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The Daudkandi model of community floodplain aquaculture in Bangladesh: a case for Ostrom's design principles

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Abstract: Floodplain water-bodies are one of the major common-pool resources (CPRs) of Bangladesh and constitute more than fifty percent of inland open water bodies. Throughout the British colonial period, Pakistani rule and the first one and half decades of independent Bangladesh, a majority of inland water-bodies remained under direct government management, though the floodplains, by getting heavily inundated during the monsoon, turn into an open access resource. In the mid-1980s, co-management was introduced on a small scale with the help of NGOs as providers of management styles and credit to communities of fishers or villagers. NGOs also got involved in floodplain water-bodies and came up with different models of user-managed fishery bodies. This paper examines a specific management system of community-governed floodplain aquaculture (FPA) known as the Daudkandi model, developed by a local NGO in the Daudkandi sub-district of the Comilla district. Applying the design principles developed by Ostrom (1990) characterizing long surviving successful user-managed common-pool resource institutions, this paper explores the rules devised by partners in the management of a FPA under the Daudkandi model. Though the FPA management model is relatively new (i.e. it has been adopted in 1996) it has been found to follow the design principles in devising its management rules. However, because of its unique features in terms of seasonality, the NGO-community partnership, the exclusion of past users, and numerous replications, the future of the model as a CPR governance system holds many challenges and deserves a continuous research focus.

Keywords: Bangladesh, common-pool resource, floodplain aquaculture, Ostrom's design principles

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I. Introduction

Floodplain water-bodies are one of the major common-pool resources (CPRs) of Bangladesh (Thompson et al. 1998; Sultana and Thompson 2008). Bangladesh is a delta and most of its 147,570 km² area (BBS 2011) is mainly composed of alluvial deposits borne by the Ganga-Padma, Meghna and Jamuna-Brahmaputra rivers and their branches. Floodplains constitute more than 55% of the land, and on annual basis from 26,000 km² to 82,000 km² of them get inundated in the monsoon and remain so for the next few months. According to Fisheries Statistical Yearbook of Bangladesh 2013–2014 compiled by Fisheries Resources Survey System (FRSS) of Department of Fisheries (DoF), Bangladesh has 2.8 million ha of floodplain water-bodies (FRSS 2015). These water-bodies are seasonal in nature and formed by submerging large or small areas of lands during the monsoon. Each of these water-bodies, in the majority of cases, brings privately owned lands of different landowners within it by flooding them, and turns them into a single continuous resource system by practically making the boundaries among the lands unrecognizable and unusable. Therefore, no single landowner legally and practically exercises property rights over a whole floodplain water-body. This reality makes floodplain water-bodies open for surrounding community members, and, as the landowners had no collective aquaculture management system, until recently these water-bodies remained as sources of capture fish, rather than cultured fish.

In this context, floodplain aquaculture (FPA) is a recent development in Bangladesh, and a WorldFish study (Belton et al. 2011) attributed its introduction to a local non-governmental organization (NGO) named SHISUK (*Shikhya Shastha, Unnayan Karjakram* in Bengali, which can be translated into English as Education, Health and Development Programme). This FPA management system, developed by SHISUK with community collaboration, was started as an independent pilot project without support of any government body in 1996 in the Daudkandi *upazila* (sub-district) of the Comilla district. The management system later gained popularity as the '*Daudkandi Model*' of community fishery/aquaculture or FPA regionally and nationally, and henceforth will be mentioned as such or simply as the '*model*' in this article. The Daudkandi model has been adopted by more than 90 similar FPA projects and companies around Daudkandi *upazila*

(Toufique and Gregory 2008). Sultana (2012) also mentioned that the model received considerable policy attention in the context of an annual 30–100% rise in enclosure-based private seasonal FPAs in subsequent decades in different parts of Bangladesh. Although the model is unique for several reasons, one of its most important features is that it keeps management of the FPA in the hands of community of users. If we consider the fact that it was a CPR, management by local users becomes more significant.

However, management of a CPR, even by the community of users, is very delicate and complex because of two characteristics all CPRs share: a) exclusion of appropriators is costly, meaning it is difficult to deny access to it, and b) the unit of the resource extracted by one appropriator is subtracted from availability for others to extract (Ostrom et al. 1999; Tietenberg and Lewis 2009). These two aspects of CPRs make their management a focus of a long-drawn investigation within and among international agencies and academicians for past few decades (Van Laerhoven and Ostrom 2007; Fennell 2011). In 1954, Gordon expounded in his seminal work a theory of open access fishery commons. Based on this same principle, Hardin (1968) subsequently generalized a tragic consequence of all commons due to the unsustainable nature of exploitation by the users of the commons (Béné 2003). For Hardin, the solution would be to bring the commons under private or state management. However, field data illustrated that both the private property and government management systems have had their failures (Feeny 1994; Feeny et al. 1996; Ostrom et al. 1999). Internationally this led to a search for the commons successfully managed by their users. Data collected from the field presented both successful and unsuccessful user-managed CPRs (Ostrom 2000). By studying both types of CPR institutions, Ostrom developed, in her book *Governing the Commons* (1990), ‘a series of design principles that characterize the configuration of rules that are used’ (Ostrom 2000, 40). She defined design principles as an ‘element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use’ (Ostrom 1990, 90). According to Ostrom, most long-term CPR institutions are characterized by most of these design principles, whereas the not-so successful institutions ‘tend to be characterized by only some of these design principles’ and failed institutions ‘are characterized by very few of these principles’ (Ostrom 2000, 40).

This paper uses these design principles in analysing the Daudkandi model on two grounds. First, Ostrom’s design principles can be a good diagnostic framework to study the management rules of the FPAs formed under the Daudkandi model. These principles, through empirical studies, have been found to be the characteristics of successful CPR institutions and may be used for studying such institutions formed by users of resources under various institutional mechanisms. Second, Ostrom argues that a self-governed CPR is one wherein ‘major appropriators of the resource, are involved over time in making and adapting rules within collective-choice arenas’ and in our modern political economies it is highly usual that ‘in a self-governed system, participants make many, but not necessarily all, rules that

affect the sustainability of the resource system and its use' (Ostrom 2002, 1317). Initially in the co-management era, primary partners in managing a resource were government and the users, and that regime has been looked into through Ostrom's framework (Yandle 2003, 2008; Gelcich et al. 2006; Schreiber and Halliday 2013; McClanahan et al. 2015). That clear dichotomy has changed in subsequent years through various experimentations, and in the case of present study, as will be shown, community users formed the main partnership with the NGO without any government initiative framework for and involvement in managing their resource. The application of Ostrom's design principles in such cases may give an opportunity to understand the various aspects and direction of such emerging partnership.

The article is outlined as follows: Section 2 reviews the evolution of the management system of open inland water-bodies. Methodology and data collection are outlined in Section 3, followed by a summary presentation of the Daudkandi model in Section 4. Collected data regarding management rules of the FPA are explored within Ostrom's design principles in Section 5. Section 6 concludes the paper by discussing significant findings and their implications.

2. Management of inland open water bodies of Bangladesh and involvement of NGOs:

Bangladesh has several types of inland water-bodies: rivers and estuaries, oxbow lakes (*boar*), permanent or semi-permanent water bodies (*beellhoar*), floodplains and marshes. According to FRSS-2015, as shown in Table 1, 83% of all fish come from inland water-bodies of which floodplain water-bodies provide more than 26% of (captured and cultured) fish.

Since the British colonial period, the majority of these inland water-bodies, except privately owned ponds and most floodplains, had been under the government ownership and considered a major source of revenues. In 1950, after the colonial period, the ownership of these water-bodies was brought under the Ministry of Land (MoL). Under the MoL the main mechanism of managing these water-bodies (including government owned floodplains) was a periodic leasing system for one to three years to the highest bidder. After the independence of Bangladesh in 1971 the system remained more or less the same, although different initiatives were taken for adopting a more appropriate fisheries management practice. This system, along with later experiments, faced severe criticisms for failing to sustain biological fisheries resources and ensure economic and social development of small but genuine fishermen through equal distribution of benefits derived from these water-bodies (Hossain et al. 1998; Thompson et al. 1999; Craig et al. 2004; Hossain et al. 2006). To all this were added the problems of feeding a population growing at an ever-increasing rate.

To deal with these problems, in 1986, the New Fisheries Management Policy (NFMP) was devised with a long-term goal of gradually phasing out the leasing system by endowing management responsibility for the water-bodies to the DoF of Ministry of Fisheries & Livestock (MoFL) from the MoL (Middendorp et al.

Table 1: Sector wise annual fish production (Source: FRSS 2015).

Fisheries sector	Water area (hectare)	Total production (metric ton)	%
A. Inland fisheries			
i. Inland open water (capture)			
1. River & estuary	853,86	167,373	4.72
2. Sundarbans	177,770	18,366	0.52
3. <i>Beel</i>	114,161	88,911	2.51
4. Kaptai lake	68,800	8,179	0.23
5. Floodplain	2,595,529	701,330	20.09
Total of capture	3,910,053	995,805	28.07
ii. Inland closed water (culture)			
6. Pond	371,309	1,526,160	43.01
7. Seasonal cultured water-bodies	130,488	193,303	5.45
8. <i>Baor</i>	5,488	6,514	0.18
9. Shrimp/prawn farm	275,274	216,447	6.10
10. Pen culture*	6,775	13,054	0.37
11. Cage culture	7	1,447	0.04
Total of culture	789,341	1,956,925	55.15
Total capture and cultured inland fish	4,699,394	2,952,730	83.22
B. Marine fisheries	-	595,385	16.78
Country total		3,548,115	100

*Pen culture is also a kind of FPA.

1999; Thompson et al. 1999). The institutional limitations of the DoF and the success stories of various NGOs in many fields led to different types of collaborations between DoF, NGOs and local fishermen, some of which brought significant advances (Hossain et al. 1998). In these projects NGOs were mainly responsible for forming and training of fishermen group, awareness creation, developing management and operational system, and providing credit facilities (Ahmed et al. 1992; Ahmed et al. 1997). This trend gave the NGOs the opportunity to get involved as partners with fishermen or community members – with or without support of government – in the management of water-bodies in various roles in different projects. Amid all this development, the NGO SHISUK without any government support developed the Daudkandi model of FPA in collaboration with community people of the Daudkandi sub-district.

3. Methodology

3.1. The site

The Daudkandi model was adopted initially as a pilot FPA project in 1996 and then formally through Pankowri Fisheries Ltd. in 1997. As Figure 1B shows, the site is 2.5 kilometres (km) north from Dhaka-Chittaong highway (indicated by red line) and spread through six villages: Charipara, Hasherkhola, Ataikhloa, Dhanuakhola, Vashkhola and Patch-pukuria of the North Elliotgonj union of Daudkandi *upazila*

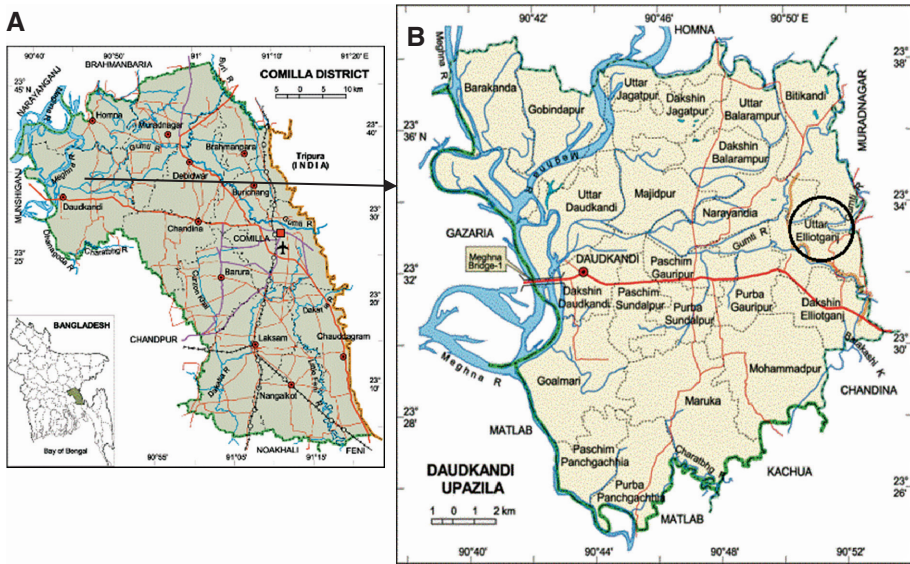


Figure 1: Research area of the Elliotganj union. (A) Comilla district. (B) Daudkandi upazila (sub-district). (Source: http://www.mapsofbangladesh.com/Comilla_District.php, <http://www.mapsofbangladesh.com/Daudkandi-Upazila.php>).

of Comilla district. Comilla District (Figure 1A) is of 3085.17 sq. km area and located between 23°02' and 24°47' north latitude and between 92°39' and 91°22' east longitudes. It is bounded by Brahmanbaria and Narayanganj Districts on the north, Noakhali and Feni Districts on the south, the Tripura state of India on the east and Munshiganj and Chandpur Districts on the west. The population density of the district has increased to 1,712 people (higher than the national average of about 1,015) (BBS 2011) from 1,487 people per square km during 2001–2011 (Toufique and Gregory 2008).

Because of the low-lying nature of its land, most of which remains under water due to frequent floods, the district long had been recognized as a food deficit area, with its lowest-lying areas growing only one crop of rice (BWDB 1994). Farming households, including well-off landowner families, experienced lack of employment, shortages of food, especially during the September–November period, and the resultant urban migration. Thus subsistence fishing became the most important occupation to marginal farming households with lack of formal activities.

In 1992 the Bangladesh Water Development Board (BWDB) put an embankment on the Gumti River – the main cause of recurrent floods – to protect villages from recurrent flooding, and this changed the landscape of the area by enclosing an area about 327 sq. km by a 45.5 km long embankment (including Daudkandi

upazila) (Toufique and Gregory 2008). As part of Daudkandi *upazila*, the area surrounding Pankowri Fisheries Ltd. is also part of the larger Meghna-Gumti floodplain and is bordered by the Gumti River on the east, north and west, and a portion by the Daudkandi-Comilla highway on the south. The entire floodplain takes the appearance of a vast water-body during the summer monsoon (June–September) by getting inundated because of its low-lying landmass, which filled with depressions like other low-lying areas of the surrounding *upazilas*. The low-lying landmass was traditionally cultivated for winter crops, like onions, garlic, pulses and sweet potatoes. In other seasons the lands were used for *Aus* (April–August) and *Aman* (April–December) rice production. However, this farming was mainly dependent on natural weather and most times production was damaged by excessive rain, floods or sometimes droughts (CIRDAP 2002).

The first attempt, although unsuccessful, of utilizing seasonally flooded private lands for aquaculture was made by a group of landowners in Daudkandi *upazila* in 1987 (Toufique and Gregory 2008). After construction of the embankment new attempts were made without involvement of any NGO. Most of these attempts failed on account of technical or organizational/financial grounds. Only after introduction of the Pankowri Fisheries project did the area found a successful management system for floodplain aquaculture in the technical, organizational and financial aspects.

3.2. Data collection

Primary data: Data from the field were collected from December to January, which included the fish harvesting period for that particular season. Main methods for obtaining primary data were interviews and participant observations.

Face-to-face interviews with NGO staff who had been involved with the FPA from the beginning until the time of the study were conducted with non-structured questions. Through these interviews information regarding the development, historical context (which worked as a driving force) prior to the FPA initiative, landowners mobilization, etc. was collected. FPA staff like the chairman of the Pankowri Fisheries Ltd, programme coordinator of SHISUK, were interviewed to learn about the operational processes, conflict resolution, compensation, dividend distribution mechanism, etc. Other interviewees included shareholders, members of the Board of Directors (BoD), officials of the FPA, and a few general villagers. Depending on the persons and suitability of the occasion, the informal interviews were conducted either during field trips at the community, during directors gatherings or at the NGO office at Dhaka. SHISUK's interviewed officials included the executive director, programme coordinator, and one FPA-related staff. They were interviewed individually at the North Elliotgonj office of the Pankowri Fisheries Ltd. and SHISUK's office in Dhaka. Members of the BoD and shareholders were interviewed when they gathered for FPA meetings, and as such these interviews were conducted at North Elliotgonj. General villagers were asked on the basis of unstructured question sets for their perception of the FPA initiative.

Besides interviews, participant observation was used as an additional way of collecting data. The researcher was present at several formal meetings of directors, NGO staff and shareholders. The decision-making process and participation of landowners in it were observed. The researcher was also present during the harvesting period, and this and other related operations were observed. These observations also supported the information collected from interviews.

Secondary data: Handfuls of quantitative data along with qualitative data about the FPA were collected from official documents, such as FPA manuals and annual reports of SHISUK and Pankowri Fisheries Ltd. Some secondary data about local conditions were collected from research materials prepared by other development organizations such as Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP).

4. The Daudkandi model of community FPA

In 1996 SHISUK initiated a pilot project to develop a viable management system of community-governed aquaculture in six villages of the North Elliotgonj union. The general people of these villages surrounding the floodplain were not professional fishermen, so before the FPA project they mainly fished only during the rainy season when the floodplain was inundated. With the main objective of utilizing a local underutilized resource through active participation of community members, the project started with around 115 ha (285 acres) of floodplain that turns into a water-body in the monsoon (June–September). The pilot project adopted an innovative mechanism to solve the primary problem of capital. It distributed shares to landowners and other villagers and started the FPA operation. Although initially the shares – each valued Tk. 1000 – had only been issued to landowners holding lands in the floodplain, the project soon found that issuing of shares in this way was ineffective to raise required capital. So other households, who didn't own land in the floodplain, were allowed to buy shares, provided that *the subscriber must be an inhabitant of any of the surrounding six villages*. No individual could buy more than 20 shares.

Eighty percent of shares were distributed to landowners and villagers, and 20% were bought by the initiator NGO, SHISUK. It kept 5% of the shares from its 20% exclusively for less advantaged and impoverished villagers. After its initial two years of success, using the issued shares, the FPA was registered in 1997 as a joint stock company under the Company Act 1994 and named Pankowri Fisheries Ltd. Table 2 shows the condition of the FPA after the company was formed. It is evident from Table 2 that not all landowners whose land fell within the selected area of aquaculture invested in the project.

All activities of the FPA have been running in the fashion of a conventional company since its formation as one. Shareholders select a board of directors comprising one chairman, one managing director and nine directors for two years. This board oversees the day-to-day operations run by a group of employed personnel and sometimes form committees for specific management operations.

Table 2: Pankawri Fisheries Limited at a glance (Data compiled from official documents of Pankawri Fisheries Ltd.)

Area	115 hectares (285 acres)
Total land owners	395
Total number of shares	2000
Total number of shareholders	387
Share price	1000
Share limit	20 shares (1% of total shares)
Community shares	1600
SHISUK shares	400 (20%)

Figure 2 shows the flow of initiation, execution and seasonal operation of an FPA under the Daudkandi model. Yellow boxes indicate the inception and development stages and green boxes the annual seasonal operations of an FPA. It is noteworthy that the mobilization of landowners and surrounding community populace of a floodplain water-body and other subsequent stages theoretically can be achieved without the NGO initiative and involvement, given that the community members engage themselves on their own.

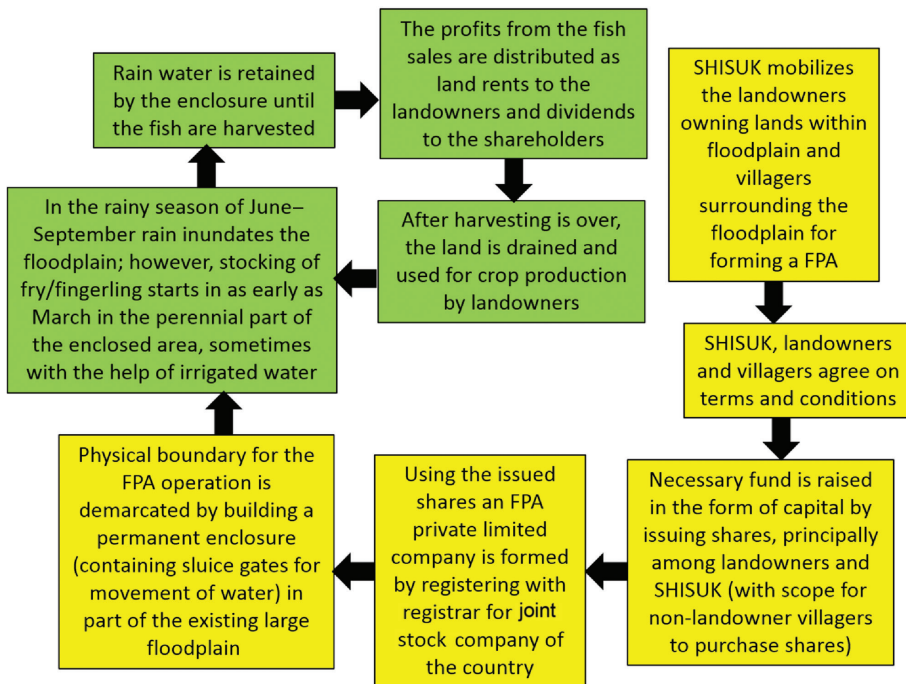


Figure 2: Development and operational cycle of FPAs under the Daudkandi model.

The FPA doesn't own the lands of the floodplain; it simply, in the form of a private limited company, takes lease of lands from landowners for use during the monsoon through a contract which grants it the legal right to use the land in exchange for the lease money. Accordingly, the FPA has to pay lease money to landowners in exchange for using their lands. After deducting all costs but before distributing dividends, this lease money is paid as 27% of initial earning. Then 70% of the net profit is distributed as dividends to shareholders regardless whether landowners or not, and 3% is kept for development of local areas. However, the amount of lease money is directly dependent on the profit the FPA makes every season, and this rate of 27% of earnings before paying dividends remains unchanged as long as the amount of leased asset remains fixed.

5. Ostrom's design principles and their application in the Daudkandi model

By studying a wide range of long-lived user-managed CPR institutions, Ostrom found that in most cases the resource and the institution survived a long period in spite of the possibility they could be exploited unsustainably by opportunistic individuals (Ostrom 1995). Ostrom, adopting the definition provided by Shepsle (1989), called these CPR institutions robust 'in the sense that they survived for very long periods of time utilizing the same basic rules for adapting to new situations over time' (Ostrom 2000, 40). As the nature of the resources these institutions govern vary, specific rules applied to one cannot be generalized for other resource systems. However, it is possible to find common principles that characterize successful CPR institutions. Ostrom identifies seven design principles (Table 3) that characterize most long-sustained CPR institutions, with an eighth principle for successful governance of larger nested CPRs. This eighth design principle was not applied in the present study, as a single management body runs the FPA under the Daudkandi model, and the FPA is not part of any larger system. In the sections following Table 3 the applicability of Ostrom's design principles are detailed in terms of FPA operational rules.

1. **Clearly defined boundaries and rightful users of the common pool resources** – *Individuals or households with rights to withdraw resource units from the common-pool resource and the boundaries of the common-pool resource itself are clearly defined:* Geographical or physical boundaries of the resource, as well as the individuals and/or households with rights to withdraw from the resource base, must be clearly defined. Without definitive borders and exclusion of non-investors, local appropriators will risk that 'benefits they produce by their efforts will be reaped by others who do not contribute to these efforts' (Ostrom 1994, 5), or make no sacrifice for enhancing the resource system. Clearly defined boundaries and users will ensure that investors will receive as high a return as they expect and that actions of others will not destroy the FPA.

Table 3: Design Principles characterized most long-surviving CPR institutions (Ostrom 2000).

1. Clearly defined boundaries

Individuals or households with rights to withdraw resource units from the common-pool resource and the boundaries of the common-pool resource itself are clearly defined.

2. Congruence

A. The distribution of benefits from appropriation rules is roughly proportionate to the costs imposed by provision rules.

B. Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions.

3. Collective-choice arrangements

Most individuals affected by operational rules can participate in modifying operational rules.

4. Monitoring

Monitors, who actively audit common-pool resource conditions and appropriator behavior, are accountable to the appropriators and/or are the appropriators themselves.

5. Graduated sanctions

Appropriators who violate operational rules are likely to receive graduated sanctions (depending on the seriousness and context of the offence) from other appropriators, from officials accountable to these appropriators, or from both.

6. Conflict-resolution mechanisms

Appropriators and their officials have rapid access to low-cost, local arenas to resolve conflict among appropriators or between appropriators and officials.

7. Minimal recognition of rights to organize

The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.

For common-pool resources that are part of larger systems:

8. Nested enterprises

Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

During the mobilization and development phase, the NGO and landowners came into agreement regarding the use of their lands for the FPA and its boundaries. Then the boundary was drawn by constructing a permanent earthen road on the west side of the floodplain, providing management a definite area to practice aquaculture. The road also works as an embankment and contains sluice gates for movement of water in and out of the enclosed area selected for aquaculture. Thus, part of the existing floodplain water-body was brought under FPA operation and management. The rest of the part remains open to the community members, even during the monsoon period as before. The right to use the land for fish culture and for setting up permanent boundaries is earned through lease contracts and thus is protected by legal mechanism.

The rights of the individuals have been created by issuing shares to landowners of the floodplain and other community members. Thus non-shareholders were excluded from receiving any direct benefit earned through extraction of resource units, i.e. fish. As a matter of fact, as

mentioned, the FPA is run as a private limited company, and this entails that only the management body of the FPA can extract resource units from the FPA. Profits earned from sales of cultured fish are annually distributed as dividends to shareholders. So it seems both the geographical limit of the FPA fish culture and the rights of users are protected through legal provisions.

- 2. Congruence between appropriation and provision rules and local conditions** – *appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material and/or money*: This design principle indicates two levels of congruence or matching. At one level, for the sustenance of a resource system there should be rules and restrictions regarding harvesting patterns, and input provision of labour and other materials. These two types of rules should be congruent with local conditions. In her attempts to broaden and revise design principle, Ostrom (2009) hinted that local conditions may include social, economic, cultural, ecological and ideological characteristics. In the case of the Daudkandi model, the FPA harvests different kinds of fish, but generally harvesting is done in bulk and around the same period, with some variance in schedule, labour amount, technology depending on fish size, type, growth, local weather, market demands etc. Fish are mainly cultivated during seven months of a year, including two-three months of rainy season when floodplain is inundated with rain waters. In the dry season when rice is grown, no aquaculture intervention can be conducted. Just after the harvesting of winter (*Boro*) crop, water supply is ensured within the enclosed part through a canal that passes along the aquaculture waterbody containing water from the sluice gates of Gumti embankment. For flooding of the lands, rainwater remains the main source, which depends on regional weather and climate conditions. Although the release of fingerlings starts in early March in the small perennial part within the floodplain enclosed for the FPA operation (sometimes by dint of flooding via irrigation system), the ultimate growth of the fish depends on supply of the rain water in the whole enclosed area. Usually water starts to inundate the lands from mid or late June, when rain begins. The harvesting of the fish starts in late September or early October, and, sometimes, based on growth, natural conditions and market demand it continues to late January or early February. After the end of rainy season, some water remains for few weeks and later water is retained through embankment built around the cultured area. Release of water starts in late December. By shutting the sluice gates water can be retained for extended culture period, but for land preparation for *Boro* paddy cultivation water cannot usually be held beyond January. So, it seems the FPA is bound to comply with local conditions in doing its business.

At the other level of congruence, there should also be some proportionality and equitability in distribution of benefits and costs derived from

the use of the CPR. The shareholders or users basically make two types of contributions. First, they raised the initial necessary capital in the form of purchased shares, and against that now they are entitled to annual benefits as long the FPA continues its business. It also means that no shareholder is allowed to harvest fish on their own. Harvesting decisions are made by an elected board of directors along with all other decision regarding the management of the FPA. By the same token, no user has to personally contribute in the input or labour supply of the resource system, and here comes the second type of contribution. The company conducts all operational requirements with its earnings, which is basically part of profit that shareholders contribute in the form of retained earnings. In reality sometimes the FPA collected funds from outside sources. Like other private limited companies, the FPA maintains a core base of experienced and non-experienced employees all around the year to support and implement decisions made at higher management level, though its main operations are conducted in and around the monsoon period for six-seven months. Most of the labour participating in fishing activities are hired only for the harvesting period, and varies according to local particularities, e.g. availability, wage, harvesting requirements, etc. The amount of fingerlings to procure varies depending on cost, maintenance capability of the FPA and the local market's supply-demand conditions.

3. **Collective choice arrangements** – *most individuals affected by the operational rules can participate in modifying the operational rules:* Shareholders are rightful users of the CPR under the Daudkandi model, and also the directly affected party of any operational rule. Most of these shareholders are also found to be the landowners whose lands fell within the enclosed part of floodplain which has been brought under aquaculture. As already mentioned, the option for collective choice action is that the shareholders will elect a board of directors for design operational rules and run the day to day management of the FPA. This also fulfils the statutory requirement of the Company Act, under which the FPA has been formed, while removing the complexities which may arise from involving large numbers of shareholders in day-to-day decision making process.

However, in the rural context of closely knitted small community, informal communication plays significant roles in expression of grievances and concerns, and this rural cultural feature is used by anyone who is affected by any rules implemented by the FPA management. In addition to the members of board of directors, a considerable number of landowner shareholders remains outside the management committee, and for them this type of communication is very important for the movement of water in and out of the enclosed part for agricultural activities. For these ordinary shareholders, the informal communication plays a very significant role, if not in directly modifying, then at least in exerting some influences on modifying operational rules.

4. **Monitoring** – *monitors, who actively audit the common-pool resource conditions and appropriator behaviours, are accountable to the appropriators and/or are appropriator themselves:* To manage any CPR successfully over a long period of time, CPR institutions have to develop some sort of monitoring system to maintain appropriate behaviours of the users. In case of Pankowri Fisheries Ltd., the company has salaried employees, along with guards, who look after the overall conditions of the FPA and monitor the behaviours of the shareholders. These monitors are, in turn, to be held accountable for their duties to board of directors and shareholders. Moreover, few directors are sometimes directly assigned to the various responsibilities regarding the FPA, and as such, remain wary of warning signs. Besides, in a rural environment shareholders show varied degree of vigilance in overseeing whether other shareholders comply with the operational rules or not. Moreover, as the FPA has been registered as a private limited company, it is legally bound to conduct audit by external certified auditors.
5. **Graduated sanctions** – *Appropriators who violate operational rules are likely to receive sanctions (depending on the seriousness and context of the offence) from other appropriators, from officials accountable to these appropriators, or from both:* Ostrom put forward some benefits of a system of monitoring and sanctioning when they are implemented together by local users of a CPR as ‘(1) it stops the infraction from continuing and may return contraband harvest to other appropriators; (2) it conveys information to the offender that someone else in a similar situation is likely to be caught, thus increasing confidence in the level of quasi-voluntary compliance; and (3) it imposes a punishment, most likely in the form of a fine plus loss of reputation for reliability’ (Ostrom 1994, 8). In Pankowri Fisheries Ltd., the sanctions for breaching operational rules were adopted at the initiation of the FPA by board of directors with discussion of ordinary shareholders, i.e. the community people. The main breach of rules is confined to the theft of the fish from the cultured area. In this case if the any rule breaker gets caught with fish, then they have to pay a fine equal to the amount of fish with which they get caught multiplied by the numbers of days from releasing the fingerlings to the day they get caught. Moreover, if the violator is a shareholder, then they, according to the FPA rule, have to forfeit their shares. Though this provision seems a bit impractical to be applied at community level.
6. **Conflict resolution mechanisms** – *Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials:* As Ostrom says ‘in field settings, applying rules always involves discretion and can frequently lead to conflict’ (Ostrom 1994, 9). In the case of Pankowri Fisheries Ltd., as well as other FPAs formed adopting the Daudkandi model, there exists several stakeholders in two levels. Within a FPA there exists general shareholder,

board of directors and staff, and outside it there are non-shareholder land-owners, other community members and local government bodies and their personnel. The disagreements that arise within the FPA are usually dealt through simple mechanisms of bringing grieving parties together and settling issues following organizational rules, priorities, goals etc. of the FPA. When there arises a conflict between the FPA and any member of the community, the first step of the resolution is to hold meeting between the conflicting parties in the presence of board of directors and officials of the FPA; and the traditional village arbitration mechanism is followed to settle the issue. In rural setting of closely knitted society, most conflicts- which may affect many besides the directly engaging parties- are solved through local initiatives without extra-community interventions. If the origin of the conflict is any breach of operational or other rules, within or without the FPA, then the reconciliation is designed to be achieved by sanctioning the rule breaker.

Moreover, the presence and involvement of the NGO in whatever degree also creates reliability on these less expensive local resolutions of any conflict among various types of parties. In any case it has been observed that, even when the NGO is engaged in any disagreement, the presence of various stakeholders who work in small and closely knitted scope try to solve any disagreements without causing too much costs.

7. **Minimal recognition of rights to organize** – *The rights of the appropriators to devise their own institutions are not challenged by external governmental authorities:* Ostrom mentioned of many inshore fisheries where ‘local fishers devise extensive rules defining who can use a fishing ground and what kind of equipment can be used’ and in all these cases as long as ‘the external governmental officials give at least minimal recognition to the legitimacy of such rules, the fishers themselves may be able to enforce the rules’ (Ostrom 1990, 101). In the case of the Daudkandi model, the FPAs, like Pankowri Fisheries Ltd., are turned into legal entities in the form of joint stock private limited companies; and, consequently, their management and operation of fishing business are legally authorized to be devised by the shareholders directly or indirectly rather than by any external government body. The FPAs thus formed are subject to only two types of external legal bounds: first, the laws which govern the activities of limited companies and, second, the existing fishing laws and regulations which are generally applicable for anyone who are engaging in fishing business in the country. With the exception of these two forms of legal bounds, the FPAs are legally independent, recognized, and protected to conduct their business in ways as they deem fit. The issuing of shares ultimately decides who has the rights over the formed FPAs and who does not have any.

In addition to the legal one, government recognitions to conduct fishing activities as per rules and procedures devised by shareholders of Pankowri

Fisheries Ltd have been extended through other indirect ways. Such indirect ways of recognitions can be found in the training courses provided by the District and *Upazila* Fishery Officers to the FPA staff, shareholders and villagers without interfering in the rules and regulations devised by the members of the FPA, and in more than one agreements regarding the replication of the model in other floodplains and non-floodplain water bodies.

6. Discussion and conclusions

This study tried to look into a specific FPA management system primarily designed by an NGO in collaboration with a community of general villagers in the changed circumstance of the overall fisheries management regime in Bangladesh. Because of floodplain water-body's CPR nature, the fitness of model's management rules within Ostrom's design principles has been tested, and it has been found that most of these principles are matched with management rules of the studied FPA under the Daudkandi model. However, as a CPR institution this FPA model is still young in comparison with many long surviving CPR institutions, and its robustness in form of future success and sustainability depends on various factors: for example, its capacity to maintain the legitimacy of the established FPAs within local community through working collaboratively, and its ability to foresee changes and the extent of adaptation to those changes. However, the major findings of this study and few related observations can be made as follows:

- i. **Fulfillment of Ostrom's design principles:** For now, the FPA model has been found to follow Ostrom's design principles in its management principles and rules regarding a definite boundary of the physical resource and rightful beneficiaries, an arrangement for collective choice actions for most of the affected parties, a monitoring system, local low cost conflict resolution mechanisms, recognition of external authorities, etc. However, the fulfilment of all these principles – about which none of the users had any previous idea- in field level is an extremely complex ongoing process. The sustainability of a CPR solely in terms of compliance with Ostrom's principles cannot be predicted as there is strong possibility of the presence of external factors like market demands or resource's various properties (Cox et al. 2010; Schreiber and Halliday 2013). Cox et al. (2010) also mentioned the limitations of Ostrom's principles in considering user community's internal power play. In general, Ostrom's design principles may be used as a guidelines to understand the sufficiency of incentives and maturity of social capital at community level; mostly through appraisal of internal institutional aspects, and without considering whole gamut of external factors (Yandle 2003, 2008; Cox et al. 2010; Trimble and Berkes 2015). Thus, we need to consider any external force, like non-authorized

users' interest in the FPA, which may hold potential opportunity or threat for the successful continuation of the FPA model.

- ii. **New property rights regime:** The management of a CPR through devising new property rights regime always includes various level of redefinition of rights and rules, including exclusion rights (Schlager and Ostrom 1992). The first design principle is about defining these property rights holders and the physical limit of the CPR, where these property rights will be exercised. In the case of Pankowri Fisheries Ltd., under the Daudkandi model, there have been found several critical features in fulfilling this principle.
 - a. First, the CPR of the study is a seasonal floodplain water-body. Part of it was brought under a new resource management system by erecting a permanent embankment. Only in the rainy season the new management regime can manage and have control over the enclosed part; and in the dry season when there is no water-body the landowners exercise their private property rights over individually held lands. However, there exists some agreement and collaboration regarding the use of land in the dry and wet season so that both parties can practice their rights in respective seasons.
 - b. Second, there are landowners who decided not to be part of new CPR management but hold lands within enclosed area of the FPA, and the relationship these landowners have with the FPA may be proved significant for the performance of the FPA.

These first two features of the FPA – seasonality and usage of lands of non-shareholder landowners – have many potential dynamics and may hold important future implications for governing the CPR under the Daudkandi model. Various dynamics of the relationship between the FPA and landowners can be found in, for example, gaining consent in using lands, or reaching an agreement regarding payment of compensation or release of retained water (so that non-shareholder landowners can conduct their agricultural activities) etc. These dynamics can result into, for example, conflicts among shareholders, landowners or between shareholder and non-shareholders; or higher lease money payment, etc. Thus, the settlement of these dynamics in the replicated FPAs requires further investigations.

- c. Third, as already mentioned, the general populace of the surrounding villages of the studied FAP were not full-time fishermen, and only used to catch fish of subsistence nature. However, the initiation of the aquaculture has put a limit on who can benefit from the FPA, for not everyone, even if interested, could afford investing in shares. So, those who were at the bottom of the society, and could not afford share purchase, but previously at least had been able to catch some fish, clearly got excluded from the direct FPA benefits. It is understandable that the exclusion of some past users by modifying property rights

might affect these past users. The nature and scope of this exclusion has not been properly studied, though mentioned with emphasis in some studies (Gregory et al. 2007; Toufique and Gregory 2008). At the same time, some general villagers emphasized that the poor section of the community are receiving some trickledown benefits through employment or working as labour at the FPA, and/or engaging in some forward or backward linkage services and supplies, or through overall increased affluence of the community.

However, in the absence of any previous baseline study of the benefits reaped by these poor section of the community, it is impossible to measure how much they have lost in terms of opportunities because of the initiation of the FPA, and make any subsequent comparison between this evident loss of access and any post-FPA benefits. A possible management intervention for the potential floodplain landowners might be to conduct some baseline survey of social, economic conditions of community members in newly planned FPA areas as part of overall project management. It is important for the long-term successful management of a FPA formed under the Daudkandi model to be locally embedded and that embeddedness would be absent if its initiation creates substantial loss for other community members.

On the other hand, on theoretical level, how the costs – now being borne by this community level past users – can be conceived within Ostrom’s design principles framework is yet to be explored as these users are left outside the pale of the new group of authorized appropriators. Part of the second design principle is about the proportional equivalence or equitable distribution of costs and benefits among users ‘who agree to use the resource according to their agreed-upon rules’, *not* among the excluded ones ‘who do not agree to these rules’ (Ostrom 2009, 7). However, the exploration of resultant social conditions of the excluded past users and community poor in a closely knitted local setting may shed lights on key issues concerning the maintenance of the FPA’s community-level legitimacy, which is important for future sustenance and efficiency of CPR institutions.

- iii. **Matching of overall benefits and costs:** The principle of congruence, along with all other design principles, has been elaborated with considerable issues and nuances over the years since their original formulation in 1990 (Ostrom 2009; Cox et al. 2010). The overall profitability of the FPAs, including Pankowri Fisheries Ltd., under the Daudkandi model was not part of the present inquiry as that has been found to be considerably high in other studies (Gregory et al. 2007; Toufique and Gregory 2008; Mustafa and Brooks 2009). However, the issue of congruence between ecology or biodiversity or overall local environment and the FPA management is something which requires prolonged engagement in the field which was not available for this study.

- iv. **Distinct features of the Daudkandi model:** The application of Ostrom's principle in this FPA management system involves some challenges, as well as some possibilities, because of several features of the model. The main innovation of the Daudkandi model is a new institutional way of collaboration between landowners of floodplain and surrounding community people so that they can engage themselves in developing aquaculture in a seasonal water-body over which no single individual can hold sway during the rainy season. This institutional way of collaboration has been achieved within the scope of a *private limited company* where issued shares are not allowed to be exchanged in the stock market and can only be held by specified shareholders (community populace and the NGO). While issuing shares to demarcate right holders from others has not been uncommon at the community level, forming a private limited company with them is new in the context of rural Bangladesh. The issuing of shares among the people of the community also ensured the procurement of initial necessary capital without taking recourse to any external development fund. This specific legal approach also entails some external statutory requirements, like annual audit, for better and transparent management of the resource, and this is also supposed to give the employed personnel a considerable role to play in operational management of the FPA. On the other hand, this is done by the collaborators with an aim to *enhance* the resource by unlocking potentialities, rather than to solve resource management problems, and without this possibility of enhancement there would have been no promise of collaboration among individual landowners. The *landowners* have collectively remained the owners and major decision makers of the FPA, though initially they were convened and later have been assisted by an NGO.

The second distinct aspect of the model is the way in which the NGO is involved as a facilitator and partner in managing a FPA. The study found that the NGO assisted the implementation of the FPA project in various ways: staffing, providing organizational support, arranging external credit, establishing networks with local, regional and national government agencies and national and international non-government bodies. It has also been observed that the presence of the NGO created hopes among general villagers and involving parties in settlement of disputes and disagreements in more credible, smooth and less expensive ways. In the sphere of co-management, many studies have concluded that different levels of competence and distributed decision-making along with multiple stakeholders with multiple relationships (Carlsson and Berkes 2005; Marín and Berkes 2010; Trimble and Berkes 2015).

The NGO's involvement should also be viewed from the perspective of capacity building of the community users; more so in this particular case because of the lack of a professional fisher group prior to the FPA initiative, and the local landowners' lack of experience in commercial fishery

or aquaculture. At the same time, capacity building – technical or managerial or institutional – whether as a partner of co-management or sole party of self-management has a temporal dimension. Historically, successful users' managed CPRs are characterized by capable group of users, and their evolving capacity in successful handling of conflicts over resource use. In the case of the Daudkandi model, the very establishment of the FPA indicated that floodplain landowners reached a settlement regarding the use (and other related issues) of the floodplain water-body for fish culture. Moreover, this study (which captures state of the FPA rules at a point of time), found that the FPA has some rules in place to handle newly-raised conflicts of affected parties (Ostrom's design principle 3 and 6). Having these rules is an indication that, at least, at the design level the managers of CPR institution are capable, for the rules were designed on the basis of collaboration rather than one sided imposition of any partner. While the compliance with Ostrom's design principles indicates the capability of CPR institutions, the level of compliance may change for better or worse with passing of time as applications of these principles in cases of co-management institutions is found in several studies (Gelcich et al. 2006; Yandle 2003, 2008; Schreiber and Halliday 2013). It is important to remember that the involvement of the NGO is theoretically not necessary for the replication of models where landowners and community people themselves come together and work out their collaboration. Thus, on the one hand, continuous research on the evolution, along with other replications, (as a learning process, or at least clear-cut success or failure) of the management system to understand the scope and nature of the NGO-community partnership may shed light on areas and upon variables which are important for its future success as a CPR governance institution. On the other hand, from the institutional capacity perspective, the real test of the Daudkandi model as a CPR institution for floodplain water-bodies will be found in the FPAs where there will be no NGO involvement in management and the community has to do everything itself.

Data for this study was collected from the field through a period of two months, which seems insufficient for capturing the whole gamut of dynamics that lies underneath the management, daily operation and issues regarding long-term sustainable relations between the resource system and resource units extracted under this particular CPR institutional mechanism. Without long-term and thorough observation, investigations and cross-disciplinary studies, many issues of sustainability and efficiency will remain indecisive. Moreover, the model has been already variously adapted by 90 other FPAs in Daudkandi and its surrounding *upazilas*; further, in few of these adaptations SHISUK has been directly involved. This scale of expansion and flexible replications may add considerable complexity through customization in each of these replications.

Literature cited

- Ahmed, M., D. Capistrano, and M. Hossain. 1992. Redirecting Benefits to Genuine Fishers: Bangladesh's New Fisheries Management Policy. *Naga: The ICLARM Quarterly* 15(4):31–34.
- Ahmed, M., D. Capistrano, and M. Hossain. 1997. Fisheries Co-Management in Bangladesh – Experiences with GO, NGO Fisher Partnership Models. *Fisheries Management and Ecology* 4(3):233–248. <http://dx.doi.org/10.1046/j.1365-2400.1997.00115.x>.
- BBS (Bangladesh Bureau of Statistics). 2011. Bangladesh Population and Housing Census 2011. Summary available at http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/Census2011/Bangladesh_glance.pdf.
- Belton, B., M. Karim, S. Thilsted, W. Collis, and M. Phillips. 2011. *Review of Aquaculture and Fish Consumption in Bangladesh*. The WorldFish Center Studies and Reviews 2011–2053, 76. Penang, Malaysia.
- Béné, C. 2003. When Fishery Rhymes with Poverty: A First Step Beyond the Old Paradigm on Poverty in Small-Scale Fisheries. *World Development* 31(6):949–975. [http://dx.doi.org/10.1016/S0305-750X\(03\)00045-7](http://dx.doi.org/10.1016/S0305-750X(03)00045-7).
- BWDB (Bangladesh Water Development Board). 1994. *Agriculture & Fisheries Development Studies for FCD-III Project, Final Report, Gumti Phase-1 Sub-project. Voi-1, Main Report*. Dhaka, Bangladesh.
- Carlsson, L. and F. Berkes. 2005. Co-Management: Concepts and Methodological Implications. *Journal of Environmental Management* 75(1):65–76. <http://dx.doi.org/10.1016/j.jenvman.2004.11.008>.
- CIRDAP (Centre on Integrated Rural Development for Asia and the Pacific). 2002. *Community Initiative for Fisheries Development: An Evaluation of Pawkowri Fishery Project in Daudkandi, Bangladesh*. Dhaka: CIRDAP.
- Cox, M., G. Arnold, and S. V. Tomás. 2010. A Review of Design Principles for Community-Based Natural Resource Management. *Ecology and Society* 15(4):38.
- Craig, J. F., A. S. Halls, J. J. F. Barr, and C. W. Bean. 2004. The Bangladesh Floodplain Fisheries. *Fisheries Research* 66(2):271–286.
- Feeny, D. 1994. Frameworks for Understanding Resource Management on the Commons. In: *Community Management and Common Property of Coastal Fisheries in Asia and the Pacific: Concepts, Methods and Experiences*, ed. R. S. Pomeroy. ICLARM Conference Proceedings 45. Silang, Cavite, Philippines, 21–23 June 1993. ICLARM, Manila, Philippines.
- Feeny, D., S. Hanna, and A. F. McEvoy. 1996. Questioning the Assumptions of the “Tragedy of the Commons” Model of Fisheries. *Land Economics* 72(2):187–205. <http://dx.doi.org/10.2307/3146965>.
- Fennell, L. A. 2011. Ostrom's Law: Property Rights in the Commons. *International Journal of the Commons* 5(1):9–27. <http://dx.doi.org/10.18352/ijc.252>.
- FRSS (Fisheries Resources Survey System). 2015. *Fisheries Statistical Yearbook of Bangladesh*, Volume 30. Bangladesh: Department of Fisheries.

- Gelcich, S., G. Edwards-Jones, M. J. Kaiser, and J. C. Castilla. 2006. Co-Management Policy Can Reduce Resilience in Traditionally Managed Marine Ecosystems. *Ecosystems* 9(6):951–966.
- Gordon, H. S. 1954. The Economic Theory of a Common-Property Resource: The Fishery. *The Journal of political Economy* 62(2):124–142.
- Gregory, R., K. A. Toufique, and M. Nuruzzaman. 2007. Common Interests, Private Gains: A Study of Co-Operative Floodplain Aquaculture. Paper Presented at the CBFM-2 International Conference on Community Based Approaches to Fisheries Management, 6–7 March 2007, Dhaka, Bangladesh.
- Hardin, G. 1968. The Tragedy of the Commons. *Science* 162(3859):1243–1248. <http://dx.doi.org/10.1126/science.162.3859.1243>.
- Hossain, M. M., S. A. Rahman, and P. M. Thompson. 1998. Building Government-Non-Government Organization-Fisher Partnerships for Fisheries Management in Bangladesh. Paper Presented at the Seventh Annual Conference of the International Association for the Study of Common Property, 10–14 June 1998, Vancouver, BC, Canada.
- Hossain, M. M., M. A. Islam, S. Ridgway, and T. Matsuishi. 2006. Management of Inland Open Water Fisheries Resources of Bangladesh: Issues and Options. *Fisheries Research* 77(3):275–284. <http://dx.doi.org/10.1016/j.fishres.2005.11.010>.
- Marín, A. and F. Berkes. 2010. Network Approach for Understanding Small-Scale Fisheries Governance: The Case of the Chilean Coastal Co-Management System. *Marine Policy* 34(5):851–858. <http://dx.doi.org/10.1016/j.marpol.2010.01.007>.
- McClanahan, T., E. H. Allison, and J. E. Cinner. 2015. Managing Fisheries for Human and Food Security. *Fish and Fisheries* 16(1):78–103. <http://dx.doi.org/10.1111/faf.12045>.
- Middendorp, H. A. J., P. M. Thompson, and R. S. Pomeroy, eds. 1999. *Sustainable Inland Fisheries Management in Bangladesh*. ICLARM Conference Proceedings 58, 280. Manila, Philippines.
- Mustafa, M. G. and A. C. Brooks. 2009. A Comparative Study of Two Seasonal Floodplain Aquaculture Systems in Bangladesh. *Water Policy* 11(S1):69–79. <http://dx.doi.org/10.2166/wp.2009.004>.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511807763>.
- Ostrom, E. 1994. *Neither Market nor State: Governance of Common-Pool Resources in the Twenty-First Century*. Lecture Series, June 2. Washington, DC: International Food Policy Research Institute.
- Ostrom, E. 1995. Designing Complexity to Govern Complexity. In: *Property rights and the environment: Social and ecological issues*, eds. S. Hanna, M. Munasinghe, 33–45. Washington, D.C., USA: The Beijer International Institute of Ecological Economics and the World Bank.
- Ostrom, E. 2000. Reformulating the Commons. *Swiss Political Science Review* 6(1):29–52. <http://dx.doi.org/10.1002/j.1662-6370.2000.tb00285.x>.

- Ostrom, E. 2002. Common-Pool Resources and Institutions: Toward a Revised Theory. *Handbook of agricultural economics*, 2(Part A):1315–1339.
- Ostrom, E. 2009. Design Principles of Robust Property-Rights Institutions: What Have We learned?. In *Property Rights and Land Policies*, eds. K. Gregory Ingram and Yu-Hung Hong. Cambridge, MA: Lincoln Institute of Land Policy.
- Ostrom, E., J. Burger, C. B. Field, R. B. Norgaard, and D. Policansky. 1999. Revisiting the Commons: Local Lessons, Global Challenges. *Science* 284(5412):278–282. <http://dx.doi.org/10.1126/science.284.5412.278>.
- Schlager, E. and E. Ostrom. 1992. Property-Rights Regimes and Natural Resources: A Conceptual Analysis. *Land economics* 68(3):249–262. <http://dx.doi.org/10.2307/3146375>.
- Schreiber, M. A. and A. Halliday. 2013. Uncommon Among the Commons? Disentangling the Sustainability of the Peruvian Anchovy Fishery. *Ecology and Society* 18(2):12. <http://dx.doi.org/10.5751/es-05319-180212>.
- Shepsle, K. A. 1989. Studying Institutions Some Lessons from the Rational Choice Approach. *Journal of Theoretical Politics* 1(2):131–147. <http://dx.doi.org/10.1177/0951692889001002002>.
- Sultana, P. 2012. Implications of Floodplain Aquaculture Enclosure. *Journal of Environmental Planning and Management* 55(9):1159–1174. <http://dx.doi.org/10.1080/09640568.2011.637104>.
- Sultana, P. and P. Thompson. 2008. Gender and Local Floodplain Management Institutions: A Case Study from Bangladesh. *Journal of International Development* 20(1):53–68. <http://dx.doi.org/10.1002/jid.1427>.
- Thompson, P. M., M. N. Islam, and M. M. Kadir. 1998. Impacts of Government-NGO Initiatives in Community Based Fisheries Management in Bangladesh. Paper Presented at the Seventh Annual Conference of the International Association for the Study of Common Property, 10–14 June 1998, Vancouver, BC, Canada.
- Thompson, P. M., P. Sultana, M. N. Islam, M. M. Kabir, M. M. Hossain, and M. S. Kabir. 1999. An Assessment of Co-Management Arrangements Developed by the Community Based Fisheries Management Project in Bangladesh. Paper Presented at the International Workshop on Fisheries Co-management, 23–28 August 1999, Penang, Malaysia.
- Tietenberg, T. and L. Lewis. 2009. *Environmental and Natural Resource Economics*. New Jersey: Pearson Education Inc.
- Toufique, K. A. and R. Gregory. 2008. Common Waters and Private Lands: Distributional Impacts of Floodplain Aquaculture in Bangladesh. *Food policy* 33(6):587–594. <http://dx.doi.org/10.1016/j.foodpol.2008.04.001>.
- Trimble, M. and F. Berkes. 2015. Towards Adaptive Co-Management of Small-Scale Fisheries in Uruguay and Brazil: Lessons from Using Ostrom's Design Principles. *Maritime Studies* 14(1):1–20. <http://dx.doi.org/10.1186/s40152-015-0032-y>.
- Van Laerhoven, F. and E. Ostrom. 2007. Traditions and Trends in the Study of the Commons. *International Journal of the Commons* 1(1):3–28. <http://dx.doi.org/10.18352/ijc.76>.

- Yandle, T. 2003. The Challenge of Building Successful Stakeholder Organizations: New Zealand's Experience in Developing a Fisheries Co-Management Regime. *Marine Policy* 27(2):179–192. [http://dx.doi.org/10.1016/S0308-597X\(02\)00071-4](http://dx.doi.org/10.1016/S0308-597X(02)00071-4).
- Yandle, T. 2008. The Promise and Perils of Building a Co-Management Regime: An Institutional Assessment of New Zealand Fisheries Management Between 1999 and 2005. *Marine Policy* 32(1):132–141. <http://dx.doi.org/10.1016/j.marpol.2007.05.003>.