

## Evaluating local rules and practices for avoiding tragedies in small-scale fisheries of oxbow lakes, Southern Bangladesh

Abdullah Al Mamun

Department of Geography and Environmental Studies, Wilfrid Laurier University, Waterloo, Ontario, Canada  
[mamun\\_fish@yahoo.com](mailto:mamun_fish@yahoo.com)

Ryan K. Brook

Indigenous Land Management Institute and Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, Canada  
[ryan.brook@usask.ca](mailto:ryan.brook@usask.ca)

**Abstract:** One of the key issues facing fishery managers, policy-makers and researchers has been acknowledging local institutions and rule systems for managing common pool resources. In this paper, we discuss local institutions and rule systems of community fisheries from two oxbow lake Fisheries in Southern Bangladesh. Both of the fisheries have been under private and state management systems resulting in different management outcomes. Control of fishers and stocking for production enhancement have been key management options of the lakes, but progress has not been satisfactory due to higher associated costs of management and uneven resource benefits distribution. On the other hand, community fisheries have focused on sharing benefits, controlling access, avoiding conflict and maintaining ecosystem health. Community fisheries have been managed through local rules and management practices above and beyond government regulations. Taking community fisheries in Bangladesh as a model fisheries and examining local rules as an effective means of controlling fisher access to a common resource, we explore here the impacts of local rules that have had different levels of governance outcomes in relation to state and private systems. Data were collected using semi-structured interviews (40 individuals) and group meetings (one for each site covering 15–20 individuals). Reviews of secondary records also support the analysis. Findings of this study highlight the advantages of local rules and also raise questions about how differential property rights and lack of negotiation power of local communities have constrained the

success of community fisheries. At the group level, the capacity of local fishers to make their own rules and implement them locally is a critical factor for community fisheries systems.

**Keywords:** Comanagement, fisheries, local rule, oxbow lake, participation

**Acknowledgement:** Our special thanks to the community members and other stakeholders of the fisheries comanagement program of the WorldFish Center, Bangladesh, who gave me the opportunity to discuss various management issues related to fisheries governance and management outcomes of community fisheries. We also would like to express my gratitude to Dr. Derek Armitage, University of Waterloo and Dr. Scott Slocombe, Wilfrid Laurier University, Waterloo, Ontario for their assistance guiding the research and preparing this manuscript. We also equally acknowledge the contribution of Dr. Paul M. Thompson, Former Project Director, WorldFish Center, and Dr. Parvin Sultana, Project Scientist, WorldFish Center, Dhaka, Bangladesh (Now with the University of Middlesex, UK), who extended their support in conducting the research and providing access to the WorldFish Database system, archival records and offered other suggestions that benefited the study. Many thanks for my colleagues at WorldFish who advised us about site selection and data collection process. Special thanks to Kirshan Chandra Mondol, M.A. Student, Jahangirnagar University, Bangladesh who supported the mapping process. We also extend our sincere thanks to Dr. Alan Potkin, University of Illinois, USA and Jeremy Pittman, PhD Researcher, Waterloo University who helped us in many ways in developing the paper. This research was funded by the International Development Research Center (IDRC), Canada ([www.idrc.ca/](http://www.idrc.ca/)) and also Wilfrid Laurier University and Dr. John McMurry Research Chair.

## 1. Introduction

This study was conducted in two oxbow lakes of Southern Bangladesh that are treated as small-scale fisheries systems. Small-scale fisheries are often a low-technology driven fishing approaches that are used mostly by subsistence fishers in developing countries for meeting their livelihood needs or protein requirements for their family (Kooiman et al. 2005; Bavinck et al. 2013; Weeratunge et al. 2013). This type of fishery is typically operated in coastal wetlands, inland lakes, and rivers where fishers use traditional harvesting techniques such as small-traps, scoop nets, arrows and harpoons, cast nets and drag nets with or without small fishing boats for transportations (FAO 2014). The introduction of technology intensive fishing such as the operation of large commercial fishing vessels or development of aquaculture at coastal and inland waters have significantly interfered with the traditional uses of small-scale fisheries, leading to reduced fish harvests and marginalization of traditional fishers (Chuenpagdee 2012). Other factors affecting small-scale fisheries systems include the presence of multiple

users within the fisheries systems (e.g. agricultural uses of wetlands) similar to many other common pool resources such as forests (Nayak and Berkes 2008) or freshwater (Gunderson et al. 2006).

The term “common pool resources” or “common property resources” (CPRs) refers to a stock of resources available to generate a flow of goods and services for shared users (Ostrom and Schlager 1996). As these types of resources are shared by multiple users, managing access is typically a significant challenge. These challenges are frequently exacerbated by existing state rules and regulations in fisheries when individual rights are not clearly established (Toufique 1997; Thompson 2006). Therefore, sustainable management (i.e. social, ecological and economic) of a fisheries commons in open waters has been debated, since it possibly contributes to inequitable resource distributions and an apparent lack of state ability to manage the commons. Small-scale fisheries are often treated as classic examples of common pool resources where user rights are shared among multiple users and rights over resources that are not well-defined in terms of harvest of fisheries and related landuse rights such as oxbow lakes of Bangladesh (Middendorp et al. 1997).

Based on the rights and access to users to a resource, common property systems including fishers share two major characteristics. First, the problem of excludability which entails the challenges of controlling the access of potential users. Second, each user is capable of reducing the overall benefits of the resource for others, which is often referred to as the problem of subtractability (Berkes 1989; Ostrom 1990; Jodha 1991; Meinzen-Dick et al. 2006). The wetlands of many countries are characterized by problems of subtractability (many users for a unit of resource such as fisheries or waters) and excludability such as many users have traditional rights on fishing/waters (Johannes 1978) or for privately used lands (Middendorp et al. 1997). For resource scholars such as Thomas Hobbes (1651) in *Leviathan* in the case of human nature; Scott (1955) and Gordon (1954) in the case of degraded fisheries; and Hardin (1968) in the case of overcrowded herds (where each herder tends to add more livestock to grazing lands) have demonstrated that, when left to their own free will, individuals are unlikely to share common goods equitably and resources will be depleted for overuses. Thus, there must be a central, absolute authority (such as a sovereign state or individual rights) to prevent common resource degradation from overuse. However, evidence of the damage that has occurred in many regions of the world due to the privatization of the commons (called neoliberalism) is also portrayed by researchers as the failure of the state to control its resources (Altieri and Rojas 1999; Anderson and Leal 2001; Castree 2006). Some common examples includes: losses of coastal fisheries in small island nations at the south pacific realm (Hanich and Ota 2013); and failures of land tenure in Sub-Saharan Africa (Platteau 1996). Two of the most studied examples of common resource degradation have been the collapse of the cod fisheries on the eastern coast of Canada (Myers et al. 1997), the abalone fisheries of South Africa (Raemaekers et al. 2011), and the loco fisheries of Chile (Hauck and Gallardo-Fernández 2013).

The common property scholars seek to support the roles of local users in attaining the goals of sustainable development of natural resources (social, ecological and economic) such as collective management institutions (Berkes 1989; Ostrom 1990; McCay 1996). Collective management systems based on shared resource uses with local control of resources often results in better governance outcomes than state controlled top-down management approaches (Clark 1990; Borrini-Feyerabend et al. 2007). These communal systems are often based on local rules, norms, and principles, such as many small-scale coastal fishers (Johannes 1978; Ostrom 1990). These systems produce effective governance outcomes (local control of the resource) as they (fishers and other stakeholders) use inexpensive local rules and sanctioning processes to control the access to resources. The recent analysis of longstanding commons is also evolving to support local institutions. Recent studies indicate that not all commons face the overuse problem stated in Hardin's parable *The Tragedy of the Commons* (Hardin 1968). In an open access situation, as long as the communities restrict the access of their own members and that of outsiders if needed then overuse can be avoided (Berkes 1989; Muller and Whillans 2008). According to the supporters of common property systems theory, the "tragedy" as stated by Hardin (1968) occurs only after the destruction of the communal systems and collective actions (Ciriacy-Wantrup and Bishop 1975; Berkes 1989; Feeny et al. 1990; Ostrom 1990), or as the result of a *de facto* open access situation created by less efficient state management systems (Pomeroy and Berkes 1997; Armitage and others 2008; Slocombe and Dearden 2008).

Viewing the scenario in this way, engaging local institutions and rules systems is an important consideration in efforts to solve problems of natural resources (Berkes 1989; Scott 1995; Basurto 2008). With regard to commons, local users set the rules and conditions for resource governance based on their local knowledge and observation of ecosystem properties, along with active consideration of the needs of communities (Ostrom 1990; Acheson 2006; Fleishman 2006). Participatory governance arrangements such as community based fisheries comanagement could be the best example in advancing local institutions for managing fisheries commons (Jentoft 2004; Thompson 2006). Studies on commons have generally agreed that joint decision making as seen in most comanagement programs for resource access as well as equitable distribution of resource outcomes are valuable to resource dependent communities (Ostrom 1990; Thompson 2006). Given the benefits of local rules and institutions, various other studies have separately investigated the processes of access control mechanisms. For example, land tenure systems in Mexico (Jones and Ward 1998), individually transferable quotas for coastal fisheries in the USA (Hilborn et al. 2005), or the applicability of alternative measures to access control in common property systems such as comanagement of New Zealand Coastal Fisheries (Imperial and Yandle 2005) as opposed to state-run systems such as charging entry fees for resource harvests under the communal control of resources (Basurto 2008). Some studies have also defined the types of local rules applicable to fisheries, such as the small-scale

fisheries systems of Asia. In this regard, Pomeroy (1994) has investigated several rules of access, species, and gear to manage fisheries through local institutions.

However, little research has explicitly investigated how a set of community-driven rules and related institutions can promote collective actions by controlling the access of potential users to resources. This study was conducted in two oxbow lakes fisheries of Southern Bangladesh where both local and communal rules are framed under co-management programs have played key roles in effectively managing fisheries (See Figure 1). These fisheries are currently managed under local cooperatives often called “Community-Based Organizations” (CBOs) instead of the previous model of privatized and/or state controls. The rules applicable to these fisheries are often in accordance with state rules under legal fish acts, but further modification has been made to suit local conditions to achieve the social and ecological objectives of the fisheries governance for sustainable use of the resources. This study was designed to investigate how a combination of local rules and practices has acted as an effective force toward excluding other users of the wetlands and establishing community control over fishery resources. It investigates the applicability of local institutions and rules that helped the governance of the fisheries to maintaining the health of the fisheries (ecosystem properties) and controlling access to resources in small-scale fisheries. It especially provides a detailed account of how the community has established different types of rules to control the behaviors of users.

## 2. The study area and settings: biophysical and social considerations

### 2.1. Biophysical considerations

The study areas include two oxbow lake systems called Porakhali Baor (total leasable area 87 ha) and the Bukbhora Baor (total leasable area 300 ha). Both the study areas are located in the Jessore District of southwestern Bangladesh (see Figure 1). They are perennial water bodies and water levels fluctuate between 3 and 10 m fluctuating seasonally and in response to precipitation. Southwestern Bangladesh is situated across several tributaries of the River Ganges, which runs east west while its tributaries run south west of the country. The main tributaries of the Ganges that intersect the study areas include the Bhairab and Kobatak rivers from where the oxbow lakes are created. As the lakes originate from adjacent rivers, fish communities in the lakes are similar fish to those in the rivers. For example, some riverine species including clupeids and small minnows are also available in the oxbow lake waters. The oxbow lakes have traditionally provided local users access to native species such as minnows, clupeids, perch and snakeheads. Communities also have relied on these lakes for collecting cattle fodder such as water hyacinths and other aquatic plants. Other lake uses include small-scale irrigation projects and short range canoe-based transportations.

Traditional fishing gear such as cotton thread made gillnets, hooks and lines, bamboo traps, lift nets, spears and bamboo fencings have been used in the lakes

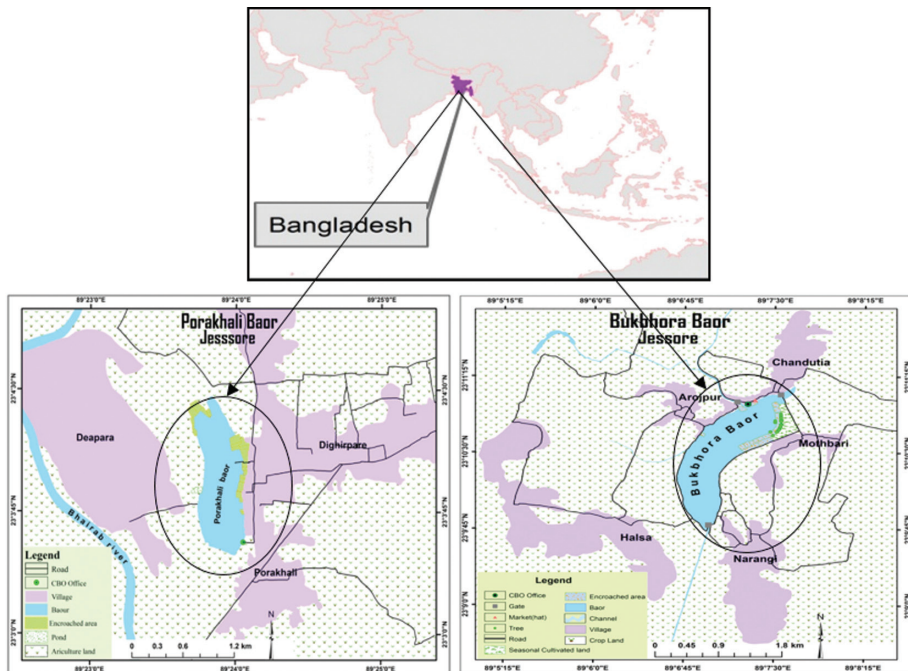


Figure 1: Map of Bangladesh showing location of the study area oxbow lakes (The Baor systems). Map credit: Kirshan Chandra Mondol, Jahangirnagar University, Bangladesh.

for targeting native fishes. The vast majority of oxbow lakes have become silted due to intensive farming in surrounding lands. This farming has caused less wetlands for fisheries growth and other related uses. Some portions of lakes that alternate between wet and dry conditions are leased out to other land users. Lease holders often isolate areas of the lake to form ponds to establish aquaculture (see the boxes in Figure 1 for encroached areas). Given the diverse uses of the lakes, management has been complex and costly to the state. The oxbow lakes are a true example of common property resources (CPRs) based on the resources they hold and the types of property rights applicable.

## 2.2. Social considerations and management options

The oxbow lake systems in the study area have gone through four different management regimes. These include: (i) communal systems (before colonial and the state acquisitions of waters as public property); (ii) zamindari and lease-based systems (pre-independence and colonial era); (iii) lease-based water estates the *Jalmohals*; (1971 and after); (iv) the community-state stocked-based partnership and (v) the community-based fisheries (1990 and present) with a diversity of governance outcomes.

(i) **Communal management system:** Bangladesh is a watershed-based country and its flat landscapes are mostly 3–4 m above sea-level. The vast majority of its lands are inundated by seasonal floods (July–October) that create opportunities for both fishing and farming. Historically, fish and rice have been the common foods for the country. Living in a watershed dynamic ecosystem that changes between wet and dry conditions, fisheries have been important part of the livelihoods of local communities with few opportunities for other livelihoods, such as hunting. Local people have maintained a diversity of relationships with the aquatic systems they live with. There is no well recorded scholarship indicating the socio-cultural relationships of local users with fisheries of oxbow lakes including other open waterbodies in Bangladesh except a few. Fisheries related scholarships have indicated the historical struggles of traditional fishers over establishing rights that were removed by government through leasing and similar other policies (The State Land Acquisition and Tenancy Act 1950) adopted by colonial rulers (Middendorp et al. 1997; Toufique 1997; Jahan et al. 2000; Nathan and Apu 2004; Mamun and Haque 2008). The social relationships of communities with local fisheries and aquatic environments (rivers and natural lakes) have been manifested through the cultural norms and principles of the communities (Pokrant et al. 1997).

In Bangladesh distinct cultural groups are evident among Hindu communities called “The Jaleys” (who live all over the Bangladesh especially with riparian villages) and “The Bansi” (who lives mostly in central area of the Country). These two distinct groups have both taken fishing as their caste-based profession. They have a belief that they are born for fishing and adopting other professions is considered as taboo for them.<sup>1</sup> Other communities in rural Bangladesh have historically also fished to meet their household needs of protein or for recreation. There are other significant cultural relationships local communities with aquatic commons. For the Hindus, open waters especially the rivers are the sacrificing places of their goddesses (e.g. “The *Ma Durga*”) after the homage is offered by the devotees. For both Hindus and Muslim communities, there are different practices that have influenced the behaviors of fishers with respect to access arrangements that are rooted in cultural traditions and norms. The local communities, especially the Hindus, do not fish during their main cultural festivals such as during the “Durga Puja” that is held at the end of October each year. Fishing also ceases in Muslim communities during their main festivals like Eid-ul Adha and Eid-ul Fitr. For shared use systems of the fisheries as “common property system”, a diversity of fishing practices have been adopted in oxbow lakes and rivers. For example, fishing gear is composed of both small and larger sizes.

A substantial benefit is visible from such fishing arrangements in communal systems given fishing pressure does not affect particular type of fish (fisheries

---

<sup>1</sup> This type of belief system is eroding from traditional fishing communities with no much opportunities of fishing from open waters.

target different fish) and conflicts related to finding fishing spots are lessened. Fishing areas are designated for particular fisheries (nearby villagers have specific rights to access) and fishers with one type of fishing gear normally do not intrude into the areas used by other gear users which have been the social norms and still practiced in rural areas. Finding better spots for fishing has not been an issue historically as fishing locations are also different for individual fishers. For example, seine nets (targeting big catches) are used in open waters with no aquatic weeds while small gear such as traps and gill-nets are used inside the thick cover of aquatic weeds. These types of fishing gear target small indigenous fishes such as minnows and aquatic vegetation loving species such as climbing perch, stinging catfish and snakeheads.

The place-based distributions in fishing systems perhaps have allowed functioning the common property systems with less conflicts. As fishing has occurred in different locations and in vegetated or non-vegetated waters alike, weed covered areas from aquatic plants that are often regarded as an issue for culture-based fisheries have less negative impacts on traditional fishing practices. Rather, weed choked areas have favored important habitats for indigenous stocks of fishes (Perch, snakeheads and minnows) with many wildlife that are scarce now such as cormorants, otters, reptiles and frogs.

With the growing needs of fisheries to support the huge amount of population, the government overrode the communal management and culture-based fisheries was introduced to the oxbow lake systems of Bangladesh beginning in the 1980s with the oxbow lakes of Southern Bangladesh. However, culture-based fisheries have followed a market-based approach such as stocking lakes to enhance production. Production from stocking has increased dramatically. Before 1990, fish production from the lakes was around 100 kg/ha but has now increased to 700–1000 kg/ha for both stocked and non-stocked species). For fish cultivation, oxbow lakes (especially at Bukbhora Lake with intensive stocking) that were reclaimed from weeds and having very little vegetation left as natural areas while Porakhali has around 20% weed covered area. Both lake support diversity of local indigenous species along with stocked carp fisheries. At present, with the rise of market prices for non-stocked fishes<sup>2</sup> attention on managing indigenous stocks of fish at oxbow lakes has been increased and the community fisheries systems as described in this paper maintains a number of sanctuaries to recover natural stocks.

**(ii) *The lease-based management (Colonial era 1957 until 1986):*** The traditional use systems with no effective damage to fisheries ecosystems of the lakes strongly suggest that the local approach was effective and adaptive within local ecosystems. Fishers have strong cultural connections with aquatic systems and managing waterbodies locally for their subsistence (livelihoods and social practices such as

---

<sup>2</sup> Non-stocked fish are sometimes valued at 3–5 times more than stocked fisheries as non-stocked fish have become scarce due to human disturbances like establishment embankments that have reduced their productions.



pujas by Hindus). The historically established management system was restricted through state-based managements such as leasing before and after independence of the country in 1971. During the colonial era (1857–1947), fishing rights at the oxbow lakes were partially revoked (The Land Acquisition and Tenancy Act 1950) and the large fishing areas (the water estates) including the oxbow lakes of this study were converted into zamindari *systems of land management* (the feudal landlords). The landlords either sub-leased the water bodies to local people on the basis of an annual payment of taxes (*khajna*) or imposed shared fishing rights. Following the independence of Indian subcontinent from colonial rule in 1947, the zamindari system was abolished in East Bengal (in 1950) and the water bodies once again became state property (Toufique 1997; Mamun and Haque 2008). Since then, the oxbow lakes we studied also have been treated as government property and leasing continued, especially after 1971 when the country got freedom from West Pakistan (East Pakistan is now Bangladesh). Through leasing, the waterbodies have been privatized by the Ministry of Land as the *jalmohals* (*water estates*) for revenue collection (Capistrano et al. 1994; Toufique 1997). Given that traditional fishers have no significant cultural connections with other professions, they have become poor from the *jalmohal* systems and their rights over wetlands were seized. The *jalmohal* leasing process of state-led social discriminations were highly criticized by social organizations such as NGOs including developmental partners (Aguero et al. 1989; SEHD 2003).

The government of Bangladesh has attempted to direct fishing access rights to fishers over government water bodies, the *jalmohals* (Toufique 1997; Thompson 2004). As part of enhancing the welfare of the fishers and local users such as reduce the poverty levels, a system of negotiated leasing out of oxbow-lakes to the fishing cooperative societies was introduced since 1973. But this was not fully realized until waterbodies were handed over to the Department of Fisheries from the Ministry of Lands in 1986. In this year a new policy called The National Fisheries Management Policy (NFMP) 1986 was enacted (Nathan and Apu 2004). This policy piloted licensing for individual fishers in the oxbow lakes and similar other waters. However, this policy change has had little positive impact in managing oxbow lake fisheries since fishers' cooperatives that are formed under the NFMP have been forced to function under the patronage of the money lenders. Fishers often could not pay the lease costs, as they normally subsist and have few assets and little cash income or hold any saving. The *de facto* leasers who helped to pay the lease costs of the fishers such as the money lenders to fishing communities (Thompson et al. 2003; Mamun and Haque 2008) enjoyed the benefits over oxbow lakes. Also, the decisions on who receives fishing licenses have been controlled by the cooperatives (*inter alia* the lease holders who are influential people of the communities) and therefore indirectly by their patrons (Ahmed et al. 1992). The lease-based approach also suffered from distributional problems as fisheries received only 25% of the share incurred from the lake fisheries where fishers had to work as fishing laborers (Middendorp et al. 1997).

(iii) *The state-community partnership (1986–1989)*: Although the oxbow lakes underwent state and private control through leasing and communal rights were revoked for a longer time, the situation changed a little under a World Bank supported fisheries called oxbow lake Project-1 (OLP-1) development program (1986–1990). For this program, lake stocking was managed by the state department (the Department of Fisheries). For this fishing support was available from local fishing groups with a secured share of 40% of total harvests, which may be considered as the first step toward revival of communal rights. However, this approach was not attractive to government as poaching increased, followed by stocking. The corruption from government officials was an issue. For example, over invoicing of stocked fish and selling harvested fishes have been recorded during this era of management that led the fisheries to earn less revenue than expected by the government (Middendorp et al. 1997; Nathan and Apu 2004). Stocking was done using private money from such as leaseholders when government revenues declined from fishing. The communities virtually become the secondary users again, which is similar to what happened with the *jalmohal* systems of leasing where local elites patronized the local fishing cooperative by helping them pay for lease costs and supporting infrastructures such as fences to prevent fish escapes.

(iv) *The community fisheries (1990–2015)*: The current operating approach to fisheries governance (after colonial/state operations of the oxbow lakes by leasing and then the initiation of stock-based enterprises by government) has been the participatory arrangement. Participatory fisheries was initiated through comanagement programs supported by IFAD (The International Fund for Agricultural Development) funding. The external stakeholders included IFAD as funders, the GOB (Government of Bangladesh) as the technical organization and country partner. For this BRAC (Bangladesh Rural Advancement Committee) worked as a community organizer who provided funding supports too as microcredits for local users. Local users (traditional fishers and farmers) worked as monitors for fisheries being the direct beneficiaries of the programs. Although started through a multi-stakeholder arrangement (1990–1997), the fisheries now have more community-based comanagement programs since 1997 (Middendorp et al. 1997). Government controls over lake fisheries lakes are vastly removed from managing oxbow lake fisheries with some exceptions. For example, communities are yet to inform the state such as the Department of Fisheries about stocking (types and quantities stocked). Communities are also responsible for seeking approval for the need to declare catch records and paying the lease fees regularly as per the conditions set for fisheries operations on state waters.

The community fisheries approach from 1990 to 1997 was designed to ensure fisher interests are addressed and to make the common property system more effective (equitable distribution of benefits, community to make decisions of management measures). For this IFAD-GOB-BRAC work together to offer long term lease for community fishers such as combining the *jaleys* (50 year terms an at a 10 year renewal basis). The CBOs for both study sites were supported through

BRAC (Bangladesh Rural Advancement Committee) which was at that time a local NGO working toward local empowerment. BRAC initiated microcredit for local fishers with low interest rates and delayed repayment until after harvesting. Fishers have used the microcredit for buying nets and stocking fingerlings. Project support was also available for the fishers cooperatives as one time grants for maintaining operational costs (stocking and fishing) but fisheries are encouraged to pay the lease costs from their own incomes by maintaining the stocking for better productions. Significant change has occurred, from a short-term lease of 3 years that was patronized by local elites to increased community securement rights that are currently under 50 year leases.

Under a comanagement program where fisher cooperatives make decisions about management systems such as stocking, fishing and guarding. Confidence of local fishers to work together has increased markedly as the programs are still continuing. The fisheries cooperatives are known locally as *Matsya Jibi Samobay Samity* in Bengali term are formed. They are the local forums as community-based organizations (CBOs). The CBOs are responsible for most of the fisheries management related decisions supported by local fisher groups. The CBOs are formed with the help of BRAC and Department of Fisheries supports. They are autonomous bodies run under the leaderships of three chairs (elected through voting mostly) called President, Secretary and Cashier and have their own constitutions (Community Record Books 2011). Provisions were made under the project that CBO leadership roles are independent of any government influences as they are registered as self-governing entities. Under this community fisheries program, some of the ponds were dug at the edges of the lakes which were granted on similar leases to poor women living at nearby villages of lakes but they are mostly occupied by local influential afterwards (Nathan and Apu 2004). So none of the fishers and the women from the surrounding villages have benefited from the pond aquaculture oxbow lake fisheries. Instead, these ponds have been the sources of conflicts with CBOs and occupants of the ponds once fish invade the areas during the wet season (September–October) and the fish are by the pond holders. Allowing these type of ponds at lake basins also has encouraged other individual owners at the fringe lands of the lake to dig more ponds at lake basins. With expanding development of these ponds, the total areas of the lakes has decreased. This issue has escalated conflicts among fishers and pond operators. Fish poaching has been relatively easy as others enter the lake areas for activities related to pond cultivations and fishers are unaware who comes for their work and who come to steal the stocked fishes. The end result is that establishing and maintaining communal rights over the lakes has become more difficult and has greatly reduced the incentive for fish stocking done by fishers.

Secured incomes over private operators (fishers get 25%) or stocked-based fisheries under government department (fishers get 40%) have been relatively more attractive for fishers to work for community fisheries. It is also for more stable communal rights over the remaining waters (except the fringe lands) have helped regulate fisheries under local rules leading to continuation of the oxbow

lakes fisheries. The community fisheries has persisted so far based on some local rules (e.g. community-agreed fishing rules about timing and type of gears to be used and who can fish when and type of share fishers many have). In a community fisheries system, a modified leasing system is applied such as introducing long term tenure-based towards communities. In this system, the state rules in combination with community-driven rules (e.g. group fishing) and practices (setting interim moratoriums) have made the fisheries in the oxbow lakes area more sustainable than the previous two recent (lease and stocking) three approaches. The diversity of management outcomes with more efficient communal management make further evaluation of these community fisheries necessary, and thus investigation of the forth approach (the co-managed fisheries) is the focus of this paper. It especially looks at the types of local institutional arrangements and rules systems that have produced more effective governance outcomes compared to the other two approaches that are more recent.

### 3. Methodology

Grounded in several theoretical frameworks of common property systems (Berkes 1989; Ostrom 1990) and social-ecological systems (Walker et al. 2004; Cash et al. 2006; Folke et al. 2010), this research employs concepts concerning (a) institutions and rule systems that set constraints on the resource use (North 1990; Young 2002; Hodgson 2006; Young et al. 2009) and (b) participatory resource governance that helped adapt communities to the social and ecological requirements of fisheries governance (Viswanathan et al. 2003; Borrini-Feyerabend et al. 2007; Armitage et al. 2008). For evaluation of institutional performance, this research emphasizes understanding the influence of governance policies, structures and processes on local rules (e.g. norms, autonomy of rulemaking, and integration of local rules in resource health management and locally based conflict resolutions and equity/benefit distribution mechanisms). The perspectives and views of local fishers concerning local rules and fishing practices are also included in this analysis, which factor into the success and failure of community fisheries.

The data were collected between May 2010 and October 2012, while final analysis continued through 2013 and 2014. For the primary data collection, key informant interviews and focus groups were used. The key informant interviews were conducted with representatives from community-based organizations along with local members, government offices, and NGOs. Forty-five interviews were conducted covering both study sites. Five of the interviews were with officials (NGOs Personnel N=3 and Government Officials N=2), while 40 were with local participants including leaders and general members of CBOs comprising 20 individuals each. Interview data also included results from two group meetings (one in each site) covering 15–20 individuals related to community fisheries. This target was not random, because a selection of well-informed interviewees with substantial knowledge and experience in oxbow lake management was key for the data collection and interpretation processes.

For both individual interviews and group meetings, open-ended questionnaires were used to seek answers about the governance outcomes of oxbow lakes based on local rules. For group meetings, some key questions were used. They included issues of historical changes on fishing patterns and community benefits, overall impacts of local rules on fishing and issues related to peripheral land use systems. Individual interviews focused on questions that were more specific to achieve in-depth answers and verify findings from the group meetings. To gather information from individual participants about institutions and rule systems, we asked questions such as, “Who is responsible for making decisions about a fish harvesting resource?” “How have changes in access rights affected fisheries and related livelihoods?” and “Who participates in processes to make decisions about access to fisheries?” In addition to developing a systematic understanding of rules concerning a specific resource, we asked questions about who can harvest what, when harvesting is permitted, how much can be harvested, and what tools and techniques are permitted.

For individual interviews, we had to contact group leaders before approaching general members. In most cases, we interviewed local respondents at community centers. The CBO leaders informed the respondents to attend the interviews. Before any interviews and focus group sessions, verbal consensus about taking the interviews and using secondary data from community sources was obtained from community leaders and anyone engaged in fisheries as they were not willing to provide a signature indicating approval. Participant observations also formed a key sources of data which include field visits of areas affected by encroachments and also fishing spots along with observation of the physical settings of the study areas such as connectivity, fishing spots and fish fencing areas.

Each semi-structured interview lasted for 2.0–2.5 hours, while the focus groups lasted 3.0–3.5 hours, depending on the number of participants. We conducted one focus group per site. Data were also collected by reviewing documents from offices and community record books such as yields and different governance arrangements. An analysis of secondary data helped us develop an understanding about the context of fisheries management and the outcomes related to various past and present policy and management approaches, including comanagement such as information on the yields. The analysis and interpretation of data was supported by changes in fish production or integration patterns of local fishers in comanagement and policy changes to support communal rights over fisheries.

#### **4. Results: Governance outcomes**

Comanagement arrangements of small-scale fisheries are typically aimed at enhancing fisheries production with the participation of local users (Thompson et al. 2003). For oxbow lake fisheries, local users are allowed to make their own rules suitable for managing the fisheries to meet the social and ecological needs of the lakes. In our study areas, CBOs have applied a number of mechanisms to manage fisheries based on local rules to address social concerns (participation

and equitable benefit sharing) and ecological issues (managing sanctuaries for conservation of small-indigenous fishes or avoiding overharvest or improper harvests). The economic dimensions related to social-ecological systems also have been addressed such as maintaining financial viability of the community fisheries (40%–50% share go to fishers and the rest are spent for management). Both oxbow lakes have almost similar rules and management practices related to controlling access and sharing benefits. The results presented here, therefore, are applicable to both fisheries systems except mentioned otherwise.

This paper identifies that several important advancements are made through community fisheries systems. The access control rules include keeping membership fixed to specific numbers and discouraging the entry of unwelcomed members such as newcomers unless they demonstrate the requisite skills to take part in CBO activities. Some other rules that have supported managing fisheries include benefit sharing rules, subsistence fishing rules, and food fish rules. Many access rules are established in accordance with state rules and are adapted to local situations. For example, legal fish acts are modified based on the needs of the ecosystem and the characteristics of the fisheries. In addition to access and benefit sharing rules, some beliefs (e.g. superstitions regarding aquatic monsters) have supported the conservation of fisheries. In combination, all of the rules and belief systems have helped the management of fisheries by keeping the fisheries away from exclusion and subtraction problems that are common in the open access situation of CPRs. Comanagement, therefore, has been more than just shared decision making but adapting to the local situation so that the community get benefits from the resource systems by managing access and by maintaining ecosystem health. The rules and how they have shaped the related practices in the oxbow lake commons are described in the next sections.

#### **4.1. Local rules: CBO membership**

Defining user rights is important when controlling access to resources (Basurto 2008). In fisheries, defining who can fish and on what condition fishing can be permitted has been an important consideration in preventing depletion of the resource base. Community fishers have set strong screening rules to differentiate fishers and non-fishers so that a decision can be made regarding who can access the resource. In this regard, CBOs have developed their own constitutions, which are approved by the social welfare department of the government. A CBO constitution sets out various rules for memberships. For example, membership is only allowed for those who fish for cash income beyond subsistence fishing and have less than 0.4 hectare of land for farming. This means that the richer members in the society are discouraged to be active members of the CBO and enjoy the benefits from fishing as a livelihood means. In addition, a group member must spend 80% of his/her time in fishing, agree to share the costs of fishing equitably, and be willing to receive her/his due shares as set by the CBO each year. To control the access to fisheries, CBOs have introduced a membership card for fishers. To maintain

their membership in good standing, members must pay monthly membership fees, attend meetings, and participate in guarding duties. Membership fees vary between Tk. 15–20 (25–30 cents US) per month. The fee amount have been low so that group members can pay it with little hardship. Decisions regarding the membership fees are made every year in general meetings and are based on the incomes of the previous years from fishing.

As a CBO is a supreme authority over community fisheries, it holds the rights for the cancellation or activation of memberships. The membership cancellation/invalidation rules of the Bukbhora and Porakhali sites include: (i) if a member works against the interests of CBOs; (ii) if a member abuses or illegally uses the community funds; (iii) if a member is distrustful and involved in activities that go against society such as divorce or the harassment of family members; (iv) if a member fails to pay membership for three consecutive months; and (v) if a member breaks the CBO rules (i.e. fails to attend guarding duties or participate in group fishing or if he is involved in unauthorized fishing). In the above circumstances, CBOs impose their locally agreed upon sanctions and punishments, such as fishing suspensions for a certain period. In the Porakhali site, violators are barred from fishing for one day during the peak fishing season if they fail to attend guarding duty for one night. After additional violations, they may lose their membership for three months. The CBOs have also developed rules for the reactivation of memberships. For example, if a member applies to CBO leaders within 90 days of cancellation, his membership can be revived if CBO leaders approve it through general meetings and if the violators provide assurance that he will not repeat the fault. We found that most of the litigations related to memberships are resolved locally except for a few cases that went beyond the CBO capacity to rule on. For example, in one case, a CBO member from Porakhali went to a law-enforcing agency as he thought that the CBO treated him unjustly by cancelling his membership.

With respect to fisheries management rules, CBOs were found to be very active to ensure that every member participates in night duties to stop poaching or illegal harvests. In both lakes, the guarding is done in rotations and guarding rules are maintained strictly in both oxbow lakes. Every night, three to four groups take part in guarding duties. To perform night duties, the CBOs have established guarding posts or small huts made of straw roofs (locally called “*Dera*”) in the bank areas of the oxbow lakes. As per CBO rules, members assigned to duties on a certain night have to be gathered in a specified *Dera* before 11:00 p.m. Attending the guarding after 11:00 p.m. is counted as a half-night duty. In this regard, the resolution from the CBO is that fishers who have violated the rules will be advised to compensate. For example, by attending duties for an extra night or a half-day of fishing in the group, but that no share of the catch would be available to them.

In addition to checking unauthorized access by guarding at night, voluntary watching by participants is more common during the daytime. The voluntary watching does not involve extra efforts for fishers as they are all originated from nearby villages. They can watch their fisheries during other tasks such as plowing

the nearby lands, bathing or harvesting fodder for their livestock from the lakes. Fishers voluntarily do monitor the lakes as they feel ownership with the fisheries which was not the case for leasing and state managed stocking program. As per fishers poaching has been reduced as fishers are all around the lake edges. The fishers claimed that, by voluntary watching, they foiled several gang fishing attempts in 2008. In this regard, the president of the Bukbhora site expressed his views as, “We have more people now to look after our fisheries as we have members in all villages surrounding our water body and outsiders cannot enter our fisheries as everybody is watching.”

#### **4.2. Local rules: avoiding unwelcomed members**

Regarding governing the fisheries, both of the study sites have CBOs headed by local leaders such as a president, a cashier, and a secretary. The leaders are honored locally, and they receive some honorariums from the total yearly harvests (i.e. Tk. 3000 or \$50 USD). They are paid from CBO funds for statutory duties such as presiding over meetings at community levels or respond to the calls from district offices. Their transportation and living costs to attend meetings with district officials are also reimbursed from CBO funds. These benefits have made the CBO leadership positions attractive. For CBOs are often pressured to select non-fishers or young individuals with political backings as leaders. However, having individuals without much experience in fishing serving in leadership roles has not been desirable in community fisheries. Based on this view, youths need to wait until they demonstrate commitment to fishing before taking on responsibility in CBOs as leaders.

As CBO members do not welcome the entry of youths, CBO leaders sometimes face political pressure to include a certain number of younger people or non-fishers in leadership positions. In this regard, a number of CBO members blame the local political systems (whoever when riding) for pressuring CBOs to include their supporters. CBOs have often disregarded the idea of the inclusion of new members in CBO leadership positions who have no prior experience with fishing. The CBO leaders believe that, if the political demands are met even once (i.e. the inclusion of supporters who are involved with political parties), it will become a tradition to include new members when the regime changes with the national election every 5 years. Therefore, CBO leaders and participating members have a policy to exclude youths who are not involved in fishing or who are not members of a fishing family approved by CBOs, even upon request from powerful individuals of the locality.

Nevertheless, disregarding such requests often bears risks related to CBO operation. For example, MPs may order the dissolution of a committee before the completion of tenure (normally, CBO terms last for 2–3 years). This information indicates that the community fisheries in oxbow lake are still under state control indirectly in the sense of management, and that an uneven power relation exists among CBOs and external authorities (i.e. between CBOs and land offices/state



individuals). The issue threatens the long term operation of the lakes under local institutions. This phenomenon is similar to the examples and concerns raised by authors working in other parts of the world. For example, the African regions where the governments have been the ultimate decision-makers, especially regarding access arrangements to fishing grounds that supersede community rights (see Hauck and Sowman 2001; Kateka 2010).

### 4.3. Local rules: legal aspects for fish moratoriums

To adjust to local social and ecological conditions, CBOs have established various operational rules (fishing rules) applicable for group members. It was found that CBOs have their own local rules for fishing that are flexible and adjusted in a way that can respond to various ecological and social requirements of the fisheries. The regulatory tools such the Protection and Conservation of Fish Act (1950) bans fishing in breeding seasons (June–September) for the safe breeding of fishes. Breeding, however, is also related to the spectrum of floods and timing of the year. It is informed by fishers that breeding times usually shift a little each year than specified in Fish conservation and Management Act 1950. Therefore, a tight timeframe (three months in a row) as outlined in the Fish Act is not been much applicable for oxbow lake fisheries. Community rules are set based on the conditions of the fisheries that match with time and flood extents. Moratoriums stay in effect between 45 and 75 days but never for 90 days in a row (see Table 1).

I also found that, except for government stated moratoriums in accordance with the Fish Act of 1950, CBOs have set additional rules to implement regarding access control during the harvest season. This self-suspension of fishing can be termed as interim moratoriums as they are not relevant to the normal fish ban rules set under legal fish acts. Fish bans are only applicable during breeding times. In contrast, interim moratoriums are implemented several times in a fishing season to keep fish healthy from the effect of recurrent gear operations. Fishing practices related to habitat destruction are well documented in many studies across the globe and it is confirmed that recurrent hauling affect fish health and related ecosystem properties such as destruction of bottoms and aquatic vegetation (Hall 1999; Turner et al. 2001; Wilson et al. 2010).

*Table 1: Moratoriums days in Porakhali oxbow lake (2007–2011).*

Year	Date of closing	Date of opening	Moratorium days effective	Conditions affected decision making
2007	February 15	April 30	75	Low rains
2008	March 1	May 10	71	Very few grown fish for late stocking
2009	April 1	May 15	45	Needed to harvest fish to meet up lease costs
2010	March 10	May 05	56	Low rains
2011	April 10	May 16	46	Enough waters and low incomes

Source: CBO consultation meetings, Porakhali, 2007–2011.

Although fishers are not blessed with access to scientific information on fishing-related damages, and although support from state department (e.g. District of Fisheries) towards the habitat recovery process to apply in fisheries management is not available, CBO members are very aware of the health of fish. Fishers truly understand that damage occurs in fish habitats from the recurrent hauling of fishing gear and thus impacts fish health conditions. In this regard, the CBOs of oxbow lakes have introduced specific rules for maintaining fish health based on the observation of fishers about local ecosystem conditions. They apply their local ecological knowledge such as water depth and timing of year and fishing loads. For example, after 15 days of fishing in a row during December–March by big seine/purse nets, there must be a one-month undisturbed period (no fishing) to maintain ecosystem properties such as growth of planktons. They believe that available foods are needed to support continuous productions and gaps in fishing help fishes being free of stresses from gear operations. Fishers are aware that fishing may move bottom debris/mud and help it mix with the water column to increase turbidity. It is scientifically proved that excessive turbidity causes a scarcity of natural foods as sunlight penetration is interrupted and the fishes start to starve (Turner et al. 2001).

The purposive rules related to the suspension of fishing (interim moratoriums) has been useful as fish become stressed from recurrent hauling in confined areas like these oxbow lakes under this study which have areas less than 100 hectares. The fish especially experience stress for fishing at low water depths in late winters. In many cases, the rules related to the suspension of fishing are scientific, as fishing has a direct impact on habitat features such as the disturbance of natural food webs (e.g. the destruction of bottom features and the uprooting of aquatic plants) as confirmed by other research works on ecology (see Turner et al. 2001; Wilson et al. 2010). The fishers of the Porakhali site informed me that habitat disturbance leads to less availability of foods and that multiple hauling in closed environments such as the oxbow lakes ultimately causes weight loss in the available fish. If harvesting continues, fishers face loss from the harvest of low quality fishes (they often have wounds and infections on their bodies and are slender in shape). For this they earn a lower wage from selling them in the market (no one want to take wounded fishes or infected fishes). As a result, the measures taken by local fishers based on community rules have both a scientific and an economic bases in responding to the needs of ecological processes. Healthy fish habitats are identified as a prerequisite to healthy fisheries, which was rediscovered through this study, too. This information about fisheries in terms of habitat needs justifies the capability of local fishers to respond regarding resource processes using their own rules and traditional techniques. It also means that fishers can respond to ecosystem needs to develop a reconnection with the ecosystems they use and that they can benefit from ecological services such as high quality catches. This observation highlights the roles of users in promoting social-ecological resilience: a key aspect of resource governance.

#### 4.4. Local rules: symbolic possessions

Property rights help the active possession of a resource such as lands by setting boundaries to control access. As oxbow lakes have both perennial waters and areas that alternate between wet and dry conditions, delineation of physical boundary through permanent markers (e.g. posts) indicating an area under control of CBOs was not possible. In this regard, the community fishers of oxbow lakes have developed some effective mechanisms of access controls that symbolically indicate their occupancy/territory to control accesses. These mechanisms include several physical interventions such as demarcation of the areas with red flags so that unwanted access to main fisheries areas can be avoided. The flags indicate that access to such areas is restricted. Additionally, the fishers hang up signboards at the banks that outline the rules and regulations for sanctuaries and highlight their purposes and importance. Communities have indicated that using legal matters at signboards has not been an issue. These actions can be treated as making cooperative management a formal institutional arrangement as government rules are mentioned in the signboards (e.g. obligations related to legal fish act 1950 and related punishments for violators). Other benefits as mentioned by fishers include user rights relevant to the signboards. The CBO members of the study areas reiterated how people will know they are working for their fisheries if there is no sign of their actions. A member from Bukbhora site remarked, "...we have signboards and flags encircling the sanctuaries and that is how we make outsiders know we are there and they avoid the sanctuary area during fishing." In sanctuary areas marked with red flags and signboards hung indicate that the deployment of fishing gear is physically impeded unless it is mentioned otherwise.

#### 4.5. Superstitions and auto-control of access

Like the informal and formal access control mechanisms and related practices described above, some superstitions and belief systems exist at the study sites that may help with restricting access to the fisheries and protecting fish from poaching. A CBO leader in Porakhali informed me that many fishers believe in the existence of giant aquatic demons or monsters called "*Daos*." They believe these monsters live in deeper areas of water bodies and come out at night to supervise their territories. As per his information, if the *Daos* are annoyed by the behaviors of fishers, they may attack and kill fishers on the spot. Due to such belief or superstitions, fishers avoid night fishing in areas with a high risk of *Daos*. In some cases, fishers do not even enter the areas where they believe the *Daos* live during the day. Called "*duabs*," these areas are a scour in river courses or a place with natural depressions in the Baors. The beliefs related to *Daos* have an impact on fisheries, as the *duabs* are not fished and access is naturally controlled. From a conservation point of view, it is always good if some part of fisheries is set aside from the disturbance of fishing. When other management-related rules fail to produce the desired outcomes, conservation is done automatically through such local beliefs. The remaining fish stocks living in *duabs* help rejuvenate fisheries

in natural systems. Many *duabs* in the study sites have been used as areas for fish sanctuaries or areas where fish aggregates (the *katas*) and harvest becomes easy in low water conditions. Materials such as tree branches and water hyacinths are added to the *katas* as construction materials that aid the fish habitats.

#### 4.6. Local rules: organized harvests and benefit sharing

Local rules are also effective in the case of organized harvesting and benefit sharing mechanism among user group members. We found that CBOs have specific fishing and benefit sharing rules supported by shared catch systems. Individual fishing are discouraged in oxbow lake fisheries and group fishing has been a common practice for both of the study sites. Harvesting undersized fish are not tolerated for the fishing groups and fisher groups who violate this fishing rule may risk losing of fishing days for every kilogram of undersized fishes harvested. In both of the sites examined in this study, large-scale fishing is mostly organized in groups (large seine nets need around 12 crew to operate) and the benefit from the catches are shared. Also important is maintaining the same number of fishers in all groups, so that the harvest amount is the same for all groups. Porakhali includes 16 fishers per group and has four groups with their own seine nets. The similar rule with respect to maintaining group members was applied for Bukbhora too. The group leaders go with the fishing boats. For authentication of fish marketing processes, the group leaders travel along with one fisher representative from the general members, to the city market to execute the selling process. From this type of sale, fishers take 40% of the sale proceeds in the Porakhali site while Bukbhora fishers take 50% of the sale. The rest of the moneys are deposited in the bank under CBO funds. The deposited money is used to repay the loans of the CBOs taken at the time of leasing, to buy fish fingerlings (mostly carp), fishing gear (boats and nets), or to repair fences to prevent fishes from escaping at high water levels. The Porakhali fishers are bound to take a lower share (40%) of the yearly sale as the Porakhali CBO has higher loans from banks and local NGOs compared to the Bukbhora CBO. The total loan of Porakhali is around \$10,000 USD while for Bukbhora it is around \$7500 USD. These loans have to be reimbursed from the total harvests of group fishing.

The total yields from community fisheries were higher in compare to previous two approaches (See Table 2). An investigation on the average incomes of

Table 2: Fish yields (kg/ha/year) from Bukbhora at different management regimes.

Type of fishes	DoF directed management (OLP-1)	DoF-community partnership (OLP-II)	Community-based fisheries (self-rules)
Carp	361	493	634
Small indigenous fish	168	155	313
Total yields	529	648	947

Source: Community Records of Bukbhora oxbow lake, 2011 and IFAD, 1997.

participating fishers of Bukbhora through this study indicates that the community fishers have earned between TK. 25,000–3000 (\$400–700 USD) seasonally. The incomes for Porakhali site have been lower (TK. 20,000–25,000, \$300–400 annually). The incomes for Porakhali is lower given the CBOs have needed to deposit more money to repay past bank loans. Therefore, it can be inferred that comanagement with more control of the resources (i.e. community-based comanagement) generated superior outcomes for the communities than the other approaches that were attempted (See Section 2.2).

#### **4.7. Local rules: food fishes and subsistence fishing**

Several technical means of access control (e.g. legal fish acts, moratoriums, fish harvest, and benefit sharing) and non-technical means (e.g. superstitions), some additional measures (e.g. soft measures) also support the access control to fisheries. Among them, catch sharing for food fishes and allowing subsistent fishing have been common in the oxbow lakes. In the lake areas, some portion of the small fish caught is shared with the people in the local communities who do not fish but who have lands in the area. The small fishes come from all types of big catches such as fish aggregating devices (FADs) set for bulk catches (February–March) that yield a large amount of fish (>100 kg per harvest). Community people who own land at oxbow lakes receive about 3–5 kg of fishes for food each year as a gift from CBOs.

The CBOs also allow some subsistence harvests for villagers or for those who own lands in the lake basins but who are not members of CBOs. Although CBO rules for stocked fishes are quite strict and harvests of stocked fishes are not expected, the harvesting rules for small indigenous fishes are somewhat flexible for local villagers. Subsistence fishing is also allowed year round except in the breeding seasons and during the stocking of carp (July–August). According to the president of the Bukbhora CBO (personal communication, February 2011), the CBO cannot fully control the fishing when a large number of villagers live in the fisheries site. He reiterated that too much control is not possible if there are many users. This type of flexibility is helpful because it reduces conflicting situations among fishers and other users that can partially enjoy the benefit of fisheries. However, these types of rules are not always effective as individual landowners often claim that the fishes on their lands belong to them with no concern regarding stocked or non-stocked species.

Claiming rights over the land has also manifested in conflicts over managing oxbow lakes fisheries. Harvesting stocked or non-stocked indigenous fishes have been common once they are available on the private lands at the times of flooding. Fringe lands are leased to private operators who constructed fish ponds not far from the areas considered as the lake boundaries. In a situation when physical boundaries and the administrative boundaries are not a match, the resource scholars (e.g. Cash and others 2006) has coined this phenomenon as the scale mismatches. In this regard, the most severely affected fisheries have been those in the Porakhali

sites, where a large amount of land (shown as green shaded area with boxes in the Figure 1) are occupied. As a fish cultivation area is established through dykes that separate around 2%–3% of the total area of the Lake. The practice of construction of small ponds (0.5–2.00 ha) by land owners has been source of conflicts as it reduces the total areas of the fisheries. They do it for commercial purposes and have established individual rights rather than communal rights with lake basins.

As per fishers, the issue of encroachment resulting from fish ponds can be exacerbated as more areas are becoming shallower due to siltation and in some years of lower rains than normal. Government attempt to lease out this land to people other than community fishers have escalated the conflicts over securing rights of the lakes. However, as leasing of fringe lands has been common practice for revenue generation for the government, it is likely that leasing process would not stop indicating community rights are infringed on. No revenue sharing mechanisms between fishers and non-fishers who establish fish ponds in lake basins has been established so far. Although the government policies supporting fisheries participation have been providing more effective outcomes, policies for leasing fringe lands for private operators has been controversial in oxbow lake systems. The leasing approach may harm the success made through existing community fisheries if further encroachments are not protected by the state. Threats such as climate change can lead to more arable lands with little or no waters at fringe lands and this has already been documented in many parts of Bangladesh (Chowdhury et al. 2010).

#### **4.8. Discussions: social-ecological outcomes and theoretical significance**

Globally, the loss of open water fisheries stocks and conflicts among resource users highlighting the rapid progressions of resource depletion, particularly in developing countries (Kurien 1992; Chuenpagdee 2012). The issues of resource degradation often related to the absence of proper tools for managing the commons which have prompted a number of theoretical and empirical works. These include: the common property resource indicates less pressuring harvesting methods and benefits sharing among users (Berkes 1989), the design principles for long-standing commons and lately the social-ecological systems for resilient commons (Walker et al. 2004; Schlüter and Pahl-Wostl 2007). These frameworks have outlined the conditions for sustainable commons and relationships of society with resources. These frameworks are useful to assess the outcomes resource governance if they are sustainably managed. Most of the literature supports local institutions such as village units or communities as custodians for commons with certain conditions inherent to them (Berkes 1989; Baland and Platteau 1996; Tucker 1999; Agrawal 2001). Making robust social-ecological connections is identified by some authors as well as the key determinant for better management outcomes where local rules play key roles (Schlüter and Pahl-Wostl 2007).

We expand the above theoretical and conceptual frameworks in connection with local rules to understand the impacts of local rules in governing the commons.

Much research has contributed to an overall understanding of management outcomes based on the above frameworks and theories covering forestry and other natural resources (Tucker 1999; Cox et al. 2010); Fisheries (Pomeroy 1994; Yandale 2003) and marine reserves (Klain et al. 2014). As such, we chose not to confine our discussions related to evaluation of management outcomes fully based on overly used frameworks such as Ostrom's Design Principles for institutional outcomes (Ostrom 1990). Rather we focused on how the local rules have facilitated related conditions concerning fisheries commons. The issues of boundary, defining users and related scrutiny processes, flexible moratoriums, managing access, and benefit sharing of the community fisheries programs as indicated in the result sections are discussed further in connection with local rules to understand the governance outcomes concerning fisheries commons.

Our results demonstrate that oxbow lake fisheries under communal management have many features indicated by common property and social-ecological system scholars. The most advancement we see here is the establishment of user rights (shared among users comprising fishers and farmers) supporting the first principle for long enduring commons by Ostrom (1990) where setting user boundaries is emphasized. Secondly, communities are given the rights to be self-organized which has resulted from the formation of CBOs in both oxbow lakes. In all commons, exclusions of other potential users can be problematic (Berkes 1989; Ostrom 1990). In the case of community fisheries, especially in the Bukbhora, this issue is addressed through some favorable approaches such as sharing small indigenous fishes for household consumptions for claimants of lands through leasing and where fish regularly travel at wet season as they submersed. Access controls are also maintained through two other means: (i) exclusion of unwelcomed members, (ii) setting conditions that support low income families and exclude the richer outsiders (e.g. members to be connected in fishing professions as full-time with low holdings of lands). This likely helped establishing faith of local fishers to support the fisheries as they have some level of ownership over the resources they manage. As per Lobe and Berkes (2004) if the community realize benefits about the participation, they tend to engage in group activities. Here we see that guarding fisheries, and operating group fishing have been effective.

Local rules are also supportive in the case of communal sanctioning processes as underpinned by Ostrom (1990). For example, exemplary punishment for the late attainment of night guiding duties or violation of CBO rules such as paying membership fees late. Some other local rules with graduated sanctioning are also implemented through community fisheries which has been very effective such as renewal rules. The rules renewal of membership have similar patterns with Ostrom's Principle pertaining to sanctioning. For example, the violators are allowed to come back to fishing after a probationary period is maintained followed by an appeal for revival of memberships to CBO leaders. No harassment and assaults are have been reported so far from both study areas.

Maintaining ecosystem health has not been explicitly mentioned in Ostrom (1990). However, some additional rules have complimented the communal fisheries

that include locally introduced measures supporting ecosystem properties such as sanctuaries. Sanctuaries have acted as safe refuges for mother stocks of local indigenous fishes supporting incomes. Sanctuaries are also believed to be a means of establishing communal rights over waterbodies that symbolizes the existence and entitlements of community for a resource systems. In this regard, community fisheries system also have formulated some straight forward rules supporting ecosystems and fisheries health. Fishing in low water conditions or recurrent hauling that makes fishes weak or wounded is not allowed. Fishing is adjusted with water level conditions and also with the market values of certain years.

Community fisheries have also promoted effective intergroup benefit distribution mechanisms such as profit-sharing of fishing sales among users (40% for Porakhali and 50% for Bukbhora are shared among CBO members and the rest are deposited on the common account maintained by CBOs. Savings at banks are used to manage the operational costs of the lakes such as paying lease costs or buying fingerlings of carp. This achievement we can treat as the economic outcomes of maintaining social-ecological relationships (Ostrom 2009).

Defining who will be allowed to access resource benefits has been important consideration for sustainable commons. For the oxbow lake projects, a number of institutional developments have been documented. They include selecting CBO members from low-income families or from traditional fishers. This strategy, however, has not been applicable in the case of leading positions as some leaders are from rich families who are not directly involved with fishing. Although against fisheries comanagement principles that try to uphold fishers right to participate, little dissatisfaction was documented among general members over the holding of leadership roles by rich members. It is understandable that fishers are interested in getting more fish and not much interested who is holding the leading positions. They are simply poor and live on day to day incomes.

Other rules made through CBOs are effective for communal systems including community arranged moratoriums on fish harvest. Moratoriums through state systems (fish bans), however, have never been an effective approach. There are a few fisheries officers living in the cities while people who fish live on lands far from the cities, making enforcement of Fish Acts and Regulation difficult. Other such rules that have supported fisheries and ecosystems and yield are development of local sanctuaries for saving mother stocks for local indigenous species covering minnows, cat fish, small shrimp and perch. Sanctuaries are also treated as a symbol of communal rights over lands. Some belief systems also supported avoiding illegal entry to fisheries areas such as local superstitions. In Bukbhora Lake that has weed choked areas, the community still believes in aquatic giants, the "Deao". The type of belief however, has been eroding with more education. It is also due to losing of water depths for siltation and thickness of aquatic weeds for stocking purposes that makes people less scared. However, it is likely that this type of belief has still have some effects on fisheries management as certain number of fishers do not go fishing on night times where they believe the Deao lives.



Local rules for ecosystem management also have been effective in ecological terms. For example, communities could operate a sanctuary to conserve the parent stocks of local indigenous species that provide higher market prices than stocked fishes. The community of Bukbhora Lake confirmed the higher occurrence of aquatic birds like cormorants and kingfishers indicating better ecosystem development. Community members have indicated that those wildlife was not present in plenty before the comanagement project started. One cause of higher abundance of aquatic birds may be the availability of their foods. It is generally the case that fish availability has increased in the lakes under community fisheries. Fishers also have taken steps towards improving ecological health of the fisheries such as avoiding fishing in the summer season when the lakes contain less waters leading to less stresses to fishes. Recurrent hauls in low waters have always been detrimental to fisheries as confirmed in this paper. The local rules investigated here that are devised locally with the consensus of general fishers have been easy to follow and implemented by users because they jointly set the rules.

In addition, the rules have been acceptable for the local situations, as not much violation of fishing rules are confirmed by the communities except a few illegal entries to fishing grounds by local farmers at Bukbhora Lake Fisheries. Therefore, the formation of rules based with a mix of informal (local rules) and formal rules (state rules supported by policies) in the oxbow lakes perhaps have been effective towards managing fisheries and providing better yields along with improving the social institutions to manage the fisheries. An overall outcome from various management options are given in Table 3 to understand the relative advantages of community fisheries over others. Table 3 indicates that state-managed fisheries yields were nearly half compared to the yields of community-managed systems from Bukbhora Lake Fisheries. There are other advancements with regards to supra institutional development as identified by Pomeroy and Andrew (2011). For example, state rules supporting community interests. For the oxbow lakes, the previous leasing systems were 3 year terms while the existing leases are 50 years terms on a 10 year renewal basis. Department of fisheries has allowed fishers to set their own rules as they needed (flexible rules) such as moratoriums for breeding and interim moratoriums for ecosystem health and fisheries growth. Citing legal matters on signboards has been approved for notification about the controlled access to lake wetlands by outsiders.

Although a set of developments have been achieved with regard to fisheries management, setting a resource boundary for the wetland systems has been a thorny issue for both of the lakes. Boundary issues specially have been conflicting as government used to simultaneously lease the fringe lands for other users interested in either fish cultivation or paddy farming. As fishes migrate to public lands under leasing, they are caught by the owners claiming fishes on their lands as belonging to them. Although fencing of lakes would be effective measures for setting boundaries, this measure is not desired at the lake environment given fishes need areas for foraging and breeding at the shallow fertile lands that are located at the edges of the lakes. However, this issues

*Table 3: Overall management outcomes at different types of governance regimes.*

Type of approach	Governance features	Key constraints	Governance outcomes
1. Market-based and leasing to third parties (<1980s)	<ul style="list-style-type: none"> <li>– Leasing/ tenure-based rights (yearly contracts)</li> <li>– Partial rights</li> </ul>	<ul style="list-style-type: none"> <li>– The auctions tended to be monopolized by the wealthier and influential people</li> <li>– No secure tenure</li> <li>– The Lakes remained poor with ecosystem (often derelict condition) such as overgrown with water hyacinth</li> </ul>	<ul style="list-style-type: none"> <li>– Poor fishers had to work as share-catchers, which limited their rights to only 25% of their catch</li> <li>– Little incentive for anyone to invest in the lakes as it was an annual contract</li> <li>– Productions were lower (200–300 kg/ha) and failed to improve the livelihoods of poor people</li> </ul>
2. State control (1980–1989)	<ul style="list-style-type: none"> <li>– Ran under oxbow lake Project-I (OLP-I) funded by World Bank</li> <li>– Stock-based/ operated by Department of Fisheries (DoF)</li> </ul>	<ul style="list-style-type: none"> <li>– Government needed continual maintenance and operational costs such as fencing to avoid fish escaping and paying cost of fish-stocking using government funds</li> <li>– Higher corruptions from managers (over invoicing for fingerling purchasing and under invoicing of fishes sold)</li> </ul>	<ul style="list-style-type: none"> <li>– Fisher rights seized and access of fishers only by hiring them</li> <li>– Poaching increased</li> <li>– Unsustainable due corruptions and in terms of benefits and costs</li> <li>– Yields between 300–500 kg/ha/year</li> <li>– Could not run after project funding from World Bank ended</li> </ul>
3. Community fisheries (1989 to till date)	<ul style="list-style-type: none"> <li>– Operated under Small-Scale Fishermen Project</li> <li>– Jointly agreed rights</li> </ul>	<ul style="list-style-type: none"> <li>– State helped rehabilitate Lake infrastructures (community center, fencing and embankment etc.)</li> <li>– Hand-over fishing right for decentralize management</li> <li>– Long-term leases to community</li> <li>– Fishers' groups were formed to share the costs and benefits</li> </ul>	<ul style="list-style-type: none"> <li>– Communal right restored</li> <li>– Fisher and local users could invest with confidence in fish stocking, maintaining Lake Infrastructure</li> <li>– Yield range between 700 and 1000 kg/ha/year)</li> <li>– Continuing with less conflicts</li> </ul>

Sources: CBO Records, 1999–2012; IFAD, 1997.

is somewhat supplanted through other means such as sharing some catches of small-fishes with the land owners who claim the fishes belong to them once they migrate to their lands with flood waters. As per leaders from both sites, the main concern is not really the illegal harvests of fishes by land owners but separating the lands from the total area of the lakes. This has happened for establishing fish culture areas in the case of Porakhali extensively and to some extent with Bukbhora. This issue of boundary management has not been settled yet in the case of community fisheries and no indication was found to address the issue by the government department (Nathan and Apu 2004). In this study, the fishers of the oxbow lakes sites questioned if the government had true intentions

of empowering poor fishers through leasing systems or if the government is undermining fisher interest by leasing land to outsiders, as fishers do not get full access to the resources of the Baors. Although the community fisheries have shortcomings, their key strength is the ability of a community to limit the access of outsiders, and introducing self-regulated harvests, management of ecosystem health (ecofriendly harvests) and benefit sharing process. In this regard, Lobe and Berkes (2004) contended that if members of a group are assured that future harvests would be theirs by right, and not end up being harvested by another group, they have the incentive to support the management. For example, they can support fisheries participating jointly organized fishing or supporting fish conservation through local monitors.

## 5. Conclusion

In CPR systems, institutions are viewed as the set of formal and/or informal rules that a group of individuals use to govern the interactions of users and access controls so that the overuse/over harvests (Often termed as resource tragedy) of resources can be avoided (North 1990; Ostrom 1990, 2008; Hodgson 2006). Examples of local institutions include: (i) the control of access to a resource by fishing permits in Seri callo de hacha fishery in Mexico (Basurto 2008); (ii) the padu system of community controlled fisheries in Coastal Kerala, India (Lobe and Berkes 2004). Local institutions are developed based on the knowledge of users that are often supportive in controlling access to CPRs. For example, community sanctions on harvesting undersized fishes of this study (Section 4.6). Many case studies on CPRs have supported local rules including norms, beliefs, values, and local sanctioning processes in order to sustainable management of CPRs (Berkes 1987; Ostrom 2002; Gezelius 2004). A common interpretation from CPR scholars is that, if the rules are fair and acceptable to users, social mechanisms are developed to ensure adherence to the rules to control the access. In such cases, distribution of benefits from the resources becomes easier leading to less conflict and less violation of fisheries rules such as catch of fish during breeding season can be avoided (Ostrom 2000; Gezelius 2004). However, formal laws often contradict local practices and that leads to a reduction in the level of compliance due to lack of local support toward the laws and regulations (Jentoft 2004; Hilborn et al. 2005). In such cases, the legitimacy of the governance process has not been strong and nor could promote local institutions supporting resource systems. The incongruence between two rules (state versus communal) leads to poor compliance towards fisheries acts that are often used as tools for access control. This study has confirmed that non-compliance was an issue for the oxbow lakes, too, in the previous two approaches (privatization and state-managed fisheries) where poaching and corruption have marred the success of the governance of the fisheries.

Also, wetlands have remained in a derelict condition under the privatization process because short-term leasing did not encourage leaseholders to invest in

conservation measures where productions have been lower (Table 2). Additionally, in the privatization process, the benefit-sharing mechanism was constrained by fewer profits for fishers since leaseholders are the sole owners or the patrons of the waterbodies. In the privatization era of oxbow lake management (<1986s), the fishers had a share of less than 25% of the fishes harvested (Apu and Middendorp 1997; IFAD 1997; Nathan and Apu 2004). Many legal rules such as fisheries acts are often violated because they are not developed based on an adequate understanding of the biophysical and social systems and they did not support the livelihoods of fishing-dependent people.

To establish a good governance mechanism, a feasible rule must be made through agreement between rule-makers and rule-followers. Therefore, the governance systems evolved could be considered as advanced in the case of community fisheries. It is because fishers have established rules based on the needs of the ecosystems and often in according with state rules. For example, they apply legal fish acts based on the flood extent. The community has developed the mechanisms to support their livelihood needs along with mainlining savings to manage the cost of lake operation. It can be inferred that a combination of rules instead of just one rule has helped advance good governance in small-scale fisheries. In combination with local rules of access, such as membership and resource sharing, the practice of interim moratoriums possibly originates as a pattern of good governance among oxbow lakes. This study illustrates further that state or private focused lease-based management has been unsustainable. In a state driven stocking program, management costs have become higher and uneven distribution of benefits from the lake systems has occurred. In contrast, community fisheries have been more advanced regarding maintaining management costs and sharing the benefits of the resources harvested.

However, several issues have emerged from the analysis of structures and the processes of local cooperatives and related rules that have various management and policy implications for wetlands as a whole and small-scale fisheries in particular. The first issue is the absence of effective communal property rights. The peripheral lands of both of the oxbow lakes are simultaneously leased to individual operators for farming. These individual sometimes do not acknowledge fishers' rights. Conflict erupts when individual leaseholders of lands claim the ownership of fishes available on the lands – fishes that are stocked by CBOs. The fishers have tried to handle the issue by allowing the catching of fish for food or by offering a portion of catches of small fishes as gifts but this has not been a success in all cases and encroachment of lake beds continue indicating mismatch ecosystem and administrative system boundaries. Given this type of conflict that has constrained the success of community fisheries based on local rules and multiple user rights, it can be inferred that a pure informal management process may not function in wetlands. It is also not possible to implement all these rules applicable to fisheries in a multiple use system. Rather a mix of property rights that ensures the diversity of uses (hereafter both fisheries and agricultural uses of the Lakes) is a better option.

Also, many new concepts are evolving for successful commons from more recent research. Recent studies have indicated that not all conditions as stated by Ostrom (1990) and many others to be met for a successful common (Pomeroy and Andrew 2011). It is further explained the user relationships with resources in social-ecological terms. It is to adapt with resource properties and ecosystems on which fisheries rely on (Armitage et al. 2008; Pomeroy and Andrew 2011) are also informant in this regard. This view holds the notion that management can be still a success given that it perpetuates with some constrains and often with supports from external organizations such as NGOs, funding agencies and government.

Fulfilling boundary aspects especially as stated by Ostrom with long standing commons (Ostrom 1990) or with the concept of fit and scale mismatches (Cash et al. 2006) is perhaps not possible with a third world country situation including Bangladesh with too many users in small-scale fisheries systems (Bavinck et al. 2013). A large and increasing amount of literature on common property systems has indicated that either of the rules (formal or informal) can never completely delineate all modes and pathways of resource access nor can they be conserved along the complex and overlapping web of use systems (Ribot and Peluso 2003; Thompson 2006). As a result, a mixed form of governance arrangement with acceptance of some constrains as a features of commons may produce better outcomes.

A mixed approach as used in this study has focused on addressing issues related to previous policies such as *jalmohal* systems and stocked-based fisheries that have suffered from equitable distribution of benefits. It is also a fact that true state policies have not been a success in all cases such as in establishing property rights over lands occupied for fish cultivation. However, initiating community fisheries (fishers get 40% share for stocked fisheries) by state has been a relative success over other management approach (Lease toward non-fishers). At lease-based management benefits did not reach to traditional fishers (This study; Nathan and Apu 2004). As the state has supported the evolution of the community fisheries, application of local rules by fishers under CBOs have been possible. Therefore, success achieved through local rules in a community fisheries setting also should be credited to government policy changes favoring local commons. This view implies that for commons to function support from both state and communities are important which is identified by recent scholarships on comanagement for common property systems (see Borrini-Feyerabend et al. 2007; Plummer 2009; Pomeroy and Andrew 2011) It may be inferred that hybrid forms of rules combining informal and formal rules and institutions in the oxbow lakes are more favorable than a single set of rules originated either from local or state sources. Future research can be directed toward how a mixed form of access regimes can be established to support common property systems as long as they do not contradict the purposes of state rules and regulations but help local livelihoods and ecosystems processes to avoid resource tragedy in wetlands or in small-scale fisheries like the oxbow lakes under this study.

## Literature cited

- Acheson, J. M. 2006. Institutional Failure in Resource Management. *Annual Review of Anthropology* 35:117–134.
- Agrawal, A. 2001. Commons Property Institutions and Sustainable Governance of Resources. *World Development* 29(10):1649–1672.
- Aguero, M., S. Huq, A. K. A. Rahman, and M. Ahmed, eds. 1989. *Inland Fisheries Management in Bangladesh*. Department of Fisheries, Dhaka, Bangladesh; Bangladesh Center for Advanced Studies, Dhaka, Bangladesh; and International Center for Living Aquatic Resources Management, Manila, Philippines.
- Ahmed, M., D. Capistrano, and M. Hossain. 1992. *Redirecting Benefits to Genuine Fishers: Bangladesh's New Fisheries Management Policy*. Naga: The ICLARM Quarterly, October 1992, 31–34.
- Altieri, M. A. and A. Rojas. 1999. Ecological Impacts of Chile's Neoliberal Policies, with Special Emphasis on Agroecosystems. *Environment, Development and Sustainability* 1(1):55–72.
- Anderson, T. D. and R. Leal. 2001. *Free Market Environmentalism*. New York: Palgrave Macmillan.
- Apu, N. A. and H. A. J. Middendorp. 1997. Establishing Fishers Groups for Self-management of Enhanced Fisheries in Semi-closed Water Bodies in Western Bangladesh. The experience of the Oxbow Lakes small scale fishermen project (OLP-II). Papers presented at the FAO/DFID Expert Consultation on Inland Fishery Enhancements. Dhaka, Bangladesh, 7–11 April 1997. FAO Fisheries Technical Paper. No. 374. Rome, FAO. 1998, 463.
- Armitage, D. R., R. Plummer, F. Berkes, R. I. Arthur, A. T. Charles, I. J. Davidson-Hunt, A. P. Diduck, N. C. Doubleday, D. S. Johnson, M. Marschke, P. McConney, E. W. Pinkerton, and W. K. Wollenberg. 2008. Adaptive Co-management of Social-ecological Complexity. *Frontiers in Ecology and Environment* 7(2): 95–102. doi: 10.1890/070089.
- Baland, J-M and J-P. Platteau. 1996. Halting Degradation of Natural Resources: Is there a Role for Rural Communities? The Food and Agriculture Organization of the United Nations. URL: [http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/21/Halting\\_degradation\\_of\\_natural\\_resources.pdf?sequence=1](http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/21/Halting_degradation_of_natural_resources.pdf?sequence=1).
- Basurto, X. 2008. Biological and Ecological Mechanisms Supporting Marine Self-governance: The Seri Callo de Hacha Fishery in Mexico. *Ecology and Society* 13(2):20. [online] URL: <http://www.ecologyandsociety.org/vol13/iss2/art20/>.
- Bavinck, M., R. Chuenpagdee, S. Jentoft, and J. Kooiman, eds. 2013. *Governability of Fisheries and Aquaculture: Theory and Applications*. MARE Publication Series 7. Springer Science and Business Media, Dordrecht.
- Berkes, F. 1987. The Common Property Resource Problem and the Fisheries of Barbados and Jamaica. *Environmental Management* 11:225–235.

- Berkes, F., ed. 1989. *Common Property Resources – Ecology and Community Based Sustainable Development*. London: Belhaven Press, 312.
- Berkes, F., D. Feeny, B. J. Mckay, and J. M. Acheson. 1989. The Benefits of the Common Commentary. *Nature* 130(6229):90–93.
- Borrini-Feyerabend, G., M. Pimbert, M. T. Favar, A. Kothari, and Y. Renard. 2007. *Sharing Power: Learning-by-doing in Comanagement of Natural Resources Throughout the World*. London: Earthscan.
- Capistrano, D., M. Ahmed, and M. Hossain. 1994. *Ecological Economics and Common Property Issues in Bangladesh's Openwater and Floodplain Fisheries*. Paper presented at the Third Biennial Meeting of the International Society for Ecological Economics: Down to Earth – Practical Applications of Ecological Economics, 24–28 October, 1994, San Jose, Costa Rica.
- Cash, D. W., W. N. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. Young. 2006. Scale and Cross-scale Dynamics: Governance and Information in a Multilevel World. *Ecology and Society* 11(2):8. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art8/>.
- Castree, N. 2006. From Neoliberalism to Neoliberalisation: Consolations, Confusions, and Necessary Illusions. *Environment and Planning A: International Journal of Urban and Regional Research* 38(1):1–6.
- Chowdhury, M. T. H., Z. P. Sukhan, and M. A. Hannan. 2010. Climate Change and its Impact on Fisheries Resource in Bangladesh. Proceeding of International Conference on Environmental Aspects of Bangladesh (ICEAB10), Japan, Sept. 2010. URL: <http://benjapan.org/iceab10/22.pdf>.
- Chuenpagdee, R., ed. 2012. *World Small-scale Fisheries: Contemporary Vision*. Delft: Eburon Publishers.
- Ciriacy-Wantrup, S. V. and R. C. Bishop. 1975. 'Common Property' as a Concept in Natural Resource Policy. *Natural Resources Journal* 15(4):713–727.
- Clark, C. W. 1990. *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*, 2nd ed. New York: Wiley.
- Cox, M., G. Arnold, and S. Villamayor Tomás. 2010. A Review of Design Principles for Community-based Natural Resource Management. *Ecology and Society* 15(4):38. [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art38/>.
- FAO (Food and Agricultural Organization of the UN). 2014. Small-scale Fishers and Communities. URL: <http://www.fao.org/fishery/topic/16602/en>.
- Feeny, D., F. Berkes, B. J. McCay, and J. M. Acheson. 1990. The Tragedy of the Commons: Twenty Two Years Later. *Human Ecology* 18(1):1–19.
- Fleishman, R. 2006. Comanagement as a Solution to the “Tragedy of the Commons”? Lessons from Thai Fisheries. *Journal of Development and Social Transformation*. URL: <http://www1.maxwell.syr.edu/uploadedFiles/moynihan/dst/fleishman.pdf?n=3969>.
- Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience Thinking: Integrating Resilience, Adaptability and

- Transformability. *Ecology and Society* 15(4):20. [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art20/>.
- Gezelius, S. 2004. Food, Money, and Morals: Compliance among Natural Resource Harvesters. *Human Ecology* 32(5):615–634.
- Gordon, H. S. 1954. The Economic Theory of a Common Property Resource: The Fishery. *Journal of Political Economy* 62(2):124–142.
- Gunderson, L. H., S. R. Carpenter, C. Folke, P. Olsson, and G. D. Peterson. 2006. Water RATs (Resilience, Adaptability, and Transformability) in Lake and Wetland Social-ecological Systems. *Ecology and Society* 11(1):16. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art16/>.
- Hall, S. J. 1999. *The Effects of Fishing on Marine Ecosystems and Communities*. Oxford: Blackwell Science, 274.
- Hanich, Q. and Y. Ota. 2013. Moving Beyond Rights-based Management: A Transparent Approach to distributing the Conservation Burden and Benefit in Tuna Fisheries. *The International Journal of Marine and Coastal Law* 28(1):135–170.
- Hardin, G. 1968. The Tragedy of the Commons. *Science* 162(3859):1243–1248.
- Hauck, M. and M. Sowman. 2001. Coastal and Fisheries Comanagement in South Africa: An Overview and Analysis. *Marine Policy* 25(3):173–185.
- Hauck, M. and G. L. Gallardo-Fernández. 2013. Crises in the South African abalone and Chilean Loco Fisheries: Shared Challenges and Prospects. *Maritime Studies* 12(3):1–20. URL: <http://www.maritimestudiesjournal.com/content/12/1/3>.
- Hilborn, R., J. M. (Lobo) Orensanz, and A. M. Parmma. 2005. Institutions, Incentives and the Future Fisheries. *Philosophical Transactions of Royal Society London B* 360:47–57.
- Hobbes, T. 1651. Leviathan. A Summary: URL <http://www.sparknotes.com/philosophy/leviathan/summary.html>.
- Hodgson, G. M. 2006. What are Institutions? *Journal of Economic Issues* 11(1): 1–25.
- IFAD (International Fund for Agricultural Development). 1997. *Community-based Natural Resource Management: How Knowledge is Managed, Disseminated and Used*. Rome Italy: IFAD. URL: <http://www.ifad.org/pub/other/cbnrm.pdf>.
- Imperial, M. T. and T. Yandle. 2005. Taking Institutions Seriously: Using the IAD Framework to Analyze Fisheries Policy. *Society and Natural Resources* 18(6):493–509.
- Jahan, K. M. E., N. M. R. Abdullah, and K. K. Viswanathan. 2000. Welfare Impacts of Fisheries Co-management System at Oxbow Lakes in Bangladesh. International Institute of Fisheries Economics and Trades. Conference proceeding prepared for the 10th IIFET Conference, July 10–14, 2000, The International Institute of Fisheries Economics and Trade (IIFET), Corvallis, Oregon, USA.
- Jentoft, S. 2004. Institutions in Fisheries: What They Are, What They Do, and How They Change. *Marine Policy* 28(2):137–149.
- Jodha, N. S. 1991. *Rural Common Property Resources: A Growing Crisis*. Gatekeeper Series 24. London: IIED.



- Johannes, R. E. 1978. Traditional Marine Conservation Methods in Oceania and their Demise. *Annual Review of Ecology and Systematics* 9:349–364.
- Jones, G. A. and P. M. Ward, eds. 1998. Privatizing the Commons: Reforming Ejido and Urban Development in Mexico. *International Journal of Urban and Regional Research* 22(1):76–93.
- Kateka, A. G. 2010. *Comanagement Challenges in the Lake Victoria Fisheries: A Context Approach*. AC TA Universitatis Stockholmiensis. Stockholm Studies in Human Geography. 274.
- Klain, S. C., R. Beveridge, and N. J. Bennett. 2014. Ecologically Sustainable But Unjust? Negotiating Equity and Authority in Common Pool Marine Resource Management. *Ecology and Society* 19(4):52. <http://dx.doi.org/10.5751/ES-07123-190452>.
- Kooiman, J., J. M. Bavinck, S. Jentoft, and R. Pullin. 2005. *Fish for Life: Interactive Governance for Fisheries*. Amsterdam, The Netherlands: Amsterdam University Press.
- Kurien, J. 1992. Ruining the Commons and Responses of the Commoners: Coastal Overfishing and Fishermen's Actions in Kerala State India. In *Grassroots Environmental Action: People Participation in Sustainable Development*, eds. D. Ghai and J. Vivian. London: Routledge.
- Lobe, K. and F. Berkes. 2004. The Padu System of Community-based Fisheries Management: Change and Local Institutional Innovation in South India. *Marine Policy* 28(3):271–281.
- Mamun, A. A. and C. E. Haque. 2008. Understanding Culture-based Fisheries: An Assessment of a Community-managed Beel Fisheries in Bangladesh. *Asian Fisheries Science* 21(3):257–273.
- McCay, B. J. 1996. Common and Private Concerns. In *Rights to Nature: Ecological, Economic, Cultural and Political Principles of Institutions for the Environment*, eds. S. Hanna, C. Folke, and K.-G. Mäler, 111–126. Washington DC: Island Press.
- Meinzen-Dick, R., E. Mwangi, and S. Dohrn. 2006. Securing the Commons. *CAPRI Policy Brief* 4:1–4.
- Middendorp, H. A. J., M. R. Hasan, and N. A. Apu. 1997. *Community Fisheries Management of Freshwater Lakes in Bangladesh*. Pinang, Malaysia: WorldFish Center, URL: [worldfish.catalog.cgiar.org/naga/na\\_2129.pdf](http://worldfish.catalog.cgiar.org/naga/na_2129.pdf).
- Muller, R. A. and F. Whillans. 2008. A Common Pool Resource Experiment with a Dynamic Stock Externality. McMaster University, Hamilton, Ontario. Available at: <http://economics.ca/2008/papers/1127.pdf> (Last accessed October 2008).
- Myers, R. A., J. A. Hutchings, and N. J. Barrowman. 1997. Why Do Fish Stocks Collapse? The Example of Cod in Atlantic Canada. *Ecological Applications* 7(1):91–106.
- Nathan, D. and N. A. Apu. 2004. Case Study of the Oxbow Lakes Small-scale Fishermen's Project (OLSSFP) Bangladesh – 1990–1997. IFAD Innovation Mainstreaming Initiative. URL: <http://www.ifad.org/english/operations/pi/bgd/documents/oxbow.pdf>.

- Nayak, P. and F. Berkes. 2008. Politics of Co-optation: Community Forest Management vs. Joint Forest Management in Orissa, India. *Environmental Management* 41(5):707–718.
- North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
- Ostrom, E. 2000. Collective Action and the Evolution of Social Norms. *The Journal of Economic Perspectives* 14(3):137–158.
- Ostrom, E. 2002. *Common Pool Resources and Institutions: Handbook of Agricultural Economics, Volume 2, Part A*:1315–1339.
- Ostrom, E. 2008. Institutions and the Environment. *Economic Affairs* 28(3): 24–31.
- Ostrom, E. 2009. Perspective: A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325(5939):419–422.
- Ostrom, E. and E. Schlager. 1996. The Formation of Property Rights. In *Right to Nature: Ecological, Economic, Cultural and Political Principles of Institutions for the Environment*, eds. S. S. Hanna, C. Folke, and K. G. Maler. Washington: Island Press.
- Platteau, J. P. 1996. The Evolutionary Theory of Land Rights as Applied to Sub-Saharan Africa: A Critical assessment. *Development and Change* 27(1):29–86.
- Plummer, R. 2009. The Adaptive Co-management Process: An Initial Synthesis of Representative Models and Influential Variables. *Ecology and Society* 14(2):24. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art24/>.
- Pokrant, B., P. Reeves, and J. McGuire. 1997. Riparian Rights and the Organization of Work and Market Relations among the Inland Fishers of Colonial Bengal, 27–48. In *Openwater Fisheries of Bangladesh*, eds. T. Chu-Fa and Y. Ali. Dhaka: University Press Limited.
- Pomeroy, R. 1994. *Community Management and Common Property of Coastal Fisheries in Asia and Pacific: Methods and Experiences*. ICLARM Conference Proceeding 45, 189 pp. Silang, Cavite, Philippines.
- Pomeroy, R. S. and F. Berkes. 1997. Two to Tango: The Role of Government in Fisheries Comanagement. *Marine Policy* 21(5):465–480.
- Pomeroy, R. S. and N. Andrew. 2011. *Small-scale Fisheries Management: Frameworks and Approaches for the Developing World*. Oxfordshire, UK, CABI: Wallingford.
- Raemaekers, S., M. Hauck, M. Bürgener, A. Mackenzie, G. Maharaj, É. E. Plagányi, and P. J. Britz. 2011. Review of the Causes of the Rise of the Illegal South African Abalone Fishery and Consequent Closure of the Rights-based Fishery. *Ocean & Coastal Management* 54(6):433–445.
- Ribot, J. C. and N. L. Peluso. 2003. A Theory of Access. *Rural Sociology* 68(2):153–181.

- Schlüter, M. and C. Pahl-Wostl. 2007. Mechanisms of Resilience in Common-pool. Resource Management Systems: An Agent-based Model of Water Use in a River Basin. *Ecology and Society* 12:4.
- Scott, A. 1955. The Fishery: Objectives of Sole Ownership. *Journal of Political Economy* 63(1):116–134.
- Scott, W. R. 1995. *Institutions and Organizations*. Thousands Oak, CA: SAGE.
- SEHD (Society for the Environment and Human Development Bangladesh). 2003. *Bangladesh Environment Facing the 20th Century*. Dhaka: SEHD.
- Slocombe, D. S. and P. Dearden. 2008. Ecosystem-based Management and Park Planning. In *Parks and Protected Areas in Canada*, 2nd ed., eds. P. Dearden and R. Rollins, Toronto: Oxford University Press.
- Thompson, P. M. 2004. Lessons from Community Based *Fisheries Management* in Bangladesh: Briefing Paper. WorldFish Center. Dhaka. URL: [www.dfid.gov.uk/r4d/pdf/outputs/rlp/CBFM.pdf](http://www.dfid.gov.uk/r4d/pdf/outputs/rlp/CBFM.pdf).
- Thompson, P. M. 2006. *Scaling up Community-based Co-Management of Wetlands and Fisheries in Bangladesh*. Dhaka: WorldFish Center, URL: [http://pdf.usaid.gov/pdf\\_docs/PNADJ856.pdf](http://pdf.usaid.gov/pdf_docs/PNADJ856.pdf).
- Thompson, P. M., P. Sultana, and N. Islam. 2003. Lessons from Community Based Management of Floodplain Fisheries in Bangladesh. *Journal of Environmental Management* 69(3):307–321.
- Toufique, K. 1997. Some Observations on Power and Property Rights in the Inland Fisheries of Bangladesh. *World Development* 25(3):457–467.
- Tucker, C. M. 1999. Common Property Design Principles and Development in a Honduran Community. *Fletcher Journal of Development Studies* XV. [online] URL: <http://fletcher.tufts.edu/praxis/archives/xv/Tucker.pdf>.
- Turner, S. J., S. F. Thrush, J. W. Hewitt, V. J. Cummings, and G. Funnels. 2001. Fishing Impacts and the Degradation or Loss of Habitat Structure. *Fisheries Management and Ecology* 6(5):401–420.
- Viswanathan, K. K., J. R. Nielsen, P. Degnbol, M. Ahmed, M. Hara, and N. M. Raja Abdullah. 2003. *Fisheries Comanagement Policy Brief: Finding from a Worldwide Study*. Penang, Malaysia: WorldFish Center Policy Brief 2.
- Walker, B. H., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, Adaptability and Transformability in Social–ecological Systems. *Ecology and Society* 9(2):5. [online] URL: <http://www.ecologyandsociety.org/vol9/iss2/art5>.
- Weeratunge, N., C. Béné, R. Siriwardane, A. Charles, D. Johnson, E. H. Allison, P. K. Nayak, and M. Badjeck. 2013. Small-scale Fisheries through the Wellbeing Lens. *Fish and Fisheries* 15(2):255–279.
- Wilson, S. K., R. Fisher, M. S. Pratchett, N. A. J. Graham, N. K. Dulvy, R. A. Turner, A. Cakacaka, and N. V. C. Polunin. 2010. Habitat Degradation and Fishing Effects on the Size Structure of Coral Reef Fish Communities. *Ecological Applications* 20(2):442–451.
- Yandale, T. 2003. The Challenge of Building Successful Stakeholder Organizations: New Zealand’s Experience in Developing a Fisheries Comanagement Regime. *Marine Policy* 27(2):179–192.

Young, O. R. 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*, 1st ed. Cambridge, MA: MIT Press, 237.

Young, O. R., A. Agrawal, L. A. King, P. H. Sand, A. Underdal, and M. Wasson. 2009. Institutional Dimensions of Global Environmental Change Project: Science Plan. IHDP Report 9. Bonn.