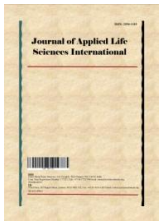

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Sustainable Inland and Coastal Fisheries: Key Lessons Drawn from Community-based Fisheries Management in Bangladesh

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aim: To build an appropriate basis for inland and coastal fisheries co-management through the involvement of key government agencies, fishers, traders and relevant stakeholders.
Study Design: Literature review of the community-based fisheries management projects in Bangladesh during 1995-2017 and examine fisher's perceptions of co-management approaches from an inclusive cross-section of fishing households.
Place and Duration of Study: The study sites are located in six riverine districts in Bangladesh, namely Bhola, Chandpur and Laxmipur within fish sanctuary areas and Barisal, Pirojpur and Jhalokathi outside fish sanctuary areas.
Methodology: The study included community-based fisheries management project's knowledge in different inland and coastal habitat types in Bangladesh. The study comprised on lessons learned from field activities, workshops on fisheries co-management with the public, NGOs, experts, civil society, fisher's organizations, traders and related stakeholders, and reviews of several reports on other community-based fisheries management initiatives in Bangladesh. The study also examined stakeholder perceptions of co-management approaches from a cross-section of 1200 fishing households in 24 fishing villages.
Results: Results indicated that performance of community-based fisheries management in Bangladesh varied widely to improve natural fish production, fish abundance and biodiversity and,

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with the nature of the community involved. These include the development capabilities of user groups through formation of village level Conservation Groups and fish landing center-based organizations, and capabilities of the key government agencies and law enforcing agencies for enhancing compliance.

Conclusions: This paper proposes a co-management arrangement for fishery management along the fish sanctuary areas of the Padma-Meghna River systems in Bangladesh. These findings provided the scientific basis of community managed fisheries management and its applications.

Keywords: Community-based fisheries management; co-management; sanctuary; inland water fishery; livelihood.

1. INTRODUCTION

Fisheries play a critical in Bangladesh economy and it constitutes to 3.57% of GDP, and it is the second largest export [1]. The country's fish production increased from 2.70 million tons in 2008-09 to 4.27 million tons in 2017-18 [1]. It provides full-time employment for more than 1.31 million fishers and 16.69 million part-time fishers, or about 11% of the total population [2].

Fish are a major source of nutrition for the poor in Bangladesh. Demand for fish will continue to grow as annual population rise by 1.19% annually in Bangladesh (www.worldometers.info 2016). Conservation is the most significant government supported effort to protect the national resource [2]. The national fish of Bangladesh is Hilsa (*Tenualosa ilisha*). Traditionally Hilsa had been seen as common property resource and a major source of earning for the poor fisher's community in the coastal region of Bangladesh. However, access of fishers in the management of fisheries resources, and over-exploitation by the relatively wealthier moneylenders are reducing the options for sustaining the livelihoods of fishery dependent communities [3].

In order to meet growing needs for fisheries management with limited resources, the government of Bangladesh in collaboration with development partners, identify co-management approaches and technical assistance for improving the capture fishery resources management and development of institutions to maximize production through involvement of community based organizations (CBOs). To strengthen the institutions, the Ministry of Fisheries and Livestock (MoFL) and Department of Fisheries (DoF), Local Government Engineering Department (LGED), WorldFish, International Resources Group (IRG), Winrock International (WI) and International Union for the Conservation of Nature (IUCN), led a number of projects on co-management throughout the country as well as community-based fisheries management.

Several studies have described fisheries production and species diversity increased over the duration of the project, due to the community management approach, which encourages participation of fishers, beneficiaries and communities in managing the renewable fishery resources [4,5,6,7,8,9,10].

Artisanal capture fisheries have expanded massively since the 1980s with the number of boats increasing from around 17,000 in the late 1980"s to 56,000 in 2000 and 67,669 in 2015 [11,2]. Catches have also increased and the artisanal fisheries sector currently contributes to about 14% of the country's total production of total fish involving 270,000 fishers [2]. However, despite its important contribution to the economy, strategic development of this sector has not been properly implemented. Instead, because of unplanned and an irrational increase in fishing effort, many of the coastal and marine fish & shrimp stocks have declined over time.

The management of these resources, based upon Marine Fish Act has however, discouraged fishers and very negligible effect on sustainable levels of exploitation [12]. Fisheries experts in Southeast Asia now recognize that fishery cannot be managed effectively without the cooperation of fishers to make laws and regulations work [13,14].

1.1 Co-management

Traditional centralized management regimes have often failed to discuss issues such as resource depletion or conflicts between fisheries sectors such as small-scale fishery. One tool that had been employed in many fisheries to help address these challenges is a collaborative management (co-management), whereby communities share responsibilities for making and

enforcing natural resource management rules with governments, civil society, and/or academia [15,16,17]. Co-management implies decentralized decision making which provides opportunities for partnership arrangements in which all major stakeholders share both responsibility and authority. It is often proposed as a strategy to achieve sustainable fisheries [18,19]. In several case studies recommended co-management systems to enhance fish stocks [20]. Co-management is increasingly being used to promote sustainability, equity, compliance, and other desirable outcomes in fisheries [21]. The overall fish production and biodiversity has been improved due to community-based co-management and this lesson be implicated widely to sustain wetland resources [22]. Community-based fisheries management approach to fisheries made a significant positive impact on income and livelihoods of households [23]. Fisheries experts now recognized that resource conflicts can be diminished and resources better managed when fishers and other resource stakeholders are more involved [24]. Small-scale fisheries involved the community or in co-managed fisheries where governance may occur at multiple levels, including the community scale [25]. Despite the heterogeneity in perceptions, the co-management system has successfully generated a strong conservation ethic in its resource users [26].

The fisheries management expert-derived consultation revealed strong local leadership, high community involvement and governance capacity as common factors of success across management tool categories [27]. Instead, co-management was less successful in developing country, artisanal, multispecies fisheries [28]. However, a number of community-based organizations (CBOs) were able to establish their access rights in the government-owned water bodies [29].

The unequal distribution of wealth and power in rural Bangladesh makes it difficult for the poorer members of society, including women to get access to natural resources such as fisheries [12]. Riverine fish populations have declined sharply due to overexploitation, siltation, pollution from urban, the effects of agro-chemicals, and changing climate. It can be adopted in many countries worldwide. This paper explains how co-management approaches is more effective in the inland water fishery. The hypothesis is that the management actions have contributed to an increase in fish abundance and socioeconomic improvement. The aim of this paper is to support fisheries management, enhance the resilience of fishes through improved co-management of the riverine fishery.

2. MATERIALS AND METHODS

In Bangladesh fisheries co-management type initiatives were implemented in collaboration with the government agencies, mostly the Department of Fisheries and a number of non-government and international organizations (e.g., Ford Foundation, WorldFish, Winrock International, the International Union for Conservation of Nature, International Resource Group), through the course of several projects. This study considers literature review of the 12 community-based fisheries management projects in Bangladesh during 1995 to 2017 [4,8,30,31,32,33,34,35,36,37,38,39,40,41,42,43]. Brief description of the 12 reviewed community-based projects is given in Table 1.

A set of inclusion criteria was developed before the start of the review to guide in the selection of literature and published or available studies. This study evaluates all reports based on following criteria:

i. Reports must have some form of community-based intervention,
ii. Reports must be fisheries management involving communities,
iii. Reports should specifically note co-management process,
iv. Reports must have community-based institutional framework, and
v. Reports must have a review of project-based learning.

The study also assesses the lessons learned report on different community based or co-management projects i) Lessons from Community based fisheries management in Bangladesh [30], ii) Recommendations of the CBFM-2 International Conference [44], iii) Lesson learned in wetlands and forests co-management [45], iv) Lessons learned from Fisheries Adaptive Co-management projects [46]. Besides, the outcomes of the lessons learned projects have been evaluated in terms of their social, institutional, and physical context, and the interactions that arose from establishing community-based organizations.

The study also examined stakeholder perceptions of co-management approaches from

more than 15000 projects beneficiaries' households, and its impacts, drawn from a cross-section of 1200 fishing households in 24 fishing villages reliant on fish sanctuaries. The study generates understanding of (i) traditional fishery management practices, (ii) participation in the fishery management, (iii) present fishery management approaches, and (iv) co-management initiatives.

The study covers a sample of 450 fishing households who live within sanctuary areas in Bhola, Chandpur, and Laxmipur districts, and 750 households who live outside fish sanctuary areas in Barisal, Pirojpur, and Jhalokathi districts. The sample was drawn by two-stage stratified cluster sampling from a sample frame generated by separate household listing exercise. At the first stage, the clusters were divided into sanctuary and non-sanctuary areas. At the second stage, the 24 sample villages were selected independently from six strata encompassing the districts within those areas, with probability proportional to the population in each stratum. Fifty households were interviewed in each village. A pool of 30 data enumerators was involved in the data collection process, using mobile devices (Google Nexus) with an electronic questionnaire based on Open Data Kit (ODK) software. All records were stored and uploaded to a cloud server using the built-in internet connectivity of devices.

These co-management approaches identified needs and responses, stakeholder analysis and consultation, primary data collection on fisheries production and consumption, and socioeconomic analysis. The present study aims to assess the fisher's benefit of community-based fisheries management.

The study also undertook a desk-based review, and analysis of the available secondary information, with a particular focus on the recent capture fisheries information collected by the different projects and the DoF's, secondly, the interpretation and lessons from the CBFM project has been widely studied [10,29,9,47]. Thirdly, the co-management information compiled by IPAC project [45]. Present review also looked at the integration of coastal resources management based on the existing literature in this sector. Fig. 1 show's location of lessons learned co-management projects in Bangladesh.

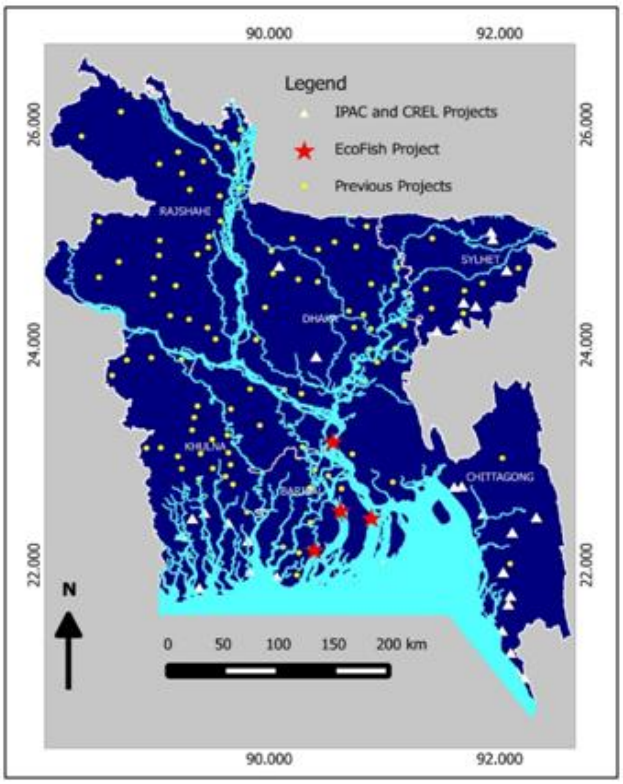


Fig. 1. Study area of lessons learned from co-management projects in Bangladesh.

Table 1. List of lessons learned projects

Sl no.	Name of project and actual implementation period	Donor	Lead agencies	Brief description of the project	References
1	Community based Fisheries Management Project-1 (CBFM-1), 1995-1999	Ford Foundation	Department of Fisheries and International Center for Living Aquatic Resources Management – now World Fish	CBFM-1 was designed as an action research project to test and assess alternative models of government-NGO-fisher collaboration in the management of inland fisheries of Bangladesh. The project was promoted sustainable use of inland fisheries resources in 19 water bodies. It promoted the sustainable use of open water fisheries resources and user community participation in their management.	[31,30,32]
2	Fourth Fisheries Project (FPP), 1999-2004	International Development Association (IDA), Department for International Development (DFID), Global Environment Facility (gef)	Department of Fisheries, Bangladesh	The aim of the project was to support the conservation of globally important wetlands and aquatic related biodiversity in Bangladesh by mainstream biodiversity and aquatic ecosystem conservation within the inland and coastal fisheries sector. Community-based organization was established at 51 project sites and an overall 65% production increased was reported (from baseline 120 kg to 247 kg/ha year^{-1}).	http://documents.worldbank.org/curated/en/808481474549905740/pdf/000020051-20140617142702.pdf
3	Management of Aquatic Ecosystems through Community Husbandry (MACH), 1998-2008	United States Agency for International Development (USAID)	Ministry of Fisheries and Livestock and Winrock International	MACH project initiated major reforms in property and user rights around access to water bodies. The project worked in three large wetland sites and developed co-management institutions between government and community organizations. MACH has demonstrated that it is possible to restore the productivity and functioning of large wetland ecosystem in Bangladesh and thereby enhance livelihoods of poorer wetland users and biodiversity. This approach has recognized in the Bangladesh Poverty Reduction Strategy Paper.	(http://www.nishorgo.org/?id=31); [32]
4	Community-Based Fisheries Management Project-2 (CBFM-2), 2001-2007	Department for International Development (DFID)	Department of Fisheries and WorldFish, South Asia	CBFM-2 promoted the sustainable use of, and equitable distribution of, benefits of inland fisheries resources. Action research was undertaken to test a range of community-based approaches to fisheries management at pilot sites throughout Bangladesh covering 23,000 direct beneficiaries. Preliminary assessments of the introduction of fisheries management and habitat restoration through various CBFM activities (fishers managed fisheries, community managed fisheries and women managed fisheries) showed fish production and biodiversity in the project's water bodies had increased by 64 percent and 28 percent respectively.	https://www.worldfishcenter.org/content/community-based-fisheries-management-fisheries-yields-and-sustainability [4,33]
5	Sunamganj Community-Based Resource Management Project (SCBRMP), 2003-2014	International Fund for Agricultural Development (IFAD)	Local Government Engineering Department (LGED) under the Local Government Division	The SCBRMP was designed to determine the relationship between management practices implemented under the fisheries component in the northeastern region of Bangladesh. Fisheries were one of SCBRMP's five components. The major improvements were in better implementation of the management guidelines, including those about conservation measures. The Beel User Groups (BUGs) achieved a sustainable balance between maintaining production and biodiversity.	(http://pubs.iclarm.net/resource_centre/WF_37453.pdf); [8]
6	Community based Fisheries Management-South and South East Asia (CBFM-SSEA), 2002-2007	International Fund for Agricultural Development (IFAD)	Department of Fisheries and WorldFish, South Asia	A CBFM - SSEA project started in the North-Eastern part of Bangladesh and Mekong basin in Vietnam. The Project target was to sustainably improve the livelihoods of poor people dependant on aquatic resources through open water fisheries management in South and Southeast Asia. In Bangladesh annual fish production (kg/hectare) at six projects sites between 2002 and 2005 increased on average by 59% per year. In Vietnam the CBFM approaches had a substantial impact on fish production and income of the beneficiary households and average per household fish catches were more than 4 times greater during lean season and more than 8 times during peak months.	[30, 34,35,36, 37,38]
7	Integrated Protected Area Co-management (IPAC), 2008-2012	United States Agency for International Development (USAID)	International Resources Group (IRG), Department of Fisheries, Forest Department and Department of Environment	IPAC project was implemented by the Government of Bangladesh involving three line agencies. The key objective was to contribute to sustainable natural resource management and enhanced biodiversity conservation in targeted landscapes with the goal of preserving the natural capital of Bangladesh. Number of beneficiaries with increased economic benefits derived from sustainable natural resource management and conservation. Training and information dissemination activities had contributed towards increased awareness and understanding of the community people, including women, about the importance of wetlands conservation.	http://nishorgo.org/projects/ipac-2008-2013/
8	Community-based sustainable management of *Tanguar Haor* (CBSMTH), 2006-2016	Swiss Agency for Development and Cooperation (SDC)	International Union for the Conservation of Nature (IUCN), Bangladesh	CBSMTH project aims to establish co-management, and governance as a foundation of grassroots resource user level that links up to the Government of Bangladesh's highest policymaking level. The project was implemented by the International Union for the Conservation of Nature (IUCN), Bangladesh. The Village Co-management Committee (VCC) is at the bottom of the governance structure. The VCCs formed Union Co-management Committees (UCCs) and the Central Co-management Committee (CCC) is the apex body at the ecosystem level.	(https://www.iucn.org/downloads/20140523_cbsmthp_mtr_final_report.pdf).

Sl no.	Name of project and actual implementation period	Donor	Lead agencies	Brief description of the project	References
9	The Wetland Biodiversity Rehabilitation Project (WBRP), 2009-2015	Deutsche Gesellschaft für Internationale Zusammenarbeit (*GIZ*)	Department of Fisheries	WBRP aims to secure and restore the biodiversity of river zones and as such protect the livelihood base for the local population through the sustainable exploitation of fishing grounds. The project implemented innovative and alternative forms of sustainable use of the natural resources in open water zones (river) and floodplain ecosystems link with the river and tributaries. These include wetland sanctuaries, excavation of silt up waterbodies, restriction of harmful fishing practices, opening of sluices to permit fish migration, and adoption of crops that are consistent with maintaining more water in the dry season for fish. The approaches had a substantial impact and increase fish production, biodiversity, brood fish for breeding, water storage capacity and natural regeneration of indigenous species.	https://www.snrd-asia.org/download/wetland_biodiversity_rehabilitation_project/Factsheet.pdf
10	Climate Resilient Ecosystems and Livelihoods (CREL), 2012-2018	United States Agency for International Development (USAID)	Winrock International, Department of Fisheries, Forest Department, and Department of Environment	CREL aims to improve the biophysical condition of biologically significant forest and wetland areas in close collaboration with co-management institutions and government agencies. CREL project has provided technical assistance, training, and modest material support to Bangladeshi communities and government agencies to enable them to manage collaboratively (co-manage) biologically significant ecosystems and surrounding landscape in four focus regions of Bangladesh. The project helps create viable, diversified livelihoods of rural poor individuals, especially women, living near protected forest areas and government-owned wetlands. CREL also builds the capacity of government agencies and community organizations to plan and implement activities that support sustainable, climate-resilient ecosystems. Lessons learned are summarized from 2012-2017.	https://www.winrock.org/project/improving-livelihoods-and-the-environment-in-bangladesh/
11	*Haor* Infrastructure and Livelihood Improvement Project (HILIP), 2014-2019	International Fund for Agricultural Development (IFAD)	Local Government Engineering Department (LGED) under the Local Government Division	HILIP project has implemented in five haor districts (Sunamganj, Netrokona, Kishoreganj, Brahmanbaria and Hobiganj) of Bangladesh to improve living standards and reduce the vulnerability of the poor. The project has strengthened the community management of water bodies that have found significant impact on fish production and increase in incomes of poor fishing households. Lessons learned are summarized from 2014-2017.	https://www.ifad.org/documents/10180/c9c52d68-a677-4660-b699-563e89021090 [39]
12	Enhanced Coastal Fisheries in Bangladesh (ECOFISH-Bangladesh), 2014-2019	United States Agency for International Development (USAID)	Department of Fisheries and WorldFish, South Asia	ECOFISH-Bangladesh project utilized innovative “research in development” approaches to address the development challenges prioritized by local, national, and regional stakeholders. The project aims to support the use of science-based decision-making in fisheries management, enhance the resilience of Hilsa populations through improved co-management of the fishery, and build the capacity of partners and fishing communities to improve enforcement in fish sanctuaries. The project established adaptive co-management involving fishers in monitoring and enforcement of compliance with fishing bans. Lessons learned are summarized from 2014-2017.	(http://pubs.iclarm.net/resource_centre/2015-38.pdf); [40,41, 42, 43]

3. RESULTS AND DISCUSSION

3.1 Key Lessons from Fisheries Co-management Projects in Bangladesh

Lessons learned from 12 key CBFM or co-management projects during 1995-2017 are summarized. The post-project as well as outcomes of the key co-management projects are associated with common lessons, and some of the main lessons drawn are that:

a. All the projects have established community based organizations (CBOs/RMOs/FRUG/BMCs/HCGs/HGGs/ CSGs[1]) and project water bodies handed over to the community through the Department of Fisheries (DoF)/ Local Govt. Engineering Dept. (LGED),
b. A large number of Community Based Organizations (CBOs) were able to establish their access rights in the government owned water bodies,
c. In many project water bodies, fish sanctuaries were established and maintained through communities; but ensuring their sustainability requires steady and intensive *effort* and takes time,
d. All CBOs have rules and regulations for fisheries management practices, but these are not always effectively observed,
e. User rights over common property resources are fundamental, high lease value makes it difficult for poor fishers to access the resources,
f. Co-management works in terms of improving productivity, biodiversity and livelihoods,
g. Other rural communities have also benefited from the project interventions.
h. Co-management initiatives established CBOs with legal entity, however, dealing with social change demands longer time and target,
i. Better linkages were established with local administration and elites,

Changing patterns of co-management system through different intervention in Bangladesh fisheries from 1995 to 2017 is shown in Fig. 2. The Fig. 2 generalizes the probable changing process for co-management systems in Bangladesh. The approaches to co-management have all increased the role of local level government agencies, both in administration and giving advice and supporting fisher's communities or empowering co-management.

Most of the lessons learned relate to institutions, governance and the effectiveness of fisheries management and alternative income generating activities. Besides, key lessons learned to facilitate the success of co-management resources include i) effective co-management and GO-NGO relationship takes time; ii) staff capacity development, including NGOs and strong local leadership is obligatory; iii) external threats, including local elites has been major issues; iv) group participation in resolving conflicts is very important; v) accountability for rule enforces; vi) DoF to ensure pro-poor lease renewal process; vii) participation of DoF and local administration is vital. A summary of common lessons obtained by scrutinizing outcomes of the nine completed projects is given in Fig. 3.

3.2 Where are we after 20 years of CBFM?

Since the early 1990s community-based fisheries management (CBFM) has been promoted an effective way of maintaining and restoring the productivity of inland water fisheries resources and the CBFM approaches has successfully established access rights for many poor fishers to aquatic resources from which they were previously excluded.

The CBFM reveals that transfers of responsibilities have occurred as a result of the community-management approach, increasing the role of the fishers in the overall application of the fisheries management. Responsibility for participatory monitoring of CBOs has enabled fishers' to defend their legal rights to protect water bodies from traditional leaseholders. The CBFM has provided compelling evidence that community-based management approaches aimed at the poor and vulnerable are effective in a wide range of different inland water body types in Bangladesh [48]. The CBFM has had a large policy impact to improve fisheries management in Bangladesh.

The CBFM study concluded that future or ongoing activities might include some form of adaptive approaches to community-based management to help identify which interventions are most significant in improving fisheries

[1] *Community Based Organizations; RMOs: Resource Management Organization; FRUG: Federation of Resource Users' Groups; BMCs: Beel Management Committee; HCGs: Hilsa Conservation Groups; HGGs: Hilsa Ghat Groups; CSGs: Community Savings Groups*

management performance [33]. The CBFM study also reported that fishing communities have demonstrated that they can be responsible for fisheries and improve their management, given the right institutional recognition and support [30]. The CBFM initiative has developed a series of fisheries management approaches for ensuring equitable access to fisheries resources for CBOs [49]. However, coordinated management of water bodies is essential given common management issues of water bodies and open water fisheries management through fisher's community involvement is a promising approach in Bangladesh [50].

The Livelihoods impact on the water body level under CBFM-2 were measured and the results shows that the involvement with CBFM-2 makes community households less dependent on moneylenders [51]. The impact study demonstrated changes in opinion and awareness of CBFM amongst policymakers from government and non-government institutions and leaders in community-based management. The inland fisheries management reveals that the basic concepts of CBFM and a positive opinion of this approach, considering it a way forward for inland fisheries management in Bangladesh [52].

3.3 Regional and National CBO Networks

In Bangladesh, a regional networking system has been introduced to encourage lesson sharing between CBOs. This has proved to be a popular development, and has led to the election of regional committees in Bangladesh with financial contributions from member CBOs towards their administrative costs. The CBOs would then establish sustainable fisheries practices such as creating fish sanctuaries, restoring habitats and reintroducing endangered species. Moving management responsibility to CBOs would in turn improve the condition of fisheries because the fishers would have a sense of ownership, and hence protection, over the resources.

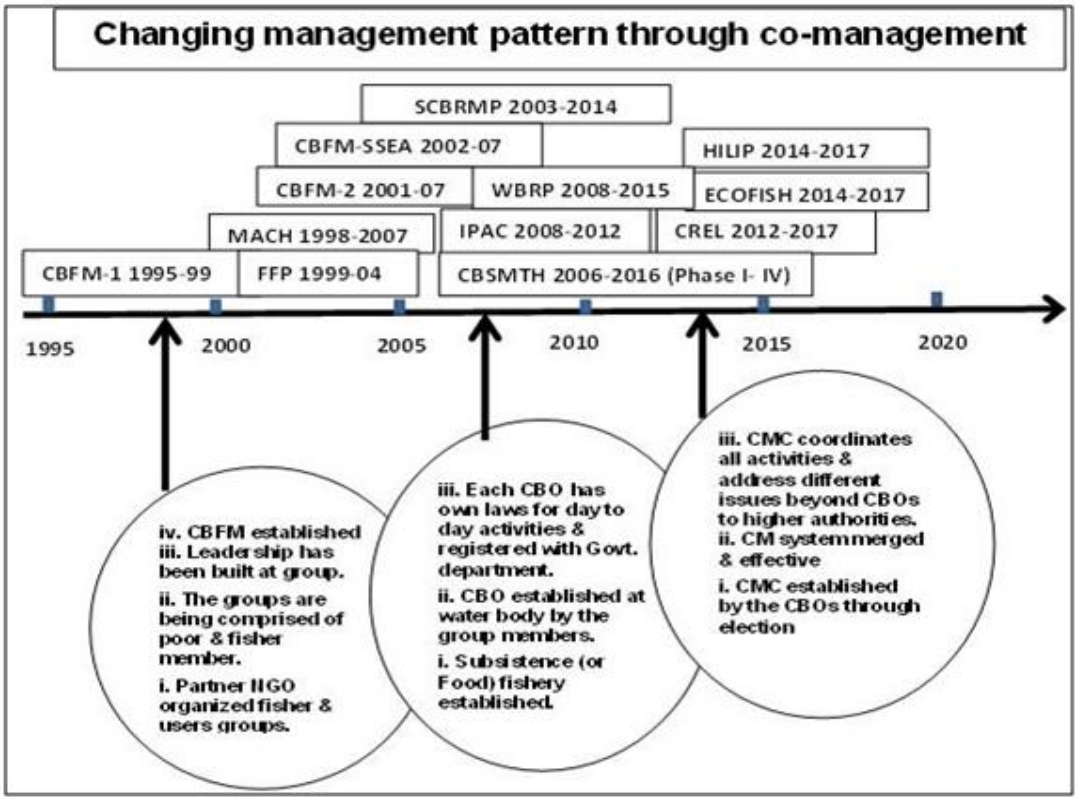


Fig. 2. Possible time path of changing management patterns through co-management projects from 1995 to 2017 in Bangladesh (CBFM=Community-based Fisheries Management, CMC=Co-management Committee, CBOs=Community-based or Co-management Organizations) (adapted from [12])

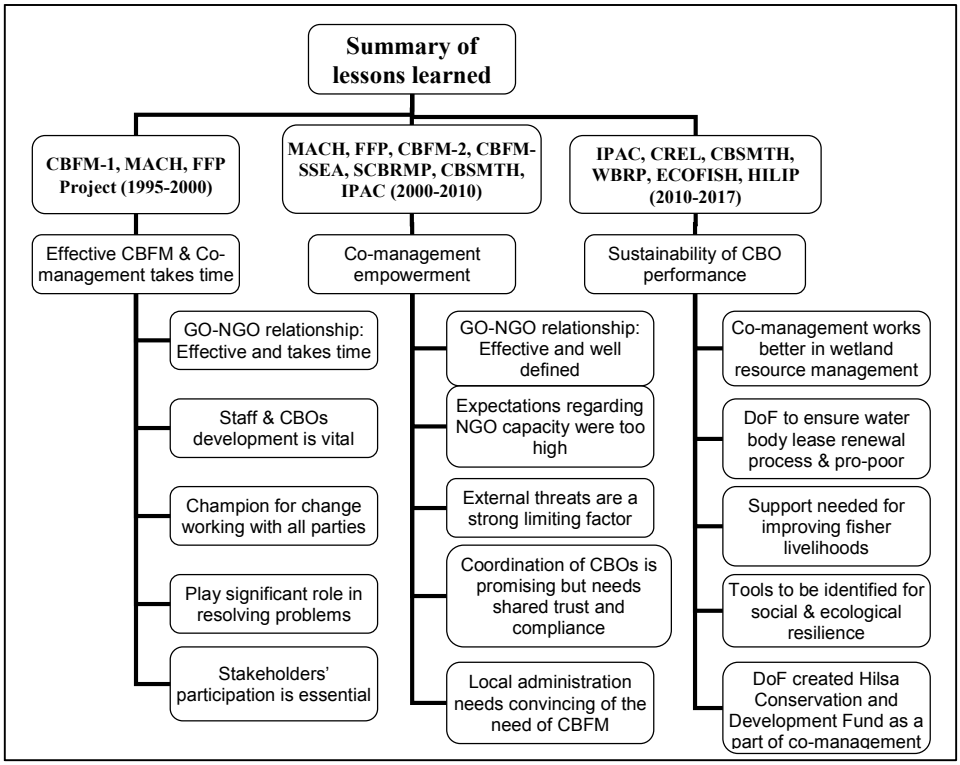


Fig. 3. Common lessons learned from key co-management projects (GO=Government, NGO=Non-Government Organization, DoF=Department of Fisheries), (adapted from [12])

3.4 CBO Sustainability

The major challenge, which faces any project, operating in complex rural societies, is ensuring that the key institutions, in this case the CBOs, are sustainable. There are many examples of failure, where CBOs soon collapse once support is discontinued or the original pro-poor aims of CBOs are overtaken by local politics. Study conducted by [41] identified a policy decision in favor of incentive-based fisheries management as a critical juncture that influenced a trajectory of recovery in Hilsa shad stocks in this complex adaptive system.

3.5 Why Should Co-management Work?

Devolving management responsibility to fisher communities is anticipated to improve management performance because:

i. Fishers have a sense of ownership over the resource encouraging more responsible exploitation;
ii. Appropriate interventions and activities can be selected and implemented by the community, according to local ecological and institutional conditions;
iii. Compliance with the rules should be greater through greater perceived legitimacy and peer pressure (self-regulation).
iv. Evidence that managing performance is better under community-based approaches are, however, scare and largely anecdotal. Policy makers are therefore often sceptical about these claims.

3.6 What Need to be Done towards Inland and Coastal Fisheries in Bangladesh?

Traditionally inland water fisheries were the domain of low caste Hindus, a culturally distinct group. However, in recent decades, more and more landless and unemployed Muslim farmers have taken up fishing as an occupation. Management of coastal and riverine fisheries has virtually gone uncontrolled over the decades except some limited interventions. In the absence of any effective management program for sustainable use of fisheries resources the fishers' adopt destructive fishing practices that

limits of the fishery's regenerative capacity – recruitment overfishing. The government in 2005 has delegated the power of implementation of the respective rules under the Marine Fisheries Ordinance (MFO) to the District Fisheries Officer of the coastal districts. However, in absence of capable technical marine fisheries staff at the district and Upazila levels, the system did not work well.

The declining trend of catch from small mesh gillnet vessel targeting Hilsa, skipjack tuna and mackerel is alarming when compared data 650 kg/day/boat in 2001-02 to less than 100 kg/boat/day in 2005-06 [11]. Management of marine fisheries is mostly focusing on the industrial trawl fishery sector and no management of artisanal small-scale fisheries sector, which operate throughout the coast and river mouths. Besides, management needs to be strengthening of enforcement of regulatory measures in the coastal waters. In the absence of staff capacity, there is an insufficient regulatory framework on Monitoring, Control and Surveillance (MCS) activities and less monitor on fishers' compliance with destructive gears and other fisheries rules.

One of the challenges to inland water fisheries management is the potential contribution of decentralized co-management. In the inland fisheries sector the CBFM has been proved to be a very successful approach and this is also recognized as an appropriate approach by the '*Marine Fisheries Sector Sub-Strategy*' 2006 [11]. Poverty and lack of alternative livelihood opportunities remain significant reasons for noncompliance with the ban as long as fishers do not have any meaningful representation in resource management and decision making [41]. The expert-derived consultation revealed strong local leadership, high community involvement and governance capacity as common factors of success across management tool categories [27].

The fisheries co-management approach significantly improved resource management regime through development of grass-root organizations – fisher's communities, increased financial strength, enhanced fisheries productivity through sanctuary management, rejuvenating fish population and increased biodiversity, enterprise development and above all improvement in livelihood of poor fishers [40]. ECOFISH-Bangladesh project supports coastal and riverine fishing communities and other key stakeholders to improve the resilience of the Padma-Meghna River ecosystem and communities reliant on fisheries. The project works with more than 15000 fishers' families living around designated Hilsa fish sanctuaries in Bhola, Patuakhali, Laxmipur, Chandpur, Barisal and Shariatpur districts (Fig. 4). Based on lessons learned a number of observations are made concerning the determination of the type of co-managements already in place and how Hilsa sanctuary-based co-management initiatives in the Padma-Meghna River systems in Bangladesh can be developed through ECOFISH-Bangladesh.

3.7 Steps towards Development of Co-management in the ECOFISH-Bangladesh Project

Selection of fishing villages: Data on these fishing communities were compiled and involvement with fishing identified using criteria that included: Total Hilsa fish landings, in value and weights, number of households involved in fishing, the list of fishers with ID-cards.

Community profiling: A variety of participatory tools are utilized to gather information on socio-demographic characteristics, such as natural resource and ecosystem characteristics, social and economic conditions, local institutions, livelihood strategies, basic household and community facilities, gender relations and social capital. Each profile provides a historical, demographic, cultural and economic context for understanding a community's involvement in fishing. Community action plans were formulated as the final output of the community profiling exercise. Besides gender analysis is one of the elements of the community profiling and includes exploration of existing gender norms and relations.

Wealth ranking: Tools used to understanding socioeconomic differences within communities and identified target group members according to economic and well-being.

Selection of true poor fishers: Socioeconomic status of fisher's households detected through FGD and information from local Union Parishad member and households are divided into four categories such as middle class, lower middle class, poor and extreme poor. The study shows that maximum fishers belong to an extreme poor category.

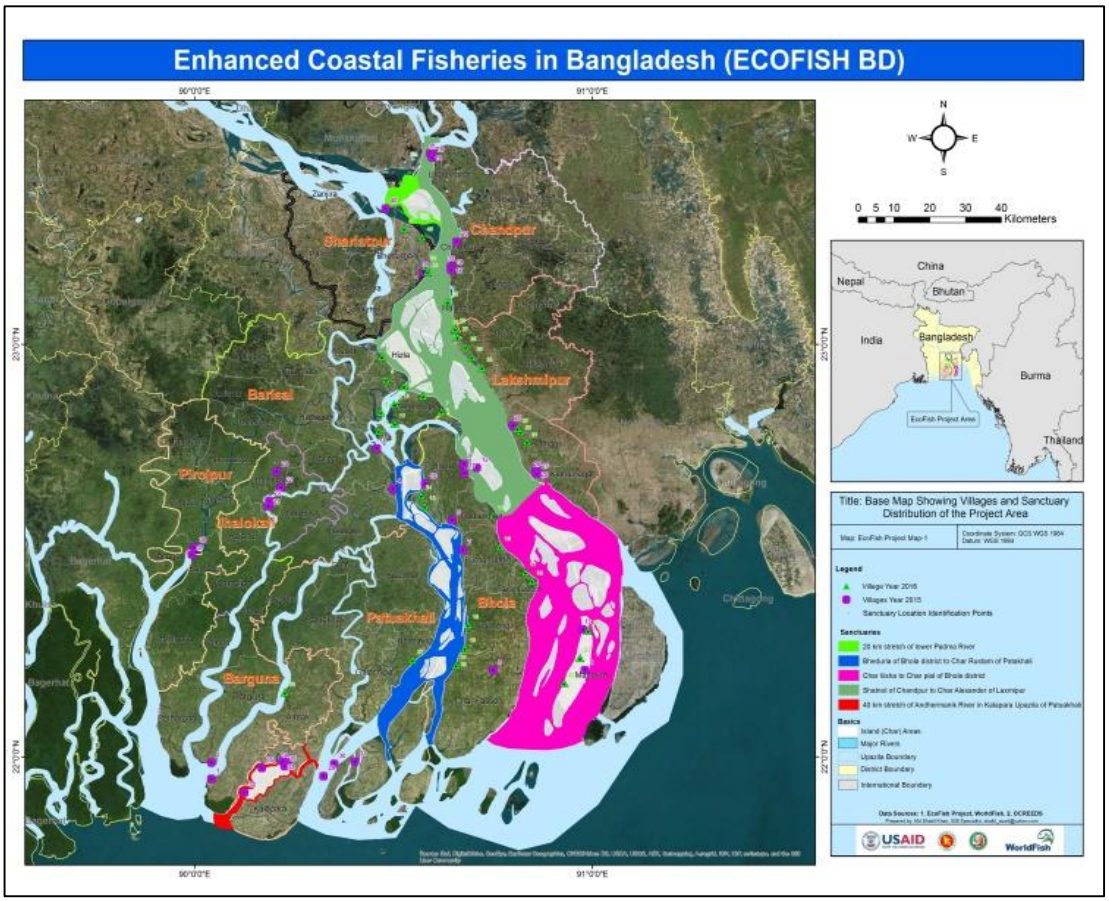
Forming Hilsa Conservation Group (HCG) and building capacity: HCGs were formed in all

target villages involving 70% fishers and 30% fishers' women. In order to involve the HCG members effectively in fisheries co-management, the ECOFISH-Bangladesh conducted learning sessions in all HCGs in 9 districts. The learning topics covered awareness building and improving knowledge of organizational skills, group collaboration, communities' role in fisheries management, planning, co-management, climate change and biodiversity, and livelihood and social development.

Forming Fishers Women Community Savings Groups (CSG) and building capacity: Rural fishing communities usually lack a culture of savings and non-fishing entrepreneurship. So, an initiative to pilot a community savings scheme exclusively for women. The CSGs were formed comprising of only fishers' women at least one in each village/community. In order to involve the CSG members effectively in savings and co-management, the ECOFISH-Bangladesh conducted training on operation, business literacy and management for CSGs.

Forming Hilsa Ghat (landing center) Group (HGG) and building capacity: HGGs were formed involving with wholesalers (*Arotder*) and money lender (*Mohajons*), boat skippers (*Majhee*), fishing labour (*Vagi*) and local leaders. Strategically the initiative worked with landing centres to create an enabling environment for effective engagement of *Arotders, Mohajons*, boat owners, *Majhee* and *Vagi* and fishers in co-management.

Formation of Community Fish Guard (CFG) and capacity building: CFGs were formed in four co-management sites involving young fishers willing to assist the DoF and law enforcing agencies, coast guards, river police and police.



Map of the working areas

Fig. 4. Working areas: ECOFISH-Bangladesh

Customized livelihoods programs to ease the hardship due to ban periods Formation of Union, Upazila, District and Central co-management committees: A four tiers co-management committee at Union, Upazila, District, and national levels has been proposed [42,43]. The members of the committees at each level have also been proposed.

These include the development capabilities of user groups through formation of village level Hilsa Conservation Groups (HCGs), Fishers Women Community Savings Groups (CSGs), livelihood support in terms of on-farm and non-farm options, formation of fish landing Center Groups (HGGs), creation of Hilsa conservation fund, promotion of dialogue among different stakeholders, developing connectivity between government departments and fishing communities, supporting the capabilities of the DoF and law enforcing agencies for enhancing compliance, and addressing the socio-political culture that prevails in the Southwest regions of Bangladesh. This study support development of a co-management framework to build a scientific basis for Hilsa co-management through the involvement of government departments, river fishers, fish traders and relevant stakeholders. The proposed framework of a co-management is constructed and adapted from [42,43], which may, if implemented, facilitate the sustainable Hilsa management and conservation in the Padma-Meghna River systems (Fig. 5).

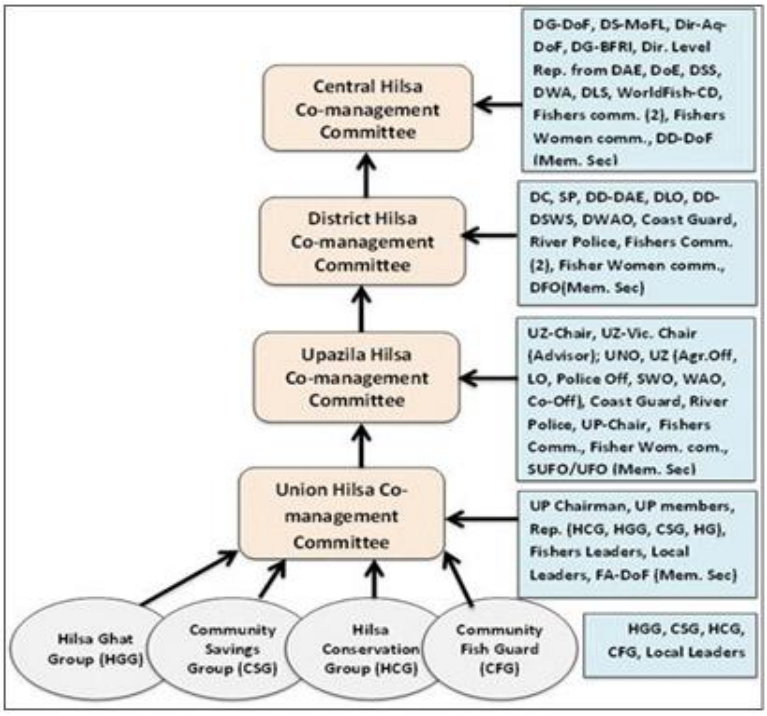


Fig. 5. Proposed co-management model (adapted from [42,43])

Abbreviations: Central Committee: DG: Director General, DoF: Department of Fisheries, DS: Deputy Secretary, MoFL: Ministry of Fisheries and Livestock, Dir-Aq: Director Aquaculture-DoF, BFRI: Bangladesh Fisheries Research Institute, Representative from DAE: Department of Agriculture Extension, DOE: Department of Environment, DSWS: Department of Social Welfare Service, DWA: Department of Women Affairs, DOL: Department of Livestock, CD: Country Director, Fishers committee, Fishers women committee, DD: Deputy Director; District Committee: DC: Deputy Commissioner, SP: Superintendent of Police, DD-DAE, DLO: District Livestock Officer, DSWS, DWAO: District Women Affairs Officer, DFO: District Fisheries Officer; Upazila Committee: Upazila Chairman and Vice Chairman (Advisor), UNO: Upazila Nirbahi Officer, UAO: Upazila Agriculture Officer, ULO: Upazila Livestock Officer, USWO: Upazila Social Welfare Officer, UWAO: Upazila Women Affairs Officer, UCo-Off: Upazila Co-operative Officer, UP-Chair: Upazila Chairman, SUFO: Senior Upazila Fisheries Officer, UFO: Upazila Fisheries Officer; Union Committee: UP: Union Parishad; and Village level committees: HGG: Hilsa Ghat Group, CSG: Community Savings Group, HCG: Hilsa Conservation Group, CFG: Community Savings Group

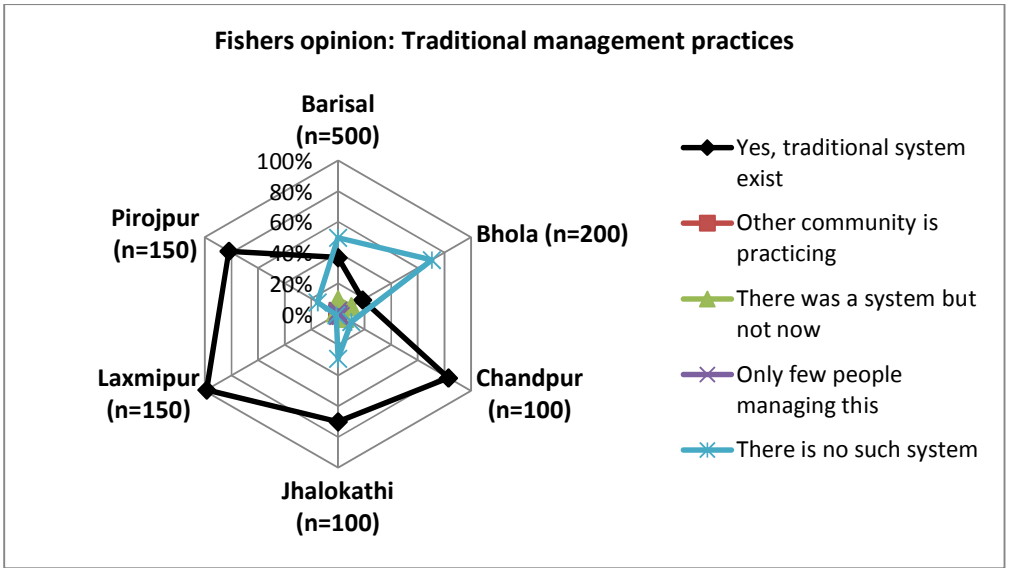


Fig. 6. Fishers view regarding traditional fishery management practices

In September 2016 ECOFISH-Bangladesh conducted a study in 24 villages across six districts (Barisal, Bhola, Chandpur, Jhalokathi, Laxmipur and Pirojpur) through involving 1200 fishing households to understand traditional management practices, participation in the fishery management activities and opinions of fisher's regarding co-management approaches. The study shows that about 54% of respondents agreed that traditional fishery management practices exist in some of the River sections in the ECOFISH-Bangladesh project areas. However, about 38% respondents believed that there is no such system exists at present, and only 6% responded believed that there was a traditional system but not now. Fisher's opinion regarding traditional management system in six districts is given in Fig. 6.

Regards to participation in the fishery management activities the present study shows that about 46% fisher family participated Hilsa fishery management activities. Yet, 52% fishers family does not participate any Hilsa fishery management activities and 2% fishers family does not aware any management activities ongoing on Hilsa fishery management. The study also examined fisher's perceptions regarding present management approach and found that about 12% responded showed very satisfied and about 67% responded also exposed their satisfaction. However, about 5% responded disagreed and 17% responded have not idea regarding present management system.

Regards to co-management initiatives the study reveals that overall 92% responded believed that co-management will improve the compliance of Hilsa fishery management and only 3% disagreed about the concept. Besides, about 60% responded certainly agreed in Pirojpur district and about 85% hope so co-management will improve compliance in Laxmipur district.

In ECOFISH-Bangladesh the CBOs (HCGs, HGGs and CSGs) were formed to manage all five Hilsa sanctuaries and a pilot, co-management committee was formed in the Andharmanik River sanctuary. These communities involved 15000 direct beneficiaries (30% women) for Hilsa sanctuary level management. Through a co-management process, the following lessons have been learned from ECOFISH-Bangladesh.

- Engagement and training of members of fishing households has increased fish conservation impacts.
- Community Action plan is useful for overall development which might supplement to the co-management and livelihoods.
- Involvement of local government institutions (Union/Upazila Parishad) is essential to establish a co-management system, as these are the lower-base tier of government administration.

- Community savings scheme offers a promising financial support during the fishing ban period, which will also ensure women's economic empowerment.
- Women show ardent willingness and possess the necessary aptitude to receive training for AIGA activities. It has been observed that households where women received such trainings have performed better.

4. CONCLUSION

The fishers in riverine and coastal regions are able to access the fisheries resources. The benefits are likely to be greater if many more communities manage their fishery in a similar way. So, community and fisher involvement in the local area or designated sanctuary management should be facilitated through the development of co-management mechanisms appropriate for the local conditions as well as for the regional context.

It is very important to adopt co-management approach followed by a program in the long-term sustainable use of the fishery resources use to sustain the livelihood potential and food security.

Guidelines, polity and action plans are urgently needed for co-management; without which, the future of the inland water fisheries in Bangladesh is greatly uncertain. The small-scale fisheries need to be supported with institutional programs – the ecosystem based co-management; and this would strengthen regulation of the Riverine and coastal fishery, addressing the empowerment of the poor fishers.

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DISCLAIMER

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COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. DoF. National fish week 2019 compendium (In Bengali). Department of Fisheries. Ministry of Fisheries and livestock, Bangladesh. 2019;160.
2. DoF. National fish week 2016 compendium (In Bengali). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 2016;148.
3. Hossain M, Aminul I, Stephen R, Takashi M. Management of inland open water fisheries resources of Bangladesh: Issues and options. Fisheries Research. 2006; 77(3):275-284.
4. Halls AS, Mustafa MG, Dickson M. Community-based fisheries management approach adopted in Bangladesh. Advances in Research. 2017;11(6):1-17.
5. Mustafa MG. Status of fish aggregating device fishery in the river Titas of Bangladesh. Advances in Research. 2017;10(2):1-14.
6. Mustafa MG. Fishery resources trends and community-based management approaches adopted in the river Titas in Bangladesh. Intl. J. River Basin Management. 2009;7(2):135-145.
7. Mustafa MG, Brooks AC. Status of fisheries resource and management approach in the open beels of Bangladesh: A comparative case study. Asian Fisheries Science. 2008;21:189-203.
8. Mustafa MG, Firoz Khan AKM, Mohsin SKM. Community-based resource management approaches adopted in the three tributaries of River Surma, North-East Bangladesh. J. Fish. Aquat. Sci. 2017;12:54-63.
9. Parvin S, Thompson P. Community based fisheries management and fisher Liveli-

hoods: Bangladesh case studies. Hum Ecol. 2007;35:527-546.
DOI: 10.1007/s 10745-006-9092-3

10. Thompson PM, Sultana P, Islam N. Lessons from community based management of floodplain fisheries in Bangladesh. Journal of Environmental Management. 2003;69:307-321.
11. Huntington T, Khan MG, Islam S, Brakel van M, Miller A. Towards sustainable coastal and marine fisheries in Bangladesh: Initiating a precautionary approach'. Report to World Fish Center, Dhaka, Bangladesh; 2008.
12. Mustafa MG. Co-management experience in Bangladesh, What need to be done towards coastal and marine fisheries for Integrated Coastal Management (ICM), In: Hoq, ME. and A. K. Yousuf Haroon (eds.), Support to sustainable management of the BOBLME Project, Bangladesh Fisheries Research Institute, Integrated Coastal Management (ICM) in Bangladesh, Sboblme: Pub./Rep. 2012;5: 45-56.
13. Kuperan K, Mustapha N. Small-scale coastal fisheries and co-management. Marine Policy. 1994;18(4):306-13.
14. Yamamoto T. An overview on fisheries management at global level with particular reference to community-based fisheries management systems. Paper presented at 7th Biennial Conference of the International Institute of Fisheries Economics and Trade, Taipei, Taiwan; 1994.
15. Pomeroy RS, Berkes FF. Two to Tango: The role of government in fisheries co-management. Marine Policy. 1997;21: 465-480.
16. Jentoft S. Co-management–The way forward. In Wilson DC, Nielsen JR, Degnbol P. (Eds.). The fisheries co-management experience: accomplish-ments, challenges and prospects (Fish & Fisheries Series). Kluwer Academic Publishers, Dordrecht, The Netherlands; 2003.
17. Jentoft S. Institutions in fisheries: What they are, what they do and how they change. Mar. Policy. 2004;28:137-149.
18. Juan CC, Omar D. Latin American benthic shell fisheries: Emphasis on co-management and experimental practices. Rev. Fish. Biol. Fish. 2001; 11(1):1-30.
19. Jentoft S, Bonnie J. McCay, Douglas C. Wilson. Social theory and fisheries co-management. Mar. Policy. 1998;22(4): 423-436.
20. Omar D, Juan CC. More than one bag for the world fishery crisis and key for co-management successes in selected artisanal Iatin American shell fisheries. Rev. Fish. Biol. Fish. 2005;15(3):265-283.
21. Joshua C, Cindy H. A comparison of social outcomes associated with different fisheries co-management institutions. Conservation Letters. 2014;7(3):224-232.
DOI: 10.1111/conl.12057
22. Mustafa MG. Evaluation of fisheries management techniques in three wetlands in Bangladesh. Advances in Research. 2019;20(5):1-14.
23. Fatema MK, Nahar MK, Gulshan MA, Fatema J, Haq MS. Impacts of community based fisheries management (CBFM) on the livelihood of fishers at Sherudanga beel in Rangpur District, Bangladesh. Journal of Agricultural Science and Practice. 2016;1:10-22.
24. Pomeroy RS. Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia. Ocean & Coastal Management. 1995;27(3):143-162.
25. Weeratunge N, Béné C, Siriwardane R. Small-scale fisheries, through the wellbeing lens. Fish and Fisheries. 2013; 15:255-279.
26. Rivera AS, Gelcich S, Garcia Florez L, Acuna JL. Heterogeneous management and conservation perception within the gooseneck barnacle co-management system in Asturias (N. Spain). Marine Policy. 2017;81:229-235.
DOI: 10.1016/j.marpol.2017.03.020
27. Selig ER, Kleisner KM, Ahoobim O, Arocha F, Cruz-Trinidad A, Rod R, Hara M, Katz L, McConney P, Ratner DM, Lina MSD, Thiao D, Torell E, Tro€eng S, Villasante S. A typology of fisheries management tools: Using experience to catalyse greater success. Fish and Fisheries; 2016.
DOI: 10.1111/faf.12192
28. Gutierrez NL, Hilborn R, Defeo O. Leadership, social capital and incentives promote successful fisheries. Nature. 2011;470:386-389.
29. Thompson PM. Lessons from community-based fisheries management in Bangladesh. Booklet 2004/01. WorldFish Center-Bangladesh and South Asia Office. 2004a;20.

30. Thompson PM. Impacts of the community based fisheries management project phase 1. Report to the WorldFish Center, Bangladesh. 2004b;107.
31. Thompson PM, Sultana P, Islam MN, Kabir MM, Hossain MM, Kabir MS. An assessment of co-management arrangements developed by the Community Based Fisheries Management Project in Bangladesh. Paper presented at the international workshop on fisheries co-management Penang, Malaysia; 1999.
32. Thompson P, Halder S. Lessons from community based co-management of large wetlands in Bangladesh. MACH Technical Paper-2. Winrock International. Dhaka, Bangladesh; 2007.
33. Mustafa MG, Halls AS. (Edited by Malcolm Dickson and Alan Brooks). Community Based Fisheries Management-Fisheries Yields and Sustainability. Policy Brief 2, WorldFish Center, Bangladesh and South Asia Office. 2006;4.
Available:https://www.worldfishcenter.org/content/community-based-fisheries-management-fisheries-yields-and-sustainability
34. Dickson M. (Eds.). Community based fisheries management, the right option. Policy Brief 4. The WorldFish Center, Bangladesh; 2006.
35. Dickson M, Usha K. Turning the tide, Community Based Fisheries Management, Protecting the poor and the environment; 2006.
36. Khan Firoz AKM, Middendrop H. Technical Advisory Notes (TAN) Bangladesh and Vietnam. The WorldFish Center, Bangladesh; 2006.
37. IFAD. Supervision report of the international fund for agricultural development, Community Based Fisheries Management: South and Southeast Asia. TAG-531: CBFM-SSEA; 2006.
38. Mustafa MG, Islam GN, Firoz AKM. Community based fisheries management CBFM-SSEA, fisheries and livelihoods impact. The WorldFish Center, Bangladesh; 2007.
39. Mustafa MG, Gopal CS, Shariff NA, Ahsanuzzaman M, Sadequr R, Azher, Rathi MM. Analysis of pond fisheries in climate change scenario in the Haor region of Bangladesh. Advances in Research. 2019;19(6):1-14.
40. ECOFISH-Bangladesh. Report of the lessons learned from fisheries adaptive co-management. Enhanced Coastal Fisheries Project, WorldFish, Bangladesh; 2015.
41. Van Brakel ML, Nahiduzzaman M, Mahfuzul HABM, Mustafa MG, Jalilur RM, Wahab AM. Reimagining large-scale open-water fisheries governance through adaptive co-management in hilsa shad sanctuaries. Ecology and Society. 2018; 23(1):26.
Available:https://doi.org/10.5751/ES-09917-230126
42. Mustafa MG, Nahiduzzaman M. Development of co-management model for large river system in Bangladesh project. I.S. River; 2018.
Available:http://www.graie.org/ISRivers/docs/papers/2018/26D63-262MUS.pdf
43. Mustafa MG, Rashedul Haque ASM, Nahiduzaman M. Introducing co-management system for hilsa conservation and development in Bangladesh. National Fish Week 2017 Compendium (In Bengali), Department of Fisheries, Bangladesh. 2017;71-75.
44. WorldFish Center. CBFM-2 international conference on community based approaches to fisheries management. WorldFish Centre, Bangladesh; 2007.
45. WorldFish-IPAC. Report: Workshop on lessons learned in wetlands and forests co-management. Submitted to USAID/ Bangladesh. 2009;74.
46. Mustafa MG. Community-based fisheries management: Improving fish biodiversity in inland fisheries of Bangladesh. Conference Revitalizing the Ganges Coastal Zone. Turning Science into Policy and Practices. Dhaka, Bangladesh. WorldFish Center; 2015.
47. Islam A. (Eds). Bangladesh Journal of Fisheries. Fisheries Society of Bangladesh. 2007;(Special issues):30.
48. Halls AS, Mustafa MG. Final assessment of the impact of the CBFM project on community-managed fisheries in Bangladesh. Consultancy report to the WorldFish Center, Bangladesh. 2006;83.
49. DFID. Liquid assets: Community-based fisheries management in Bangladesh. Published by WREN media, Crown Copyright; 2010.

50. Khan Firoz AKM, Mustafa MG, Niamul Naser M. Effective supervision of inland capture fisheries of Bangladesh and its hurdles in managing the resources. Bandung: Journal of the Global South. 2016;3: 17.
DOI: 10.1186/s40728-015-0026-6
Available:http://link.springer.com/article/10.1186/s40728-015-0026-6
51. Gazi Nurul I, Barr J. Livelihoods impact, policy brief 3, the WorldFish Center, Bangladesh and South Asia Office. 2006;12.
52. Pemsl DE, Seidel-Lass L, White JL, Ahmed MM. Community-based fisheries management project in Bangladesh, In CGIAR Science Council, Impact Assessment of Policy. Oriented Research in the CGIAR: Evidence and Insights from Case Studies, A study commissioned by the Science Council Standing Panel on Impact Assessment. CGIAR Science Council Secretariat: Rome, Italy; 2008.

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