গ্রহণ প্রক্রিয়া বর্ণণা করা হয়েছে। অধ্যায় ৪ এ বসতবাড়ি ও প্লাবনভূমিতে মাছচাষের কারিগরী ও সাংগঠনিক প্রভাব সম্পর্কে আলোচনা করা হয়েছে। মাছের আয় সম্পর্কিত প্রভাব বিশ্লেষনের জন্য আমি এখানে র‍্যানডম ইফেক্ট মডেল অনুসরণ করেছি। সবশেষে অধ্যায় ৫ এ পরিবার পর্যায়ে সমাজভিত্তিক মৎস্যচাষের অর্থনৈতিক প্রভাব সম্পর্কে আলোচনা করা হয়েছে।

সামাজিক অংশে তিনটি প্রকল্পধীন প্লাবনভূমিই বিভিন্ন পর্যায়ে সুষ্ঠু ব্যবস্থাপনার মাধ্যমে প্লাবনভূমি থেকে অধিক লাভ অর্জন করার সাংগঠনিক বিষয়টি বর্ণণা করা হয়েছে। এক্ষেত্রে অংশগ্রহণকারীদের মধ্যকার সম্পর্ক নির্ধারণ করা হয়েছে যে কে কিভাবে (প্রত্যক্ষ বা পরোক্ষ) প্লাবনভূমির সাথে যুক্ত। সিদ্ধান্তগ্রহণ প্রক্রিয়া এবং সহ ব্যবস্থাপণা সম্পর্কিত বিষয়ও এখানে আলোচনা করা হয়েছে। প্লাবনভূমির ব্যবস্থাপনা সম্পর্কিত বিভিন্ন তথ্য সামাজিক গবেষণা পরিচালনা পদ্ধতি ও কৌশল যেমন ইন্টারভিউ, ফোকাস গ্রুপ ডিসকাশন, মূল তথ্যপ্রদানকারীর সাথে অআনুষ্ঠানিক আলোচনা, জরীপ ইত্যাদির মাধ্যমে সংগ্রহ করা হয়েছে।

অর্থনৈতিক বিশ্লেষণের জন্য প্রকল্পধীন তিনটি প্লাবনভূমি এবং প্রকল্পভূক্ত নয় এমন অন্য তিনটি প্লাবনভূমির সাথে তুলনা করা হয় যা অধ্যায় ৪ ও ৫ এ বর্নণা করা হয়েছে। আর্থ-সামাজিক বেসলাইন তথ্য হিসেবে পরিবার ভিত্তিক জরীপ তথ্য, পরিবারের তিন মাসের মনিটরিং তথ্য এবং প্লাবন ভূমির বিশ্লেষণ এখানে অর্ন্তভূক্ত করা হয়েছে। এই জরীপএর মাধ্যমে শস্য উৎপাদনের জন্য উপকরণের ব্যবহার, পরিবর্তন, কৃষি জমিতে উৎপাদিত পণ্যের গুণগতমান, এর প্রভাব ইত্যাদি বিষয়ে আলোকপাত করা হয়েছে। পরিবারের খাদ্যগ্রহণ এর ধরণ, পরিমাণ বিশেষ করে প্রতি মাসে কতবার মাছ খেয়েছে তা মাসিক জরীপ এর মাধ্যমে প্রতি মাসের ১ এবং ১৫ তারিখে সংগ্রহ করা হয়েছে।

অধ্যায় ২ এ বর্ণিত বাংলাদেশের মৌসূমী প্লাবনভুমিতে সমাজভিত্তিক মৎস্য চাষ প্রকল্প পরিচালনার জটিল সাংগঠনিক সম্পর্ক আমাদের বোধগম্যতা বৃদ্ধি করেছে। আনুষ্ঠানিক সংগঠনসমূহ যথা মৎস্য

অধিদপ্তর, ওর্য়ল্ডফিশ ও বাংলাদেশ কৃষি গবেষণা কাউন্সিল এ প্রকল্পের সফলতার জন্য মূল ভূমিকা পালন করেছে। মৎস্য অধিদপ্তর হলো সরকারি সংস্থা যেখানে প্রসাশনিক বিভিন্ন স্তর রয়েছে। মৎস্য অধিদপ্তরের সাংগঠনিক কার্যক্রম মৎস্য পেশাজীবিদের মাধ্যমে প্রয়োগ করা হয়েছে। প্লাবনভূমিতে সমাজভিত্তিক মৎস্যচাষ প্রকল্প সফলভাবে পরিচালনার মাধ্যমে ভূমিহীন দরিদ্র্য মৎস্যজীবিসহ বিশাল জনগোষ্ঠি যেমন মৎস্য চাষি, জমির মালিক উপকৃত হয়েছে। ফলাফল হিসেবে আমরা সকল স্তরের জনগোষ্ঠির আয়বৃদ্ধি, মৎস্য জীবিদের সম্পর্ক উন্নয়ন দেখতে পাই।

কেস ২ ও কেস ৩ এ আমি দেখেছি ব্যক্তিমালিকানাধীন প্লাবনভূমি যা বর্ষা মৌসুমে প্লাবিত থাকে। এসব প্লাবনভূমিসমূহ সমআকৃতির যার চারপাশে তুলনা করার জন্য উপকারভোগী এবং সমসংখ্যক গ্রাম রয়েছে। দেখা যায় যে বিভিন্ন শ্রেণীর মধ্যে ভূমিহীন মৎস্য পেশাজীবিদের চাইতে ভূমির মালিকরাই প্রকল্পের মাধ্যমে বেশি উপকৃত হয়। মৎসচাষি সমবায় সমিতি সদস্য নয় এমন চাষিদের জীবিকা নির্বাহের জন্য মাছ ধরার স্থানীয় সরজ্ঞাম ব্যবহার করে অচাষকৃত মাছ ধরতে অনুমতি দিয়ে থাকে। এর অর্থ হলো মৎস্য সমবায় সমিতি এধরণের চাষিদের ক্ষেত্রে শর্ত সাপেক্ষে অন্যদের থেকে বেশি সহানুভূতিশীল। মৎস্য সংরক্ষণ আইন ও নীতিমালা এভাবে নিশ্চিত হয়। পাশাপাশি আর্টিশেনাল গিয়ার ব্যবহার করার ফলে অমজুদকৃত মাছের প্রাপ্যতা বৃদ্ধি পায় যার ফলাফল হলো গরীব চাষিদের আয় ও আনুসংগিক সুযোগ সুবিধা বৃদ্ধি। প্লাবন ভূমিতে যারা জমি বা পুকুরের মালিক তাদের অমজুদকৃত মাছের উপর নির্ভর করতে হয় না বরং তারা শুষ্ক মৌসুমে নীচু জমিতে ধানের চাষ করে থাকে।

কেস ১ সরকারি প্লাবনভূমি সাধারণত ব্যক্তিমালিকানাধীন জমি দিয়ে বেষ্টিত থাকে। এসব সরকারি জলাশয়সহ ব্যাক্তিমালিকানাধীন জমি যেগুলো বিত্তশালী বা রাজনৈতিক প্রভাবশালীদের সাধারণত: মৎস্যজীবিদের কাছে লীজ দেয়া হয়। অন্য দুটি প্লাবনভূমির থেকে এটি বড়। কিন্তু উপকারভোগীদের মধ্যে মৎস্যজীবিদের সংখ্যা ভূমিহীন ও ভূমির মালিক উভয়ের থেকে বেশি।

সাধারণত সরকারি -বেসরকারি প্লাবনভূমিতে প্রয়োগ করার জন্য নীতিমালাগুলো মৎস্য অধিদপ্তর এবং মৎস্যজীবিদের মধ্যে একটি স্মারকলিপি করা হয়। মৎস্য জীবিদের নিয়মিত সভায় নীতিমালা সম্পর্কিত প্রতিদিনের কর্মকান্ড লিপিবদ্ধ করে সদস্যদের মধ্যে বিতরণ করা হয়। দেখা গেছে যে তিনটি ক্ষেত্রেই কর্মকান্ড পরিচালনা নীতিমালা, সমবায় নীতিমালা এবং সাংগঠনিক নিয়ম সম্পর্কিত নীতিমালা প্রয়োগ করা হয়েছে।

অংশগ্রহণকারীদের মাঝে প্লাবনভূমিতে উৎপাদিত মাছের লভ্যাংশ বন্টন বিষয়ে প্রকল্প কর্মকান্ডের শুরুতেই সিদ্ধান্ত নেয়া হয়। বিভিন্ন শ্রেণীর ক্ষেত্রে এর তারতম্য হতে পারে যা তাদের সম্পৃক্ত থাকার উপর নির্ভর করেছে। সরকারি প্লাবন ভূমি থেকে মৎস্যজীবিরা মোট আয়ের ৪০% এবং জমির মালিকগণ পেয়েছে ৩৮ % যেহেতু তাদের লীজ নেয়ার জন্য ব্যয় হয়েছে। কিন্তু ব্যাক্তিমালিকানাধীন প্লাবনভূমির ক্ষেত্রে সকলেই আয়ের ২৫% ঘূর্নায়মান তহবিল রিভলভিং ফান্ড হিসেবে জমা করেছে। মৎস্যজীবিরা অচাষকৃত মাছের সর্বশেষ আহরণের ৫০% এবং চাষকৃত মাছের ১০-১৫% আয় পেয়ে থাকে। জমির মালিকগণ জমির পরিমাণ অনুযায়ি ৪০-৫০% আয় পেয়েছে। ভূমিহীন মৎস্যজীবিদের অচাষকৃত মাছ ধরার ক্ষেত্রে সম্পূর্ণ অধিকার রয়েছে। এছাড়া সকলেই সমাজসেবামূলক কিছু কাজ যেমন মসজিদ বা মন্দির নির্মান বা সংস্কার এর জন্য আয়ের সামান্য অংশ খরচ করেছে।

অধ্যায় ৩ এ তিনটি প্লাবণভূমিরই প্রত্যক্ষ বা পরোক্ষভাবে জড়িত বিভিন্ন ধরণের উপকারভোগীদের ক্ষমতায়ন সম্পর্কে বর্ণনা করা হয়েছে। দ্বিতীয়ত, বিভিন্ন সংগঠনিক বিবেচনায় কো- ম্যানেজমেন্ট সম্পর্কিত বিষয়ে তাদের ক্ষমতা স্থানান্তর, সিদ্ধান্তগ্রহণ প্রক্রিয়া ইত্যাদি বিষয়ে স্টাডি করা হয়েছে। সাংগঠনিক সম্পৃক্ততার তালিকা করা থেকেও আমি বাংলাদেশের সিবিএফসির পাওয়ার প্রাকটিস বা স্টেকহোল্ডারদের বিভিন্ন গর্ভনেন্স মডেলের অভ্যন্তরীন সিদ্ধান্ত গ্রহণ প্রক্রিয়া স্টাডি করেছি। বর্তমান

কো ম্যানেজমেন্ট বিভিন্ন এক্টরদের অসম অংশগ্রহণ বিশিষ্ট, যার ফলাফল হলো পেশাজীবি মৎস্যজীবি ও ভূমিহীনদের প্রান্তিক করে তোলা। প্লাবনভূমি ব্যবস্থাপনার সংগে সম্পৃক্ত দুধরনের পাওয়ার চিহ্নিত করেছি ক) নীতিমালা ও সিদ্ধান্ত গ্রহণ প্রক্রিয়া সম্পর্কিত খ) দ্বন্দ নিরসণ ও ঐক্যমত নিশ্চিতকরণ সম্পর্কিত। প্লাবণভূমি ব্যবস্থাপণা কমিটি সরকারি নীতিমালা পর্যালোচনা করে প্রয়োজন অনুযায়ি সংস্কার করেছে। মৎস্য অধিদপ্তর ও প্লাবনভূমি ব্যবস্থাপণা কমিটি সরকারি ও বেসরকারি প্লাবনভূমির জন্য নীতিমালা তৈরি করেছে। প্রতিটি নীতিমালাই মৎস্য আইন অনুসরণ করে করা হয়েছে। প্লাবণভূমিতে যেসব নীতিমালা প্রয়োগ করা হয়েছে তাব জন্য মৎস্য অধিদপ্তর ও প্লাবনভূমি ব্যবস্থাপনা কমিটির মধ্যে একটি সমঝোতা স্মারকলিপি তৈরি করা হয়েছে। উদাহরণস্বরূপ, সদস্যপদ, নেতৃত্ব, সীমানা ও অধিকার, বরাদ্দ, জরিমানা, উপকরণ, দ্বন্দ নিরসন সম্পর্কিত বিষয়সমূহ সমাজভিত্তিক মৎস্যচাষ ব্যবস্থাপনায় নিশ্চিত করা হয়েছে।

প্লাবনভূমিতে সরকারি মাৎস্য আইন ২০১০ অবমাননার জন্য ম্যাজিস্ট্রেট জরিমানা নির্ধারণ করতে পারে। এধরণের আইনের অনেকগুলো সাজা রয়েছে। পাশাপাশি সরকারি বা বেসরকারি উভয় ক্ষেত্রেই প্রয়োগকারি সংস্থা অবৈধ জাল ব্যবহারকারীদের আর্থিক দন্ডে দন্ডিত করতে পারেন।

সমাজভিত্তিক মৎস্য চাষ প্রেক্ষাপটে সুশাসন ব্যবস্থাপনায় সরকার যে বিষয়গুলো বিবেচনা করেছে তা হলো ভূমিমালিকদের প্রকটতা (ডমিন্যান্সি), অনানুষ্ঠানিক নীতিমালা ও ঐতিহ্য এবং স্টেকহোল্ডারদের সামাজিক ও ক্ষমতার সম্পর্ক। সরকারি প্লাবনভূমির সমাজভিত্তিক মৎস্যচাষ এর সফলতা সুশাসন প্রক্রিয়ায় অর্জিত দায়িত্বশীল নেতৃত্ব ও অংশগ্রহণেরই ফলাফল। ব্যাক্তি মালিকানাধীন প্লাবনভূমি ব্যবহার সম্পর্কিত ব্যবস্থাপনা বিষয়ে এ ধরণের সুশাসন নেই। ফলে তারা শুস্ক মৌসূমে তা শস্য উৎপাদনের জন্য ব্যবহার করতে পারে। সমস্যা সমাধানে স্থানীয় নেতৃবর্গ ও মৎস্য অধিদপ্তরের সহযোগী ভূমিকা পালন ধন্যবাদ পাবার দাবী রেখেছে।

অধ্যায় ৪ এ ওয়ার্ল্ডফিশ পরিচালিত প্রকল্পের মাধ্যমে মৌসুমী প্লাবনভূমিতে সমাজভিত্তিক মৎস্যচাষ করার ফলে সংশ্লিষ্ট পরিবারের উপর মাছের উৎপাদন, ভক্ষন বা আয়বৃদ্ধিতে কী ধরনের প্রভাব পড়েছে তা পরীক্ষা করা হয়েছে । এক্ষেত্রে সমাজভিত্তিক মৎস্যচাষ কীভাবে পজেটিভ প্রভাব ফেলেছে তা গুণগত ও পরিমাণগত উভয় পদ্ধতিতেই বিশ্লেষণ করা হয়েছে। প্রকল্পের কারণে প্লাবনভূমিতে মাছের উৎপাদন ২৭৪%বেড়েছে, পাশাপাশি ৪৩% চাষি সেচকার্যের জন্য ভূগর্ভস্থ পানি ব্যবহার না করে প্লাবনভূমির পানি ব্যবহার করেছে ফলে এখানে বোরো ধানের উৎপাদন বেড়েছে ১৮.৯% এবং আমন ধানের উৎপাদন বেড়েছে ২৮.৯% ।

আয় বৃদ্ধি সমাজভিত্তিক মৎস্যচাষের একটি গুরুত্বপূর্ণ অর্জন। সমসাময়িক কালে মাছচাষের ফলে প্রকল্পের সকল সদস্যের আয় ২৪০ ডলার বৃদ্ধি পেয়েছিল যা কন্ট্রোল গ্রুপের সদস্যদের থেকে ২৩৭% বেশি। র‍্যানডম ইফেক্ট মডেল এর ফলাফল প্রকল্পের সদস্যদের আয় কন্ট্রোল সদস্যদের থেকে বেশি তা প্রদর্শণ করে। অধিকন্তু ওয়ার্ল্ডফিস প্রকল্পের সাথে সম্পৃক্ত পরিবারের সর্বমোট আয় ১৭৫ ইউএস ডলার বেড়েছে।

প্রকল্প এলাকায় জুলাই থেকে ডিসেম্বর পর্যন্ত মাছের সরবরাহ বেড়েছে। প্লবনভূমিতে মাছ চাষের মাধ্যমে প্রকল্প সদস্যদের মাছের চাহিদা ৬৮-৭৫% পূরণ করা সম্ভব হয়েছে। ২০০৯ সালে নেয়া তথ্য অনুযায়ি প্রকল্প এলাকার চাষি পরিবারের মাথাপিছু মাছ খাওয়ার পরিমাণ প্রতিমাসে ১.২৬ কেজি থেকে বেড়ে ২.৩১ কেজি হয়েছে।

পরিবারের আয় ও খাওয়ার পরিমাণ বৃদ্ধি ছাড়াও এ ধরণের কর্মকান্ডের ফলে এলাকায় কর্মসংস্থান, বাজার ব্যবস্থাপনার উন্নয়ন ঘটেছে। পরোক্ষভাবে এর ফলে দ্বন্দ নিরসন, জনগণের মধ্যে সহযোগীতাপূর্ণ মনোভাব এবং সামাজিক পূঁজির উন্নয়ন হয়েছে।

যেখানে জনগণ খাদ্যের জন্য প্রতিযোগিতা করে সেখানে দরিদ্র জনগোষ্টির জীবনযাত্রার ব্যয় এর ধরণ আয় এর থেকেও ভালো নির্দেশনা দেয় । ফলে এ গবেষণায় আমি আয় এর তথ্য ব্যবহার না করে ব্যয় এর তথ্য সংগ্রহ ও ব্যবহার করেছি । সমাজভিত্তিক মৎস্য চাষ প্রকল্পের সুফলভোগীদের খাদ্য সংক্রান্ত ব্যয়সহ ও যাবতীয় ব্যয় এর গুরুত্বপূর্ণ প্রভাব অধ্যায় ৫এ বর্নিত হয়েছে । পিএসএম পদ্ধতি ও গিনি অনুপাত পদ্ধতির মাধ্যমে ব্যয় সংক্রান্ত বিশ্লেষণ করা হয়েছে । ফলাফলে দেখা গেছে এ প্রকল্পে যোগদানের ফলে সুফলভোগীদের আয় পরিবার পিছু ৯৩ মার্কিন ডলার থেকে বৃদ্ধি পেয়ে ১৪১ মার্কিন ডলারে পরিণত হয়েছে । প্রকল্পের সদস্যগণ খাদ্যের জন্য অন্যদের থেকে তুলনামূলকভাবে বেশি ব্যয় করতে সক্ষম হয়েছে । অধিকন্ত খাদ্য ছাড়াও অন্যন্য উপকরণ যেমন পরিধেয় কাপড়, চিকিৎসা, শিক্ষা, গৃহ নির্মান ও ভ্রমণ ইত্যাদি বাবদও তারা বেশি ব্যয় করতে সক্ষম হয়েছে (৪৫ মার্কিন ডলার থেকে ৭৪ মার্কিন ডলার) । প্রতি বছরই এর পরিমাণ বাড়ছে । সামগ্রীকভাবে প্রকল্পের সদস্যদের পরিবার প্রতি ব্যয় ১৩৪-২১৫ মার্কিন ডলার যা সদস্য নয় এমন পরিবারগুলো থেকে বেশি । এটি সদস্য পরিবারগুলোর জীবনযাত্রার মান ভালো তা নির্দেশ করে ।

গিনি ইনডেক্স অনুসারে প্রকল্প সদস্য এবং সদস্য নয় এমন পরিবারের সামগ্রীক ব্যয় যথাক্রমে ০.৩৪ এবং ০.৪০, যার অর্থ হলো অসদস্য দের চেয়ে সদস্যদের মধ্যে ব্যয়সমূহ অধিকসমভাবে বন্টিত করা হয়েছে । এর ব্যবধান হলো ০.০৬ । অর্থ্যাৎ সমাজভিত্তিক মৎস্যচাষ প্রকল্প ব্যবস্থাপনা কমিটি সুফলভোগীদের মধ্যে সামগ্রীক ব্যয় সমভাবে বরাদ্দ করেছে ।

পলিসি পরামর্শ

প্লাবনভূমির স্থায়িত্বশীল ব্যবস্থাপনা, উৎপাদিত মাছের সুষ্ঠু বিপনন, সুফলভোগীদের মাঝে এর লভ্যাংশের সুষম বন্টন অধিক উৎপাদনশীলতা এবং সম্পদের উপর দরিদ্র জনগোষ্ঠির অধিকার নিশ্চিত করে যা দীর্ঘদিন যাবৎ ধনীদের দ্বারা অনুসাশিত হচ্ছিল । প্লাবনভূমি, বিল ইত্যাদির সুব্যবস্থাপনার জন্য সরকার বাস্তবায়িত প্রকল্পের পলিসি প্রয়োগ করতে পারে এতে সম্পদের সুষ্ঠু ব্যবহার ও সুফলভোগীদের অর্থনৈতিক সুবিধা বেশি নিশ্চিত হবে ।

সমাজভিত্তিক মৎস্য চাষ প্রকল্পের সকল শিক্ষনগুলো বিবেচনায় নিয়ে সরকার জেলে সম্প্রদায় বা ভূমিহীনদের জন্য প্লাবনভূমি বা জলমহাল ব্যবস্থাপনার নীতি নির্ধারণ করতে পারে । প্রকল্পের অর্জনসমূহ বাস্তবায়নের জন্য সমাজভিত্তিক সংগঠনসমূহের নীতি নির্ধারণ বা পূর্নগঠন করা যেতে পারে । যে সব প্লাবনভূমি ব্যাক্তিমালিকানাধীন সেগুলো যাতে স্থানীয় দরিদ্র জনগণের অধিকারে আসে সে ব্যাপারে নীতিনির্ধারণী হতে পারে । সিবিও রেজিস্ট্রেশনের জন্য এবং এদের মান উন্নয়নের জন্য সরকারি সহায়তা নিশ্চিত করতে হবে; সরকারি প্লাবনভূমির দীর্ঘমেয়াদি লীজ প্রদান বিষয়ে প্রধান্য দিতে হবে । প্লাবনভূমির অবকাঠামোগত উন্নয়নের ব্যবস্থা থাকতে হবে । সরকারি-বেসরকারি প্লাবনভূমিগুলো সিবিও ব্যবস্থাপনার অধীনে আনার জন্য পলিসিতে আদর্শ রূপরেখা সংযুক্ত হতে পারে যা সরকারি নিবন্ধন সুনিশ্চিত করবে, দীর্ঘদিন (১০-১৫ বছর) লীজ নেয়ার ব্যাপারে নিশ্চয়তা থাকবে, প্লাবন ভূমির ইনলেট-আউটলেট অবকাঠামো তৈরির ব্যাপারেও সম্মতি থাকবে, সিবিওগুলো সংযোজন বা বাদ দেয়ার ব্যাপারে একটি কার্যকরী নিয়মাবলী তৈরি করতে হবে ।

ভবিষ্যত গবেষণা

সরকারি ও বেসরকারি প্লাবনভূমিতে ব্যাপকভাবে সমাজভিত্তিক মাছচাষ প্রকল্পের প্রসারের জন্য সিবিওর মাধ্যমে সিবিও এপ্রোচ উদ্ভাবন এবং প্রাতিষ্ঠানিক সংগঠনসমূহের সম্পৃক্ততা ও সহযোগিতার ফলপ্রসূতা যাচাই ভবিষ্যত গবেষণার বিষয় হিসেবে বিবেচনা করা যেতে পারে ।

Samenvatting

Seizoensafhankelijke vloedvlakten staan 5-6 maanden per jaar onder water. Gedurende die tijd kunnen er vis en andere in het water levende dieren worden geteeld. In Bangladesh is naar schatting 1,5 miljoen ha van de in totaal 2,8 miljoen ha die deels of geheel onder water komen te staan in de natte tijd beschikt voor lokaal beheerde visteelt (community based fish culture of CBFC). WorldFish heeft van 2005 tot 2010 een interdisciplinair actie-onderzoeksproject uitgevoerd, met als doel de productiviteitsverhoging van periodiek onder water staande vloedvlakten ten behoeve van de duurzame verbetering van de levens omstandigheden van de armen.

Ik was als PhD van 2007 tot 2009 bij dit project betrokken om de verschillende ingewikkelde institutionele arrangementen te bestuderen en de invloed van het beheer van lokale visteelt op de vloedvlakten voor het duurzaam gebruik ervan en inkomstmaximalisering van de opbrengst voor de doelgroep.

In het actie-onderzoek waren zes seizoensgebonden vloedvlakten geselecteerd door het Ministerie van Visserij in samenwerking met de Raad voor Landbouwkundig Onderzoek van Bangladesh. Voor het onderzoek waarover deze dissertatie handelt zijn hieruit drie vloedvlakten gekozen, respectievelijk in de Brahamaputra, Padma en Teesta stroomgebieden, gelegen in de districten Mymensingh, Rajshani en Rangpur. Drie andere vloedvlakten in dezelfde stroomgebieden, dichtbij de onderzoek plaatsen, dienden als controle gebieden. Gegevens van deze controle gebieden zijn alleen opgenomen in de economische hoofdstukken (Hfst. 4 en 5). Alle zes vloedvlakten vallen onder twee typen eigendomsrecht: publiek en privaat.

Het proefschrift is onderverdeeld in een sociologisch en een economisch deel, voornamelijk vanwege methodologische verschillen. De Hoofdstukken 2 en 3 bespreken de institutionele arrangementen en de machts- en besluitvormingsprocessen in het lokaal beheer van de visteelt (CBFC). Hoofdstuk 4 behandelt de algehele economische invloed van de technische en institutionele organisatie van visteelt, zowel op het niveau van de vloedvlakte als geheel als wel op het niveau van de huishoudens.

In het sociologische gedeelte geven de drie vloedvlakten de verschillende institutionele vormen weer die het management en maximalisering van de voordelen ervan brengen voor de verschillende klassen van begunstigden. Machtsrelaties tussen de diverse sleutelfiguren als stakeholders die direct of indirect bij de vloedvlakten betrokken waren, werden onderzocht terwijl tevens de besluitvormingsprocessen in de uitvoering van het co-management op verschillende institutionele niveaus werden bestudeerd. Hierbij werden sociologische onderzoeksmethoden toegepast, zoals half gestructureerde interviews, Focus Group Discussies, informele gesprekken met sleutelinformaten. Kwantitatieve surveys werden gebruikt om gegevens te verzamelen van Floodplain

Management Comités, dorpelingen en institutionele stakeholders om het gebruik van de vloedvlakte als CPR te onderzoeken, alsmede de wijze waarop lokale instituten en organisaties werden gevormd.

Voor de economische analyse van de Hoofdstukken 4 en 5 werden de drie vloedvlakten in het project en de drie controle gebieden vergeleken wat betreft de invloed van de project interventie op het niveau van de individuele huishoudens en van de gemeenschappen als geheel. De huishoudsurvey omvat een basis studie met sociaaleconomische informatie, een driemaandelijkse monitoring van praktijken op gemeenschaps- en huishoudniveaus, zowel als een bepaling van de natuurlijke hulpbronnen van de vloedvlakten. De seizoensurvey omvatte veranderingen in input voor de productie van landbouwgewassen (wanneer de vloedvlakte niet onder water staat), veranderingen in de kwaliteit van de opbrengst van de landbouwgrond en de effecten van projectinterventie op gewasproductie. Tenslotte werd een maandelijkse survey gedaan op de 1e en 15de dag van de maand om greep te krijgen op het consumptiepatroon van huishoudens, speciaal met het oog op de frequentie en kwantiteit van vis en vlees consumptie.

Hoofdstuk 2 geeft ons meer inzicht in het complexe geheel van institutionele verbanden in het beheer van lokale visteelt in de seizoensafhankelijke vloedvlakten van Bangladesh. Formele institutionele relaties tussen het Ministerie van Visserij, het WorldFish centrum in Dhaka en de Raad voor Landbouwkundig Onderzoek van Bangladesh (BARC) speelden een sleutelrol in het succesvol verloop van het project. Het departement van Visserij heeft vestigingen op verschillende administratieve niveaus. Institutionele inbedding van het departement door vissers coöperaties (FMC) bleek bijzonder behulpzaam te zijn in het bereiken van de doelgroep. Grote aantallen mensen, inclusief landloze arme seizoenvissers, professionele vissers die tevens land bezitten en grootgrondbezitters – die zelf niet vissen – hadden baat bij de succesvolle invoering van lokale visteelt activiteiten in de vloedvlakten. Het onderzoek wijst uit (zie ook Hfst. 4 en 5) dat er een significante inkomensverbetering heeft plaatsgehad bij alle klassen van begunstigden als gevolg van inkomensdeling door hun betrokkenheid bij de vissers coöperaties en visteelt.

In de tweede en derde case komt privé land onder water te staan in het natte seizoen; deze vloedvlakten zijn vergelijkbaar in grootte, met een vergelijkbaar percentage begunstigden en dito aantal dorpsgemeenschappen aan de rand van de vloedvlakten. In deze gevallen hebben de land bezittende klassen meer profijt van de visteelt dan de landloze seizoenvissers. Vissers coöperaties staan meestal de seizoenvissers – die geen lid zijn – toe om in de vloedvlakten te vissen omdat zij van visserij moeten leven, maar zij mogen alleen niet gekweekte vis vangen, met lokale

technieken. Dit betekent, dat het CPR karakter van het management van de coöperaties enigszins 'poreus' is met betrekking tot de landloze vissers die geen lid zijn, maar wel onder strikte ruimtelijke, tijdelijke en technische voorwaarden. Regulering en bescherming lijken de beschikbaarheid van niet-gekweekte vis in de vloedvlakten positief te beïnvloeden, wat resulteert in hogere verdiensten en bijkomende voordelen voor de armere huishoudens. Huishoudens die land of slootjes bezitten in de vloedvlakte zijn niet afhankelijk van niet-gekweekte vis omdat zij in hun vijvers geteelde vis kunnen vangen en er tevens 'wilde' vis kunnen oogsten. Bovendien kunnen zij in het droge seizoen gewassen telen op de lager liggende gronden.

De eerste case van een publieke vloedvlakte omringt door privé land verschilt aanzienlijk van de privé vloedvlakten. Hier wordt het publieke land gedurende het natte seizoen verpacht aan vissers, inclusief de privé gronden die het eigendom zijn van een rijke en politiek invloedrijke dorpselite. Deze vloedvlakte is groter dan beide andere, maar zowel het percentage landloze vissers als dat van de grondbezitters is lager, zodat de klasse van de land bezittende professionele vissers de meerderheid vormt onder de begunstigden.

In het algemeen worden de regels en bepalingen betreffende publieke en private vloedvlakten vastgelegd in een MoU tussen het Ministerie van Visserij en de individuele vissers coöperaties (FMC). Tijdens hun vergaderingen notuleren de coöperaties ook de dagelijkse praktijk van de regels die betrekking hebben op de visteelt en het beheer, en deze worden gedistribueerd onder de leden. Het blijkt dat operationele regels, gemeenschappelijke besluitvorming en constitutionele regels niet aanmerkelijk verschillen tussen publieke en private vloedvlakten.

Bij het begin van het project was het principe van befenit sharing uit visproductie in de vloedvlakten door alle stakeholders aanvaard, maar de mate waarin ze hier gehoor aan gaven verschilde tussen de klassen en per case. Er was er een belangrijke toename in inkomen voor de verschillende klassen stakeholders door hun deelname in de visteelt. In de publieke vloedvlakte (case 1) zagen de vissers hun netto inkomen groeien met ca. 40% en de grondbezitters met 38%, aangezien zij het departement de pacht moesten betalen voor de vloedvlakte. In de private vloedvlakten (cases 2 en 3) poneerden alle stakeholders ongeveer 25% van hun netto inkomsten in een gezamenlijk fonds. De vissers verdienden met de laatste visoogst 50% van de prijs van de niet-geteelde vis en 10% - 15% van de geteelde vis. De grondbezitters ontvingen 45%-50% van hun inkomsten, afhankelijk van het landareaal. De landloze vissers hadden vrije toegang tot de niet-geteelde vis in de vloedvlakte gedurende de natte moesson. Tenslotte droeg iedereen, zowel in de private als in de publieke vloedvlakte, een klein deel van hun inkomsten bij aan sociale doelen, zoals de collectieve bouw van een moskee of een Hindu tempel.

Hoofdstuk 3 gaat primair om de machtsrelaties tussen de diverse sleutelfiguren of stakeholders die direct of indirect betrokken waren bij de visserij in de vloedvlakten in de drie onderzoek locaties. Verder gaat het vooral om de verschuivingen in machtsrelaties en besluitvormingsprocessen in de co-management praktijk die in de drie verschillende institutionele contexten van de onderzoeksgebieden werden bestudeerd gedurende de interventie van WorldFish. Wij hebben meer willen doen dan het louter benoemen van de instituties door de feitelijke machtsprocessen en besluitvorming tussen de stakeholders in de drie cases te bestuderen, teneinde inzicht te krijgen in de werking van de verschillende visteelt modellen in Bangladesh. Bestaande co-management structuren zijn namelijk gekenmerkt door ongelijke machtshoudingen tussen de verschillende actoren, wat vaak resulteert in de marginalisering van professionele vissers en arme, landloze vissers en dit project beoogde een gelijker machtsverdeling. Ik heb onderscheid gemaakt tussen twee typen macht in mijn studie van de aquacultuur en de betrokkenheid van stakeholders in de vloedvlakten, namelijk a) de macht om regels en besluitvormingsprocedures te formuleren en b) de macht om geschillen op te lossen en instemming te bereiken. Het Management Comité van de vloedvlakte (FMC) bekijkt de regels en bepalingen van de overheid (het departement van Visserij) en brengt deze zo nodig in overeenstemming met de visie en rol van de FMC. Dit betreft toegangsregels tot de vloedvlakte, maar ook regels voor de visteelt in publieke en private vloedvlakten. De meeste van deze regels zijn afgeleid van de nationale visserijwet. Degene die werden toegepast op de vloedvlakten zijn vastgelegd in een overeenkomst (MoU) tussen het departement en het comité, zoals bijvoorbeeld regels en bepalingen over lidmaatschap, leiderschap, grenzen en toegang, strafmaatregelen en conflictbeslechting.

In Bangladesh hebben politierechters op lokaal niveau beslissings- bevoegdheid om overtreders van de Nationale Visserij Wet van 2010 (D0F 2013) te beboeten wat betreft het beheer van visserij en aquacultuur, inclusief de vloedvlakten. Daarnaast hebben de leiders van inheemse organisaties op lokaal niveau het gezag en de macht om in de publieke zowel als de private vloedvlakten illegaal gebruikte netten te confisqueren en overtreders van de wet geldboetes op te leggen.

Mijn onderzoek naar de governance van lokaal beheerde visteelt richt zich op de dominantie van de grondbezitters, de informele normen en het sociale netwerk en de machtsrelaties tussen de stakeholders. In de publieke vloedvlakte (case 1) resulteerden beheer afspraken in verantwoordelijk leiderschap en een vertegenwoordiging van leden die bepalend bleken te zijn voor het succes van het lokaal beheer van aquacultuur (CBFC). Maar het succesvol inrichten van CBFC in de publieke vloedvlakte vereiste wel de continue institutionele steun van instellingen zoals het Ministerie van Visserij, omdat verhoging van productie en inkomen tevens het risico van elite capture met zich brengt.

In de private vloedvlakten (case 2 en 3) was geen bepaalde beheerstructuur voor de toegang en het gebruik ervan in de natte tijd, in tegenstelling tot de droge tijd wanneer individuele huishoudens het land gebruiken om gewassen te verbouwen. Ondersteuning door Visserij zorgde voor meer verantwoording van de leiders en een evenrediger vertegenwoordiging van de stakeholders, waardoor er minder leiderschapsproblemen waren en deze sneller konden worden opgelost.

Hoofdstuk 4 behandelt de invloed van CBFC op de huishoudens die in het WorldFish project zaten, vooral wat betreft vis productie, consumptie en inkomensvorming. Zowel kwalitatieve als kwantitatieve methoden werden gebruikt om na te gaan welke positieve invloeden er waren. De algehele visproductie ging 274% omhoog. Door de projectinterventie middels visteelt konden 43% van de omliggende boeren de vloedvlakte gebruiken voor hun waterbehoefte door irrigatie in plaats van grondwater te gebruiken, wat de rijstproductie in de vloedvlakten in het droge seizoen (Boro rijst) met 18,9% deed stijgen en in het natte seizoen (Aman rijst)
met 28,9%.

Een beter inkomen is een belangrijke stimulans voor de uitbreiding van lokaal beheerde visteelt in Bangladesh. Gedurende het project steeg het gemiddelde inkomen uit visproductie tot $240 voor alle betrokkenen, wat 237% hoger is dan het inkomen van de controle groep. De resultaten van de toepassing van het random effect model tonen aan dat de huishoudens in het project hun inkomen uit vis aanzienlijk konden verhogen in vergelijking met die in de controle gebieden. Tenslotte steeg het totale inkomen van de huishoudens die in het WorldFish project deelnamen tot $175 per huishouden.

Van juli tot december kwam er ook meer vis ter beschikking in het projectgebied. Gedurende deze maanden kon ongeveer 68%-75% van de behoefte aan vis voor consumptie worden gedekt door de nieuw geïntroduceerde visteelt in de vloedvlakten. Voedselconsumptie statistieken laten zien dat de per capita visconsumptie in de projectgebieden is toegenomen van 1,26 kg per capita per maand in het startjaar tot 2,31 kg per capita per maand in 2009.

Naast het directe effect op inkomen en voedselconsumptie per huishouden, heeft het CBFC project ook werkgelegenheid geschapen en toegang tot de markt om vis te verkopen. Als indirect effect hebben we gezien dat er minder conflicten waren en dat sociale relaties en coöperatie versterkt werden in de gemeenschap.

Het uitgavenpatroon is eigenlijk een betere maat voor welvaart dan inkomen, zeker daar waar de mensen arm zijn en moeite moeten doen om aan voedsel te komen. Daarom heb ik in deze studie data verzameld over het uitgavenpatroon. De resultaten van Hoofdstuk 5 laten zien dat het CBFC project een significante invloed had op uitgaven voor voedsel, voor andere basisbehoeften, en voor het algemene uitgavenpatroon.

Project invloed op uitgaven en op de ongelijkheid van uitgavenpatronen werd gemeten door middel van Propensity Score Matching (PSM) en Gini indexen. De uitkomsten laten zien dat de geschatte voedseluitgaven per jaar per huishouden (per panel) toenamen van $93 tot $141. Projectdeelnemers konden duidelijk meer besteden aan voedsel dan de huishoudens die niet deelnamen. Daarbij namen de uitgaven aan voedsel ieder jaar toe. Bovendien konden participerende huishoudens meer besteden dan niet-participanten aan andere uitgaven dan voedsel, zoals kleding, gezondheidszorg, onderwijs, behuizing, transport, etc., namelijk $45 - $74 per jaar meer dan de totale uitgaven van de controle groep. Met andere woorden, de levensomstandigheden van de huishoudens in het project waren beter.

De Gini index voor het project was 0,34 en die van de controle groep 0,40 wat betekent dat de hoogte van de uitgaven min of meer gelijk was tussen de huishoudens, maar dat de verdeling tussen de klassen meer gelijkmatig was onder de huishoudens in het visteelt project dan de controle groep erbuiten. De ongelijkheid in uitgaven tussen het CBFC project en de controle gebieden houdt in dat de introductie van het lokaal beheerssysteem ertoe heeft bijgedragen dat de totale uitgaven meer gelijkelijk werden verdeeld over de omliggende gemeenschappen van de vloedvlakten.

Beleidsadviezen

Om een beter beheer van de beels in de vloedvlakten te bewerkstelligen, kan de overheid een vergelijkbaar beleid voeren voor een meer duurzaam gebruik van de natuurlijke hulpbronnen en voor de economische voordelen voor de doelgroepen. Een betere verantwoording, een duurzaam gebruik van de vloedvlakten, juiste vermarkting van de vis en gelijkheid in de verdeling van de voordelen van het beheer van de vloedvlakten leiden duidelijk tot verhoogde productiviteit en verzekerde toegang tot de bronnen voor de armen en landlozen, zolang elite capture wordt beteugeld.

Wanneer de overheid van Bangladesh alle lessen uit dit project ter harte neemt, is het inderdaad mogelijk om het beleid voor de vloedvlakten en natte gronden zodanig te wijzigen, dat arme vissers en landloze boeren er baat bij hebben. Beleids(her)formulering zal ook nodig zijn voor de verdere verspreiding van de benadering van lokaal beheerde visteelt en zodoende de invloed ervan te vergroten. Om de rechten te verzekeren van lokale organisaties (CBOs) onder leiding van vissers, is het nodig dat het beleid van verpachting van vloedvlakten wordt verbeterd. Met name door publieke en private vloedvlakten onder CBO beheer te brengen, overheidssteun voor hun formele registratie als CBO te verzekeren en zo de institutie te versterken, de garantie te geven - met prioriteit - dat CBOs een lange termijn contract (10-15 jaar) verkrijgen voor het pachten van de publieke ruimte van de vloedvlakten; door kleinschalige infrastructurele werken uit te voeren in de toegangspunten en uitgang van het water van de vloedvlakten; en

door een functioneel model te ontwikkelen voor opschaling (wat beleidsconsequenties heeft) en de verdere verspreiding (scaling-out) van lokaal beheerde visteelt in Bangladesh.

Toekomstig onderzoek

Er zal een benadering moeten worden ontwikkeld om de effectiviteit van de opschaling van CBFC in publieke en private vloedvlakten vast te stellen door middel van horizontale contacten tussen de lokale organisaties (CBOs) onderling, maar met de steun van de formele overheidsinstellingen die in dit project essentieel zijn gebleken. Hier wil ik verder aan werken.

Note on the author

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