Climate Change Impacts on Small-Scale Hilsa Shad Fishery in Bangladesh

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Hilsa species constitute the most important fishery of Bangladesh but are vulnerable to climate change. (Photo: Mahmudul Islam, 2019).

Tropical hilsa shad (Tenualosa ilisha) is an anadromous fish migrating from the sea to spawn in a freshwater river. This fishery constitutes an important fishery: it is the largest single-species fishery and contributes more than 10% of total fish production in Bangladesh. In recent decades, it appears that climate change impacts negatively affected the fisheries in various ways. Climate change has potential impacts on the internal mechanism of hilsa species that may drive the fishery to shift their habitat, which is reflected in the diverging catch statistics of the hilsa fishery. The hilsa catch has declined in the inland due to the anticipated impact of anthropogenic changes, including climate change, whereas production from marine water is increasing. Apart from increasing fishing efforts, it could be assumed that the hilsa population is moving from the river towards the sea. The climate change-induced habitat change of the hilsa shad fishery has enormous implications for the livelihoods and occupational safety of the fishers. If the climate change impacts continue to aggravate, small-scale fishers are likely to be one of the worst victims because they are heavily dependent on the climate-vulnerable hilsa population. Further, if the hilsa fishery collapses, Bangladesh may face a significant implication for achieving the UN Sustainable Development Goals (SDGs).

Introduction

Marine fisheries and ecosystems provide a crucial foundation for human well-being, particularly in developing countries (Blasiak et al., 2017). In Bangladesh, the hilsa shad (*Tenualosa ilisha)* fishery constitutes the largest single-species fisheries and contributes more than 10% of total fish production (Hossain et al., 2019). It has a large market demand and fetches the highest price in the local fish market. The fish is extremely rich in amino acids, minerals and lipids, particularly in essential and polyunsaturated fatty acids. The availability of hilsa fishery in the rivers is lower compared to the marine waters, due to the unplanned water control system, disruption of migration routes, habitat degradation, and increased hilsa fishing effort in nearshore and estuarine waters (Hossain, 2017). However, the catch in both inland and marine waters

has been increasing in last few years (Figure 1). This might be the result of successful fisheries adaptive co-management that recently took place in the hilsa fishery in Bangladesh (Rahman et al., 2020).

Over the course of this century, climate change is projected to have an adverse impact as well as the greatest threat to biodiversity (Trew & Maclean, 2021). The fifth report of the Intergovernmental Panel on Climate Change (IPCC) also anticipated that due to climate change, by the mid-21st century and beyond, marine species will redistribute their niches (Pachauri et al., 2014). Bangladesh is very vulnerable to climate change, which is likely to threaten the country's economy, fishery resources and socio-economic condition of coastal fishers (Islam et al., 2020). Bangladesh is ranked 18th in position in terms of national vulnerability to climate change impacts on marine fisheries due to low-lying topography, high population density, climate-sensitive economy, and poor governance (Blasiak et al., 2017). Consequently, marine biodiversity will be reduced, and might impact significantly on fisheries and ecosystem services in Bangladesh. The temperature fluctuations cause marine species' habitat shift, which leads to pressure on fishery stock, habitat loss and other stresses (Pecl et al., 2017). This chapter discusses the potential climate change impacts on inland and marine hilsa fishery, focusing in particular on the impact on small-scale fisheries spawning grounds, and climate change impacts on the internal mechanism of hilsa in Bangladesh coastal areas.

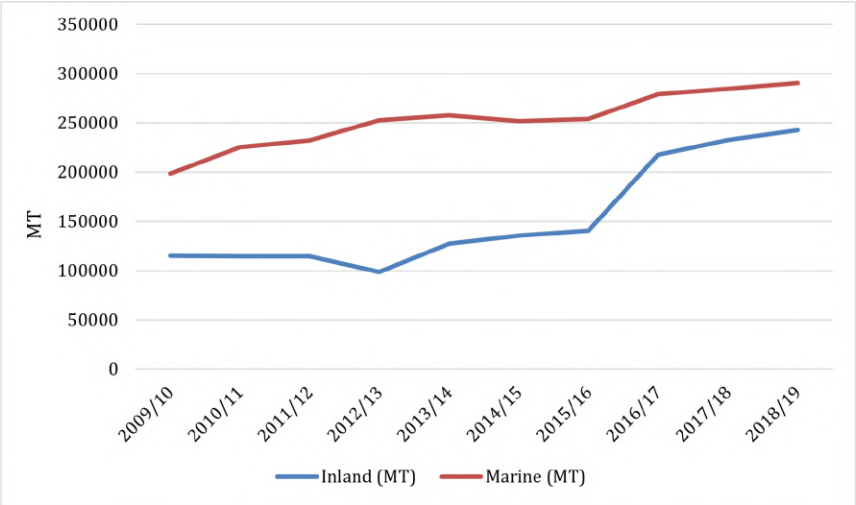

Figure 1. Annual catches (last ten years) of Hilsa in inland and marine waters in Bangladesh. MT=Matric tone (Source: DoF, 2021).

Climate change and environmental degradation issues on the hilsa fishery

The impact of climate change has a huge negative impact on the lifecycle of the hilsa fishery. Temperature rise is one of the major issues and has the highest climate sensitivity, including its impact on primary production on sea surface (Fernandes et al., 2016). The juvenile hilsa catch has declined in the rivers due to climatic change-related distortions, including siltation, closure of migration routes, and habitat degradation (Hossain et al., 2018). Besides, riverine hilsa catch has also declined in Bangladesh waters due to anthropogenic activities such as aquatic pollution, overfishing, and increasing fishing efforts (Dutton et al., 2018). The hilsa fish production is likely to reduce in the exclusive economic zone by 10%, and the impact can be worse in potential catch by 2030 and a significant decline (25%) by 2060 (Fernandes et al., 2016).

Sea level rise and salinity intrusion have a negative impact on the hilsa fishery in Bangladesh. Hilsa migration and spawning patterns, growth and

production are adversely impacted due to increased salinity (Islam et al., 2020). In addition, other oceanographic changes such as ocean acidification and inappropriate water quality also harm the feeding and nursing of the hilsa larvae, thus reducing larval growth and increasing mortality (Islam et al., 2020). El Niño and La Niña have great threats to coastal fisheries resources and to the marine ecosystem in Bangladesh. El Niño and La Niña have a significant impact on the water temperature, hydrology and rainfall in the Bay of Bengal in Bangladesh (Islam & Parvez, 2020).

Bangladesh receives approximately 40% of the total impacts of global storm surges due to its geographical location, and the country is turning more prone to severe cyclones, particularly during November and May (Hossain et al., 2018). A number of major adverse climatic conditions, including flood and tidal surge in 1985, devastating cyclone in 1991, flood in 1987, 1998, 2004 and 2007, cyclone *Sidr* in 2007, *Rashmi* in 2008, *Aila, Nargis and Bijli* in 2009, *Mahasen* in 2013 and *Gorki* in 2016, have caused a huge loss in the coastal infrastructure of Bangladesh. In most cases, the adverse impact on the coastal fishing communities has been devastating, destroying their residents and fishing utensils and leading to o illegal fishing to compensate for the loss.

Climate change impact on the internal mechanism of hilsa

Climatic variability such as cyclones, storm surges, sea-level rise, temperature changes, salinity changes, and rainfall changes affect the hilsa fishery's stocks (Islam et al., 2020). Besides, sedimentation increase into the riverbeds, and changes in rainfall pattern (rain is necessary for breeding) also negatively affect the availability of the hilsa population. Hilsa is particularly affected during the life cycle stages of egg, larvae, juvenile, and adult. Therefore, the lifecycle mechanism of hilsa is altered (Figure 2). Consequently, the hilsa population is gradually moving towards the sea, leading to increased marine catches and decreased in inland areas.

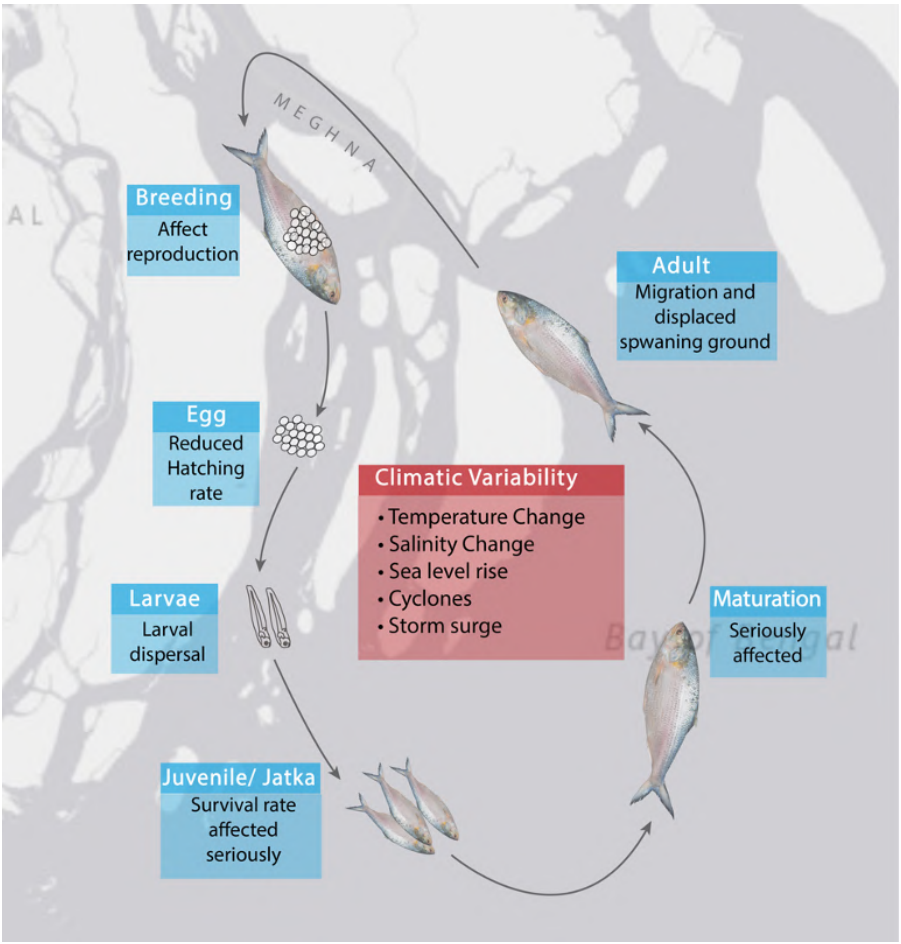

Figure 2. Climate change impacts the internal mechanism of the hilsa population

Socio-economic impact

The capacity of small-scale fisheries to catch hilsa fish is low compared to large-scale fisheries since they use small-size boats with engines of limited horsepower. Small-scale fishers are not able to chase hilsa fish from the river to the sea. Thus, the change in hilsa fish's availability in the rivers largely affects the income and livelihoods of the small-scale fishers. Bangladesh is

one of the countries where most of the coastal fishers are part of small-scale fisheries. The small-scale fishers are the most vulnerable group to the impact of climate change (Islam & Jentoft, 2019). Along with the climate change-related vulnerability, coastal fishing communities are exposed to different uncertainties throughout the year (Islam et al., 2020). The coastal fishing communities are frequently hit by cyclones, flooding, salinity intrusion as well as pollution caused by anthropogenic activities. Poor socio-economic conditions and impacts of climate change negatively impact human wellbeing and surrounding environment. The livelihoods of small-scale fishers greatly depend on hilsa fishery in coastal regions in Bangladesh. Thus, socio-economic conditions, and their livelihoods are tremendously affected by the adverse impacts of climate change.

Natural calamities such as cyclones, strong wind and waves, and current and tidal surges make the livelihood of the fishers more vulnerable. It does a lot of harm to the communities by damaging houses, sanitation systems, fishing instruments, and communication systems and pushes them into the debt cycle of money lenders. Fishers are unable to go fishing during extreme events. On the other hand, the family expenses increase along with increasing pressure of money lenders to pay their loans. The unequal distribution of wealth and power in rural Bangladesh makes it difficult for small-scale fishers, including women, to access fisheries resources (Dickson and Ahmed, 2006). The failure of centralized authorities in managing such resources has been recognized, and delegation of management of small-scale fisheries to the local resource users is now seen to be the only rational way of obtaining effective governance. Metzner (2008) highlighted that there are many examples of limited access to fisheries resources where the stocks have been overfished, over capacitated, and unprofitable. Limiting participation to fisheries and catch is not the solution; there is a need to have a sharing mechanism that determines equitable distribution of benefits.

Climate change impacts often become compound with other issues. Several fishing bans and seasonal closures reduced the number of fishing days by almost a half. The remaining fishing days are also affected by rough weather. Thus, the overall number of fishing days is very limited. As a result, fishers

fish indiscriminately without due consideration of conservation regulations. The reports of distant-water bumper catch often appear in the newspapers, implying that nearshore fisheries provide poor catch and that fishers are moving to fish in the deeper waters. Fishing in the deep waters entails several risk factors. Small-scale coastal fishers do not have any technology such as radio communication to receive weather forecasts or navigation during deeper water fishing. They mostly rely on cellphone-based communication to relay messages. However, the cellphone network coverage is weak in the offshore areas. In such situations, small-scale fishers rely on indigenous knowledge and observation to predict and apprehend rough weather situation. Many fishing boats have no lifesaving supports. For example, during the cyclone *Mora* struck the Bangladesh coast in 2017, a government estimate reported that the cyclone killed 53 fishers from Moheshkhali while they were out fishing. Although the government agencies have a system in place to inspect fishing boats to ensure they have the proper safety equipment, the functioning of that system is uncertain.

The vulnerability of small-scale fishers is not all the time related to extreme events; it is also connected to economic conditions and power relations. Small-scale fishers often work as a hired crew in others' fishing boats. In many cases, given the poor socio-economic condition, small-scale fishers are unable to afford their own boat. Instead, they rely on fishing boat owners and have no options but to accept whatever facilities the boat owner provides. The hired crews are likely to have no or little power to negotiate with the boat owner for better protection against extreme weather during fishing. Boat owners often force fishers to continue fishing even during rough weather conditions. Besides, in an extreme case, if any fishers dies during onshore, the boat owners are unlikely to provide any financial support to to the families of deceased fishers. In such a case, the government provides one-time support of BDT 50,000. The participation of small-scale fishers in governing fisheries resources is extremely important in order to achieve the SDGs, particularly goal 13 (taking urgent action to combat climate change and its impacts) and goal 14 (conserve and sustainably use the oceans, seas, and marine resources for sustainable development).

In Bangladesh the co-management project has been successful in encouraging fisher communities to develop alternative income-generating activities by providing micro-credit support through partner NGOs aiming to reduce fishing pressure on waterbodies (Islam et al., 2011). The co-management initiatives play a major role as a safety net during the lean fishing season and have contributed towards improving the livelihoods of fishing households in project areas. The combination of conservation measures, establishment of fish sanctuary and habitat restoration have resulted in upward trends for enhanced fishery management performance, sustaining production and increasing biodiversity. Organized fishing communities generally appear to embrace the concept and perceive significant benefits, but the main issues remain the financial and institutional sustainability of the community-based approach, where further support may be needed for existing community-based organizations.

Conclusion

This chapter discusses the impacts of climate change on the hilsa fishery system within the context of of Bangladesh's coastal region. The study concluded that the hilsa population is moving from the river towards the sea due to various climate change-induced drivers. Climate change has potential impacts on the internal mechanism of hilsa fishery, such as life cycle stages, migration patterns and spawning grounds of hilsa. Furthermore, climate change has an adverse impact on small-scale fisheries and their livelihoods. Small-scale fisheries are heavily dependent on the climate-vulnerable hilsa population, which threatens the livelihoods of fishing communities if the stock collapses. This type of changes in hilsa production and if continue, the impacts on hilsa fishery-based livelihoods that might have significant implications for achieving the UN Sustainable Development Goals (SDGs). Community-based fisheries management approach may help fishers to adapt in situations where government, NGOs, organizations and fishing communities work together to improve the livelihoods of poor fishing communities. The co-management approach is yet to be functional in the coastal fisheries. Still, we

can hope that science-based fisheries co-management will be established in the near future to improve the potential hilsa catch from Bangladesh's marine waters. The implementation of a community-based approach and proper poverty reduction strategies would be an effective and viable strategy for the sustainable livelihoods of coastal fishing communities in Bangladesh.

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