Untangling the Complexities of Tanguar Haor's Fisheries' Social-Ecological System through Ostrom's SES Framework

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Swamps, reeds, and forests constitute the unique fishery of the Tanguar Haor (Photo: Iftekhar Ahmed Fagun, 2017).

Abstract

This chapter presents a case study addressing the complexities of the Tanguar Haor fisheries' social-ecological system. The study adopted Ostrom's Social-Ecological System (SES) framework to analyze the complexities. The study identified how the actors interact with the biophysical system through a governance system. As a result, the actors involved with fishing faced a more complex governance system, which has implications on social equity and sustainability of the SES system. The analysis revealed the necessity of developing a long-term participatory management initiative and improving the system's sustainability. The research will be helpful as a diagnostic tool for identifying management challenges and complexities that lead to a disadvantaged socioeconomic position of Tanguar Haor's small-scale fishers, who are already living on the fringes of society.

Introduction

A *haor* is a low depression in the form of a basin or saucer, often described as a backswamp, found in the northeastern region of Bangladesh, which remains inundated with water for around six months in a year. The Tanguar Haor is home to at least 141 freshwater fish species, 150 wetland plant species, 11 amphibians, 34 reptiles (including 6 turtles, 7 lizards, and 21 snake species), 208 bird species, and 19 mammal species (IUCN Bangladesh, 2016). In addition, it serves as important grazing, spawning, breeding, and nursery area for freshwater fish and prawn species. These rich fisheries resources add a considerable value to the national economy by contributing 14 percent of the yearly catch of the open-water fisheries production in the Sunamganj district and 0.67 percent at the national level (IUCN Bangladesh, 2016). As such, Tanguar Haor directly supports the livelihoods of around 60,000 people from 88 nearby communities and contributes significantly to the nation's aquatic food production and food security. On average, more than sixty percent of the surrounding communities earn a living from fishing or related activities

from this ecosystem (Alam *et al.*, 2015). However, the natural fish populations have decreased significantly over the years due to increased fishing pressure and anthropogenic activities that cause siltation, water pollution, and loss of natural habitat for spawning and growth (Akhteruzzaman *et al.*, 1998). Tanguar Haor's ecosystem, communities, and livelihood are also vulnerable to natural calamities like flash floods (Munasinghe, 2000).

Dominant elites controlled the Haor's fisheries through a lease system that drastically exploited its fisheries resources from the 1930s until the end of the last century. The leaseholders used their power, cash, and muscle to prevent the impoverished fishers and the locals from accessing the natural resources of the Tanguar Haor. Consequently, this became a sad example of fishing rights violations. Until recently, while the *Haor*'s lease system was functioning, fishers had to fish illegally and were forced to poach to sustain their subsistent living. And if the leaseholders caught them, they faced repercussions. Some fishers were allegedly killed in several circumstances (The Daily Star, 2009).

The Tanguar Haor was declared an Ecologically Critical Area (ECA) by the Government of Bangladesh (GoB) in 1999, in recognition of its ecological significance as well as its critical condition caused by the overexploitation of its natural resources (GoB, 2004). On July 10, 2000, it became the second Ramsar site of Bangladesh due to its global importance as a migratory habitat for waterfowls and its enormous biodiversity (IUCN Bangladesh, 2016). The leasing system was phased out in 2001, and the ownership of the Tanguar Haor was transferred to the Ministry of Environment and Forests (MoEF) from the Ministry of Land (MoL), following the Ramsar site designation (Kabir and Amin, 2007). The district administration of the Sunamganj District was in charge of the management.

The National Conservation Strategy Implementation Project was the government's first conservation effort, launched in the mid-1990s. In 2006, a project entitled 'Community Based Sustainable Management of Tanguar Haor' (CBSMTH) was initiated by the MoEF, with the financial assistance of the Swiss Agency for Development and Cooperation (SDC) and technical assistance of the International Union for Conservation of Nature (IUCN) in Bangladesh. A preliminary phase (2006-2009), a development phase (2009-

2012), and a consolidation phase (2012-2016) have already been completed for the project (IUCN Bangladesh, 2016). At the end of this project, the government initiated a new project titled 'The Tanguar Haor Bridging Phase (THBP) project (2016-2018)'. Currently, no remarkable development or management project is happening in the Tanguar Haor region. Therefore, the complex interaction between the most important resource user (fisher) and threatened resource system (fisheries) needs to be analyzed to implement management strategies that will improve fishing livelihoods and sustainably conserve the fisheries resources. Against this backdrop, this study aims to address and explore the complex fisheries-based social-ecological system of the Tanguar Haor.

The empirical data of this study is gathered from fieldwork and desk studies based on the literature review. The study employed the Social-Ecological System (SES) framework proposed by Ostrom (2009), which provides the most utilized tools to analyze the complexity of social-ecological systems. The SES framework is a common framework for studying various aspects of a social-ecological system through time.

Ostrom's framework for the fisheries-based SES of the Tanguar Haor

The resource system, the resource units produced by that system, the governance system, the actors in that system, and the focal action situations – interactions and outcomes, are eight primary tiers that make Ostrom's SES framework. The SES framework has been adapted to improve its ability to evaluate complicated SESs and allow social and natural scientists to use this framework (Hinkel *et al.*, 2015). McGinnis and Ostrom's (2014) framework of 56 second-tier variables was used in this study (Table 1). The fisheries-based SES of the Tanguar Haor was developed following Ostrom's framework and is presented in a narrative style.

Table 1 (part a): Second-tier variables of a social-ecological system (adapted from McGinnis and Ostrom, 2014).

Social, economic, and political settings (S)	Governance system (GS)
S1—Economic development	GS1—Government organizations
S2—Demographic trends	GS2—Non-government organizations
S3—Political stability	GS3—Network structure
S4—Other governance systems*	GS4—Property-rights systems
S5—Markets*	GS5—Operational-choice rules
S6—Media organizations*	GS6—Collective-choice rules
S7—Technology*	GS7—Constitutional-choice rules
	GS8—Monitoring and sanctioning rules
Resource systems (RS)	Resource units (RU)
RS1—Sectors	RU1—Resource unit mobility
RS2—Clarity of system boundaries	RU2—Growth or replacement rate*
RS3—Size of resource system	RU3—Interaction among resource units*
RS4—Human-constructed facilities	RU4—Economic value
RS5—Productivity of system	RU5—Number of units
RS6—Equilibrium properties	RU6—Distinctive characteristics
RS7—Predictability of system dynamics	RU7—Spatial and temporal distribution
RS8—Storage characteristics	
RS9—Location	

Table 1(part b): Second-tier variables of a social-ecological system (adapted from McGinnis and Ostrom, 2014).

Actors (A)	Related ecosystems (ECO)
A1—Number of relevant actors	ECO1—Climate patterns
A2—Socioeconomic attributes	ECO2—Pollution patterns
A3—History or past experiences	ECO3—Flows into and out of focal SES*
A4—Location	
A5—Leadership/entrepreneurship	
A6—Norms (trust-reciprocity)/social capital	
A7—Knowledge of SES/mental models	
A8—Importance of resource (dependence)	
A9—Technologies available	
Action situations: Interactions (I) → Outcomes (O)	
Interactions (I)	Outcomes (O)
I1—Harvesting	O1—Social performance measures
I2—Information sharing	O2—Ecological performance measures
I3—Deliberation processes	O3—Externalities to other SESs
I4—Conflicts	
I5—Investment activities	
I6—Lobbying activities	
I7—Self-organizing activities	
I8—Networking activities	
I9—Monitoring activities	
I10—Evaluative activities	

Resource Systems (RS)

[RS1] All parts of the environment and *haor* ecosystem that sustain the fish population, feeding, breeding, and nursery grounds in the Tanguar Haor are included in the fisheries resource system. The swamps and reed beds exclusively support the fish population. [RS2] One-third of the *Haor* is in Tahirpur Upazila (sub-district) and the rest is located in Dharmapasha Upazila; both are part of the Sunamganj District of the Sylhet Division, near the Indian border, along the Meghalaya hill region. [RS9] The *Haor* is located between 25°06″ to 25°11″N and 91°01″ to 91°06″E (Chowdhury, 2010). [RS3] The Tanguar Haor spreads over an area of 10,000 hectares, approximately 50 percent of which is covered by water bodies. A total of 54 *beels* (lake-like wetland with stagnant water) comprises the *haor* ecosystem. These *beels* hold the remaining water during the dry season and shelter the brood fish. During the rainy season, all of the *beels* merge into one enormous lake, forming the Tanguar Haor, the largest freshwater wetland of Bangladesh. [RS5]

The Tanguar *Haor* is a highly productive ecosystem in fish production, biodiversity preservation, meeting local and regional demand for fish, and providing a good source of fish seed supply for other water bodies. The estimated fish stock of Tanguar Haor is 6,701 tons (Ahmed, 2015). Low sedimentation rate caused by the absence of major rivers passing through the *Haor*, safe breeding ground and shelter support from natural reeds and swamps, availability of food and nutrients, and natural ecological balance make the Haor suitable for feeding, breeding, and growth. [RS4] Local fish landing sites are located in Tahirpur Upazila, Dharmpasha Upazila (of Sunamganj district), and Mohanganj Upazila (of Netrakona district). The only well-structured fish landing center, established by the Bangladesh Fish Development Corporation, is located in Dobor Ghat, Sunamganj. Unfortunately, the center is far away from fishing zones and is not being adequately maintained.

Fish processing activities and facilities are limited in the Tanguar Haor

region. Instead, fish is dried using the traditional, open sun drying process. [RS8] The fish collectors collect fish from the 88 villages and preserve harvested fish in locally manufactured iceboxes in seven collection points in the surrounding area. [RS6] The most unsustainable fishing tactics utilized in Tanguar Haor include harvesting the last remaining fish through dewatering, using unlicensed and harmful gear (e.g., monofilament gill nets), drying out water bodies, and over-harvesting. In addition, unsustainable usage and destruction of swamp forests and reeds, coal storage and transportation, and water contamination put the entire resource system's integrity in jeopardy. [RS7] All of these concurrent negative factors that contribute to the decline in the health and productivity of the system are preventing fishers and local people from making accurate predictions about the system's productivity. Thus, they believe that the dynamics of the ecosystem cannot be adequately predicted.

Resource Units (RU)

The fish species that inhabit in Tanguar Haor are considered RUs. [RU5] The identified number of RUs (fish species) is 141 under 35 families (IUCN Bangladesh, 2016). The number of fish species is around half of the total 260 freshwater fish species found in Bangladesh. [RU6] Aside from providing habitat to many species, this Haor also harbors many rare and threatened fish species. The critically endangered species like *Bagarius bagarius* (Devil Catfish), *Clupisoma garua* (Garua Bachcha), *Crossocheilus latius* (Gangetic Latia), *Ctenops nobilis* (Frail Gourami), *Eutropiichthys vacha* (Batchwa Vacha), *Labeo boga* (Boga Labeo), *Mystus seenghala* (Giant River-Catfish), *Notopterus chitala* (Clown knifefish), *Pangasius pangasius* (Yellowtail catfish), *Rasbora elanga* (Bengal barb), *Rita rita* (Rita), *Rohtee cotio* (Cotio), *Silonia silondia* (Silond Catfish), and *Tor tor* (Tor mahseer) can all be found in Tanguar Haor. Indigenous fish species are dominant in this ecosystem. However, three species are considered extinct: *Channa barca* (Barca snakehead), *Labeo boggut* (Boggut labeo), and *Labeo nandina* (Nandi Labeo), while 16 are critically endangered, and 26 are endangered (Giesen and Rashid, 1997).

[RU1] The fish stock is maintained through a natural recruitment process, and recruitment occurs both within and outside the Tanguar Haor. After spawning, a remarkable number of fingerlings/juveniles scatter to the other *haor* ecosystems every year. This dispersal of larvae/juveniles from Tanguar Haor enriches the fish stock of eight districts in Bangladesh. Simultaneously, non-native fish from other *haors* also immigrate to the Tanguar Haor for shelter and growth. The fish population of the Haor follows different types of migration. *Ujja*, or pre-monsoon migration, breeding of fish within Tanguar Haor, and the return migration in September and October represent the main types of movement. Migration takes place *beel* to *beel* through a river, Tanguar Haor to the Surma River, Tanguar Haor to the Jadukata River, or vice-versa. [RU7] The Jadukata and Patlai rivers are considered special breeding grounds for many fish species in Tanguar Haor. In March-April, small fish breed in connecting channels, hill streams, and inlet channels. Medium-sized fish breed in connecting channels of the Tanguar Haor. [RU4] The monetary or economic value of this vast fisheries resource is USD 1,765,626.91 per year (Solayman *et al.*, 2018).

Actors (A)

The actors are fishers whose livelihoods depend solely on catching fish resources in the Tanguar Haor. [A1] There are both full-time fishers (2,070) and part-time fishers (6,930) (Ahmed *et al.*, 2015). However, more than 70 percent of the households in the adjacent villages occasionally fish for income or food (Minkin *et al.*, 1997). [A2] Fishers' socioeconomic conditions can be interpreted as backward and bleak. Around 80 percent of fishing households have no or minimal alternative income-generating opportunities. Dietary diversity is also low as fish, vegetables, and rice are the main food ingredients. About 27 percent of fishers have a monthly income of USD 35-80. More than 30 percent of fishers have a monthly income between USD 58-80, while 25 percent have an income between USD 18-35. Around 6 percent of fishers have a monthly income that is less than USD 18. The fishers lack access to many necessities such as electricity, water, sanitation, schools, and marketplaces.

The households of 78 percent of fishers are made of clay and bamboo, and only a few are made of bricks (7 percent) (Mamun *et al.*, 2018).

[A3] Fishing is the hereditary profession of most actors. During the years 1780-1900, there was a significant outward migration from the Tanguar Haor due to a succession of natural disasters that led to a population decrease. However, by the second half of the nineteenth century, the situation changed as the *haor*'s basin ecosystem recovered from the environmental stress and restored its productivity. Starting in the first quarter of the twentieth century, the area saw the return of settlers from the surrounding regions, latterly those involved in fishing (Nishat, 1993). Furthermore, during the monsoon season, many fisherfolks (1200-2000) and their families settled in temporary fishing camps at the Tanguar Haor and then back to the villages (IUCN Bangladesh, 2015).

[A4] The fishers from Tanguar Haor reside in 88 island-like villages, some of which are as few as five houses while some villages contain as many as 571 households. [A5] Usually, the group of fishers meets before a fishing trip. The traditional *katha* fishing (by piling tree branches and aggregating fish within it) is always headed by a group leader and consists of 5-12 group members. Notably, community leadership capacity was built under the CBSMTH and THBP projects. The fishers were involved with cooperative societies, learned to harvest fish sustainably, and became conscious of protecting biodiversity. Currently, societies are experiencing challenges due to complicated governance systems at the local levels and wider social-political instability.

Nonetheless, the leadership of the central cooperative society's remained active. [A6] To protect fish biodiversity and the ecosystem, community patrolling was introduced and supported by law enforcement agencies. Sometimes fishers were faced with the most perplexing dilemma: by paying a bribe of merely one USD to administrative authorities such as Ansars (a paramilitary auxiliary force responsible for the preservation of internal security and law enforcement in Bangladesh), certain corrupted fishers, and agents of local water lords so they can continue illegal fishing. In fact, illegal fishing (e.g., poaching) happens all year around (Alam *et al.*, 2015). [A7] However, the

majority of the actors held a conservationist view as more than ninety percent of the actors are willing to participate in sustainable ecosystem management activities (Mondal *et al.*, 2010). Thanks to community-based management projects implemented in the *Haor* region, the actors are now aware of the value of the social-ecological system.

[A8] According to an IUCN survey conducted in 2008, more than ninety percent of the residents reported some dependence, via their occupation, on Tanguar Haor. More than sixty percent were involved in fishing-related activities. [A9] The fishing gears used by the fishers can be classified into three main groups: fishing traps, hooks, and nets. They generally use 10-15 different types of fishing traps, including: closed traps (*Icha Chai, Banjali, Sat Muikkha, Burchunga Chai, and Gui*) and open traps (*Katha, Chai Ban, Light Trap, and Garojal*). Hooks are frequently used to catch fish. *Pocha hook, Tanga hook, Daitta borshi, Laar borshi, Chip borshi, Khili borshi, Tuni borshi, Dori borshi,* and *Fol* are commonly used hooks. Fishers widely use around 15 nets to catch fish, including *Chowhanda Jal, Garojal/Chackjal/Jhap Jal, Ber Jal, Push Jal, Fash Jal, Thela/Felun Jal, Gon/Gan/Ghuraina Jal, Koi Jal, Chela Jal, Koni/Jhaki Jal, Bachuri/Eknaia/Bichani Jal, Utar/Gaitya Utar, Naia Utar Jal, Tana net, Koti/Horhori Jal*. *Katha* fishing is a traditional fish harvesting technique that involves aggregating fish to a specific region by erecting shelters. Branches or entire treetops were taken from swamp forests to construct *Katha* enclosures. Before fishing, they encircle the harvesting area with a nylon net. Then, they progressively pull the lower and upper parts of the net from all sides, enclosing both portions of the net and catching the fish that became entangled in the net.

Governance System (GS)

[GS1] As a local government administration of the Department of Fisheries (DoF), the Upazila Fisheries Officers of Tahirpur and Dharmapasha Upazilas (sub-districts) of Sunamganj district are in charge of managing the Tanguar Haor. During the CBSMTH project, a three-tiered community-based governance system was formed by the Government of Bangladesh (GoB) with

the technical assistance of IUCN. After that, the co-management system in Tanguar Haor remained operational, primarily through the Tanguar Haor Management Committee (THMC), which connected community organizations with the government. The Deputy Commissioner (DC) of the Sunamganj district leads the THMC.

At the national level, a Project Steering Committee (PSC) was formed and headed by the secretary of MoEF. THMC and PSC were established through GoB gazette notification. [GS2] Different non-government organizations such as the Center for Natural Resource Studies (CNRS), Efforts for Rural Advancement (ERA), HELVETAS Swiss Inter-cooperation Bangladesh, Bangladesh Environmental Lawyers Association (BELA), and *Gana Unnayan Sangstha* (GUS) have actively participated in the community-based management system with the GoB and IUCN. [GS3] The CBSMTH project formed a Central Co-management Committee (CCC), which was registered as 'Tanguar Haor Somaj Bhittik Soho-Bebostapona Society' (THSBSS). Four Union Co-management Committees (UCCs), including 74 Village Co-management Committees (VCC), functioned under the CCC. Later, the THBP project converted 41 VCCs into registered cooperative societies. A central cooperative society led these societies with representatives from all village cooperative societies across the Tanguar Haor. [GS4] On March 13 2008, through GoB gazette notification, the MoEF set the proportion of fisheries resource earnings for the three stakeholders: 40 percent would go to fishers (harvesters), 36 percent to community groups, and 24 percent to the district administration (local government).

[GS5] Several methods for commercial and non-commercial fish harvesting were developed and approved by the government. In 2011, five fish sanctuaries were established. Commercial harvesting operated under direct supervision and authorization within the core region, and non-commercial harvesting without permission and supervision outside the core area (refer to buffer region) within the Tanguar Haor boundaries. [GS6] The internal rules of the cooperative societies are based on democratic procedures of election by following the Central Co-management Committee's constitution. [GS7] At the local level GS, the village cooperative societies follow the 'Tanguar Haor Management Rules' under the supervision of the THMC. [GS8] An executive

magistrate with 12 police, 24 *ansars* (national para force), and 29 community guards were assigned to protect fisheries resources from illicit harvesting and maintain law and order.

Action situations: Interactions (I) → Outcomes (O)

[I1] Two fish harvesting rules (commercial and non-commercial fishing) were devised to keep fish harvesting at a sustainable level. A community-led monitoring system was created and practiced (Table 2) to ensure that the fishing ban period is enforced and the sustainable yield level is maintained (Ahmed *et al.*, 2015).

Table 2: Summary of commercial fish harvesting from 2009 to 2014 (January to April).

Year	No. of *Beels*	Harvested Fish (kg)	Fish Price (USD)	No. of Days of Fishing
2014	8	13,920	29799.97	26
2013	8	8,316	8458.60	52
2012	12	55,580	69945.78	75
2011	5	6,195	7702.89	16
2010	10	18,738	45935.33	54
2009	7	20,218	26707.98	26

[I2] The fishers involved with the village cooperative societies and the leaders organize weekly and monthly meetings. In these meetings, the actors share relevant resource conservation issues. [I3] Since its inception, the three-tier community organization has been operating and has built democratic and accountable deliberative processes. [I4] Conflict may arise due to cattle grazing, irrigated water distribution, fishing location, domestic issues, marriage, political issues, etc. Local elites, public representatives such as chairmen and members of the Union (smallest and the third tier of local government administration after Upazila and district), religious leaders, and village leaders often arbitrate conflicts. If local efforts fail, it may lead to filing

cases with the police station, which may end up in the courts.

[I5] The fishers invest their money in buying and repairing fishing equipment and vessels and buying seasonal licenses/permits for non-commercial fishing. [I6] The fishers participate actively in the THMC's bottom-tier village co-management committee or cooperatives. [I7] The fishers can engage in sustainable fish harvesting, collect their share, and continue community guarding to protect the resource system through the CBSMTH project. However, in recent years, complexities have arisen around self-organization due to a lack of supporting projects. [I8] Full-time fishers catch and sell around 2-3 kg/day to the village fish trades and mobile collectors who look for fish as commission agents of the sellers in Dhaka city. [I9] The fishers played the role of community guards to protect the fish resources from illicit harvesting. They seized 15,075 kg of fishing net, 1,143 boats, and 9,940 traps that were used for illegal fishing during the project phases. [I10] The project CBSMTH introduced participatory resource monitoring and evaluation to the community that helped assess the health of Tanguar Haor fisheries resources (IUCN Bangladesh, 2016).

[O1] Apparently, the income distribution among fishers achieved a high level of equity during the CBSMTH project phases. However, after the project was phased out, most of the fishers believe that the revenue distribution among them became unequal due to the influence from the local elites; meanwhile, illegal fishing has increased. On a positive note, knowledge of community-based resource management, leadership capabilities, and social strength have increased. [O2] Over-harvesting, illegal fishing, use of illegal gear, water pollution, unregulated eco-tourism activities, and swamp deforestation negatively impact the aquatic environment biodiversity and are responsible for the extinction of several indigenous fish populations from the *haor.* [O3] However, establishing five fish sanctuaries and restoring swamp and reed beds supports the fish populations, enabling safe breeding and feeding and enhancing the ecosystem's health.

Related Ecosystems (ECO)

[ECO1] Tanguar Haor's climate is sub-tropical-monsoon, with three distinct seasons: summer, monsoon, and winter. In the northern part of Sunamganj, the average annual rainfall is around 8,000 mm, with summer accounting for 65-69 percent of total precipitation. Evaporation increases rainfall during the spring, generating flash floods in the Tanguar Haor region. Summer lasts from April to June, with temperatures ranging from 30.9 - 33.4 degrees Celsius, monsoon lasts from May to September, and winter lasts from October to February, with temperatures ranging from 8.5 to 16.6 degrees Celsius (IUCN Bangladesh, 2016). In the wet season, humidity is around 83 percent, while in the dry season, it's around 64 percent (Alam *et al.*, 2012). [ECO2] Environmental pollution in the Tanguar Haor is a severe problem, most notably water pollution. The significant factors of water pollution include the use of pesticides (35.5 percent), sewage leaks from unsanitary latrine (35.5 percent), burned oil spilling from mechanized boats (17.2 percent), water washed from the coal mines (11.8 percent) (Islam *et al.*, 2014). Fish species die due to water pollution and toxic substances in the water. During the monsoon season and after a flood, the Haor area has a surplus of fish. On the other hand, water logging and rotten paddies create water pollution, which leads to mass mortality of fish species.

Social, economic and political settings (S)

[S1] In the Tanguar Haor region, fishing is the primary source of income. However, because each fisher only harvests a small number of fish, income from fishing is insufficient for lifting people out of poverty (Alam *et al.*, 2015). [S2] Due to certain fishing restrictions, the fishers recognized the long-term benefits of abstaining from over-fishing and fishing during breeding seasons. Therefore, they started looking for alternative income-generating opportunities. The fishers started carrying coal and worked as day laborers, stone brokers, ferry boatmen, and seasonal farmers. However, no significant change occurs in the demographics of the fishing communities of the adjacent

villages. [S3] A continuous power struggle is going on over the access to fisheries resources. From the 1930s till the end of the last century, the Tanguar Haor fisheries were run by powerful elites through a leasing system. Negative propaganda from local elites against community-oriented initiatives was a severe worry for the CBSMTH project.

Challenges and conclusion

The Tanguar Haor ecosystem and its vast fisheries resources attracted much attention from the government, NGOs, and international donors as an ecosystem of immense ecological significance. Both CBSMTH and THBP projects have positive and negative social, ecological, conservation, and governance outcomes. The achievements include improving fishers and people's knowledge base, reestablishing fishers harvesting rights, organizing national and local level governance systems, establishing fish sanctuaries, restoring swamps, initiating community patrolling, and formulating profit distribution ratios and sustainable practices management guidelines. In addition, the small-scale fishers of the Tanguar Haor learned the importance of conserving the fisheries resources through training and their fishing right was reestablished by developing community-centric management.

On the other hand, the fishing community's self-organizing capacity, awareness about sustainable fisheries management, leadership, governance, and decision-making ability has not yet been built. As such, the democratic processes of local-level community organizations became questionable. Fishers' reliance on natural resources has increased, and their socioeconomic conditions worsen due to a lack of options for alternative income-generating during fishing restriction seasons. Local conflicts and power struggles over the access and control of resources became a severe issue. The prevalence of illegal and unauthorized fishing is increasing due to the limited manpower of the law enforcement agencies to protect a large area and the corruption of the assigned ones. Unregulated and uncontrolled eco-tourism activities are negatively impacting the ecosystem and fish populations.

The comprehensive approach adequately portrayed the socio-ecological

system, demonstrating the interactions of actors with resources and the influence of GSs on social and environmental performance. This study shows that governance is a crucial component of achieving sustainable resource usage; a long-term participatory ecosystem management project should be designed, which will enable small-scale fishers to manage the vast fisheries resources and the ecosystem confidently on their own, free from dependance on any external funds and influence. The social-ecological system of Tanguar Haor can only be sustainable if the small-scale fishing communities become conscious about ecosystem management, benefit from sustainable management, and make their own decisions without interventions and facilitation from any project.

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