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Lessons from the Hilsa: An Aquascape Approach to the Sustainable Management of Blue Foods and Threatened Aquatic Species in the Bay of Bengal

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Abstract

The Hilsa shad (Tenualosa ilisha) is among hundreds of other species of aquatic animals and plants collectively referred to as "blue foods" in the Bay of Bengal. They form a crucial source of food, livelihood, and culture for millions of coastal communities in India, Bangladesh, Myanmar, and Sri Lanka. This policy brief highlights the need to take on a regional ecosystem approach when it pertains to the conservation of aquatic biodiversity and the sustainable management of the Bay of Bengals´ productive, albeit stressed fisheries resources (blue foods). The various challenges, including overfishing, pollution, and habitat destruction are major threats to aquatic biodiversity and in turn threaten the livelihoods and lives of millions of people in this region. As the demand for blue foods grows in the Bay of Bengal countries, emerging political powers will come under immense pressure to safeguard their dwindling fish stocks and protect their citizens' interests. Therefore, beyond tackling the scientific questions, there is a need to address the capacity deficit, both at the intra- and inter-governmental levels. This brief argues for a sustained capacity development strategy that will be implemented at multiple levels, viz., the local (community level), mid-management (forest and fisheries), national and regional. An regional approach to managing the Bay of Bengal marine ecosystem that also considers the entire watershed from mountains to ocean – the Aquascape will be crucial.

***Recommended citation*:**

Lobo, A. S. (2022). Lessons from the Hilsa: An Aquascape Approach to the Sustainable Management of Blue Foods and Threatened Aquatic Species in the Bay of Bengal. In Xavier, C. & Palit, A. (Eds). *Connectivity and Cooperation in the Bay of Bengal Region.* (pp. 83-90). Centre for Social and Economic Progress. Retrieved from https://csep.org/BjDWEZJ

Aquatic species and the Blue food system of the Bay of Bengal

The Hilsa shad (*Tenualosa ilisha*) is the national fish and part of the very identity of Bangladesh, almost always served at weddings and religious ceremonies, and exported to Bengali stores the world over. Approximately six million people are engaged in the Hilsa value chain in the countries of the northern Bay of Bengal where 95% of this fish is caught. Bangladesh nets the highest quantities (76%), followed by Myanmar and India (Bay of Bengal Large Marine Ecosystem Project, 2010). It contributes to about 10% of the total fish production in Bangladesh and to approximately 1% of the country´s GDP (Fisheries Resources Survey System, 2014).

The Hilsa is among hundreds of other species of aquatic animals and plants collectively referred to as blue foods. They form a crucial source of food, livelihood, and culture for millions of coastal communities. However, these blue foods, particularly in the Bay of Bengal, are subject to various challenges, including overfishing, pollution, and habitat destruction— problems that transcend local communities and affect their livelihoods (Ghosh & Lobo, 2017). Interestingly, while the Hilsa is known to be a resilient species whose population can recover if appropriate management measures are put in place, the same might not be the case for several other species that may be far more vulnerable but receive much less attention. These include the Gangetic Shark (*Glyphis gangeticus*), the Northern River Terrapin (*Batagur baska*), and the Ganges River Dolphin (*Platanista gangetica gangetica*)—all aquatic animals threatened with extinction.

Beyond its socio-economic and cultural significance, the Hilsa can also be considered a conservation mascot of sorts for the Bay of Bengal region. In its short life of approximately four years, the fish traverses several geographies. From the Bay of Bengal, the adult fish swims upriver to lay its eggs, covering several hundred kilometers from the sea to freshwater. The eggs hatch and the young fish migrate downstream towards the Bay. By the time they reach the estuarine areas of the Sunderbans, they grow to a size called *Jatka*. From here they move into the Bay and are said to reach their productive best between August and November. Most importantly, the Hilsa highlights the fact that nature does not know the political boundaries we draw for ourselves.

The case study of the Hilsa highlights the need to take a 'fish-eye' view when approaching issues pertaining to the management of aquatic natural resources like blue foods and other threatened marine wildlife, particularly in a common sea like the Bay of Bengal. Beyond tackling the scientific questions, there is a need to address the capacity deficit, both at the intra and inter-governmental levels. This will require a sustained capacity development strategy that will be implemented at multiple scales viz., the local (community level), mid-management (forest and fisheries), and national and regional.

Socio-ecological and Economic Challenges

The stronghold of the Hilsa is the Ganges delta, the world´s largest delta covering an area of approximately 100,000 sq.km, formed by 3 major rivers—the Ganges, the Brahmaputra, and the Meghna which flow into the northern Bay of Bengal. Approximately two-thirds of the delta lie in Bangladesh, while the rest is in the Indian state of West Bengal. Large volumes of silt deposited by these rivers and their distributaries, along with the mixing of fresh water with the salt, create the perfect conditions for mangroves, the coastal forests that straddle these transitional zones, to thrive in. It is not surprising then that the world´s largest delta also happens to host the largest contiguous patch of mangrove forests, the Sunderbans, which covers a total area of 9,630 sq.km shared by India (38%) and Bangladesh (62%). However, despite its vastness and socio-ecological and economic significance, this region is faced with a whole host of challenges.

First, overfishing, pollution, and habitat destruction along various sections of the

hilsa´s aquascape threaten a large number of aquatic species. Additionally, dams built on these rivers affect the migration of the Hilsa and a host of other aquatic species. This has been one of the most significant causes of decline of the Hilsa catch. Among the most notable is the 2.3 km long Farraka barrage that was constructed on the Ganga, close to the India-Bangladesh border and was attributed to bringing about precipitous declines of Hilsa catches in both India and Bangladesh. Before the construction of the barrage there are records of Hilsa migrating up the Ganga right till the towns of Agra, Kanpur, and Delhi, covering maximum distances of approximately 1,400 km from the Bay of Bengal.

The decline in catches of the Hilsa shad is easily felt by communities and generally reflected by marked increases in prices, prompting governments in both countries to put in place several moratoria to reverse this decline. In Bangladesh this has included fish sanctuaries, seasonal fishing bans, bans on fishing for *Jatka* as well as 'fish ladders' being tested out in the Farraka barrage to enable fish to scale the dam and reach their spawning grounds on the other side.

Second, the Bay of Bengal, particularly the continental shelf areas, are subject to heavy fishing pressure from both industrial and artisanal fleets. The industrialisation of fisheries in the Bay of Bengal began with the introduction of mechanised trawlers in the 1960s. Since the trawlers were introduced, the area covered by fishing fleets expanded four times till 2000 (Bhathal & Pauly, 2008)which are usually managed on a single species basis, has led to calls for 'ecosystem management', along with the development of various ecosystem indicators. Trawling is a highly efficient, albeit destructive, fishing method responsible for over half of the total seafood landings in India and is responsible for the destruction of the sea floor ecosystem. The nets with extremely small mesh size capture a large number of species, beyond the target (commercially important) species, and often in far greater proportions than the target catch. ´Trash fish,´ the degrading term for this non-target fish biomass, was traditionally discarded. Trash fish constitutes hundreds of species, each playing a different role in the marine food web and are vital to food and nutrition security to coastal communities. ´Trash fish´ is now landed, dried, and ground before being sold at low rates as fishmeal to the fast-growing poultry and aquaculture industries in the country (Lobo, Balmford, Arthur, & Manica, 2010).

The resultant effect is not just seen in the Hilsa population, but among other species as well. For instance, India´s eastern coastal state of Odisha, also located along the Bay of Bengal, hosts the largest rookery (nesting beach) for sea turtles in the world. In 2015, at one of the mass nesting beaches in Rushikulya, Odisha, an estimated number of 170,939 Olive Ridley sea turtles (*Lepidochelys olivacea*) came ashore to nest over a span of six nights (Chandarana, Manoharakrishnan, & Shanker, 2017). Interestingly, sea turtles nesting on the beaches of Odisha are known to travel south to feeding grounds off the coast of Sri Lanka (Behera, Tripathy, Choudhury, & Sivakumar, 2018). Although it is illegal to hunt or kill of sea turtles in all the countries of the Bay of Bengal, they are accidentally caught as bycatch in fishing nets and die of drowning. Thousands of dead sea turtles that suffer bycatch related mortality drift to the shore along the East coast of India, a fate shared by a large number of other marine mammal species which include Dolphins, Dugongs and even large Baleen whales (Dudhat, Pande, Nair, Mondal, & Sivakumar, 2022) population health and status of marine ecosystems. Opportunistic reporting of strandings also serve as a powerful low-cost tool for monitoring these elusive mammals. We collated data over ~ 270 years available through various open access databases, reports and publications. Annual strandings along the Indian coast (mean = 11.25 ± SE 9.1).

Third, large scale (industrial) aquaculture, to meet the global demand, just like industrial fisheries which is a big producer of the country´s protein, comes with its own set

of environment and social challenges. It is predicted that the global demand for blue foods will roughly double by 2050 and most of this will be met by aquaculture production. In 2020, of the total of 214 million tonnes of blue foods (aquatic animals and seaweed) produced globally 58% came from the farmed sector, while wild harvests including capture fisheries accounted for the remaining 42% (FAO, 2022). Asia has dominated the farm sector for the production of blue foods for decades now and in 2020 accounted for 91.6% of the total production with India, being the second biggest producer after China.

However, the dominant form of coastal aquaculture practiced in the wider Bay of Bengal region is intensive shrimp aquaculture. In India, the coastal state of Andhra Pradesh along the country´s east coast is the stronghold of the shrimp aquaculture industry. The Pacific white-legged shrimp (*Litopenaeus vannamei*), a species originally native to the Pacific coast of Central America dominates the production—a monoculture of sorts–in the country. Between 2019 and 2021, the state of Andhra Pradesh alone accounted for 69% of the shrimp produced in the country, wherein 73% of this was attributed to the non-native white-legged shrimp (Koshy, 2021). While this intensive shrimp aquaculture is capable of generating huge profits, if not properly regulated, can come at a high cost to coastal ecologies and livelihoods. These farms received a lot of criticism for releasing untreated water into the adjoining waterways. This often leads to the spread of diseases to surrounding ponds and pollutes estuaries and nearshore coastal ecosystems. Coastal aquaculture has also driven the conversion of several important coastal ecosystems such as tidal mudflats, mangroves, salt pans, and agricultural ecosystems into aquaculture ponds.

An aquascape approach to managing the Bay of Bengal's large marine ecosystem

Any management plan to sustainably manage blue foods and conserve other highly mobile aquatic species in the Bay of Bengal will require an approach that spans multiple aquatic ecosystems (from freshwater to estuarine and marine) and international borders—the aquascape. This will require a serious effort by individual states in the Bay of Bengal region to imaginatively look beyond protected areas and international boundaries. This will not only help better manage fisheries but will help strengthen conservation efforts of other flora, fauna, and habitats, while helping reduce pressure on species such as the Hilsa that depend on a continuum of aquatic habitats from marine to freshwater. Beyond inter-agency coordination within each country, this will require better transboundary cooperation to implement such plans.

As the demand for blue foods grows in the Bay of Bengal countries, emerging political powers will come under immense pressure to safeguard their dwindling fish stocks and protect their citizens' interests with regard to growing protein and livelihoods needs. The mismanagement of these ecosystems could spark conflict as desperate fishers, in their struggle to stay profitable, violate international laws and agreements and cross-border transgressions increase, a pattern that is being observed in several parts of the world (Higgins-Bloom, 2018). Fishing transgressions and consequently arrests seem to have become a regular occurrence in the India-Bangladesh maritime space (Bose, 2021). Transgressions by Indian trawlers in Sri Lankan waters of the Palk Bay have long been the cause for diplomatic tensions. This is particularly significant as Sri Lanka is currently reeling under the effects of the worst economic crisis in its history, and fuel shortages have impacted patrolling efforts and have led to a consequent decline in the enforcement by their navy (Ramachandran, 2022).

Any recommendation or solution for a situation as complex as this will likely come with trade-offs. However, it is often the poorest and most marginalised communities that bear the brunt of such interventions, whether it is due to the setting up of a new Marine Protected Area (MPA) or fisheries

management measures to enforce regulations against the capture and trade of contraband marine species such as sharks, sea horses, coral, sea cucumbers, etc. It is crucial that ocean equity and justice be made central to any plan and underrepresented communities, including small-scale fishers and indigenous groups, have a say in the planning process.

Managing a Bay without borders

An initiative that deserves a special mention when it comes to transboundary ecosystem management in this region is the Bay of Bengal Large Marine Ecosystem (BOBLME) project, a FAO/GEF-funded project that started in 2009 and is currently in its second phase of implementation. This project is a coordinated effort involving eight countries in the Bay of Bengal region viz., Maldives, India, Sri Lanka, Thailand, Indonesia, and Malaysia.

To its credit, the BOBLME project adopted a macro approach to manage the Bay. It employed an Ecosystem Approach to Fisheries Management (EAFM), an integrated approach that promotes the conservation and sustainable use of the ecosystem as a whole. This is of particular relevance in the context of tropical marine ecosystems that are characterised by a high diversity of species caught using a wide range of fishing craft and gear. One of the significant achievements of the project was the production of "a Transboundary Diagnostic Analysis (TDA) that identifies the major shared issues affecting the Bay of Bengal ecosystem" and it also "developed a Strategic Action Programme (SAP) that set out the actions needed to address these issues and their causes" (BOBLME, 2010).

There is also the Bay of Bengal Programme-Inter Governmental Organization (BOBP-IGO). This is a Regional Fisheries Advisory Body (RFAB) of the countries bordering the Bay of Bengal. It serves as "the think tank on transboundary and contemporary national issues of the member countries concerning fisheries management" (BOBP-IGO, n.d.).

30 by 30: Marine Protected Areas and other effective area-based conservation measures

The 30 by 30 target is a global initiative for governments to designate 30% of the world's land and oceans under some form of protection by 2030. It is one of the 21 action-oriented targets (specifically Target 3) of the Post-2020 Global Biodiversity Framework of the Convention on Biological Diversity (CBD). Most countries of the Bay of Bengal are now part of this initiative. In fact, this target to protect at least 30% of the oceans is based on scientific evidence as the minimum area required to safeguard biodiversity, reverse adverse ecological impacts while continuing to deliver ecosystem services including fisheries, climate regulation, and sustaining long-term ocean health (Woodley, Locke, Laffoley, MacKinnon, Sandwidth, & Smart, 2019).

Many countries in the Bay have taken proactive steps towards meeting this target. For example, the Government of Bangladesh has greatly augmented its MPA network, covering a total area of 7,367 km^2, approximately 8.8% of the EEZ of Bangladesh. In 2019, Bangladesh had also declared Nijhum Dwip as a MPA, covering an area of 3188 km^2. Interestingly, unlike most MPAs in South Asia that focus on conserving species and ecosystems with no-take areas prohibiting extractive activities, this MPA was created with the Hilsa as the focal species and was done to boost sustainable fisheries and livelihoods while protecting the marine biodiversity of Bangladesh. The inception and creation of this MPA was based on the research recommendations of three organisations viz., the World Fish Centre, the International Union for the Conservation of Nature (IUCN), and the Wildlife Conservation Society in Bangladesh, as well as extensive and sustained consultations with the local community.

However, simply increasing the area under MPA coverage will not necessarily guarantee effective marine conservation. To be effective this target requires a more nuanced view that

recognise several other elements including ecological effectiveness, biodiversity, representation, connectivity, and ecosystem services (Spalding, Meliane, Bennett, Dearden, Patil, & Brumbaugh, 2016).

In the populous countries of the Bay of Bengal, declaring protected areas often comes at a massive social cost (Jalais, 2007). While the significance of MPAs is well understood, securing the access rights of poor coastal communities, particularly small-scale fisheries, to these marine spaces should be well embedded in the planning process.

The WTO agreement on ending harmful fisheries subsidies

The basis of the agreement was to do away with harmful fisheries subsidies, which were responsible for contributing to overfishing globally. Subsidies, particularly fuel subsidies, often allow fisheries that have become unprofitable due to overfishing, to continue because they subsidise operational costs (in this case fuel). This exacerbates the crisis and can lead to a collapse of fish stocks, threatens the integrity of the marine ecosystem, and poses a threat to the livelihood sustainability of the region. The three focal areas/ pillars for prohibition include: (1) subsidies that support IUU fisheries; (2) subsidies in areas where stocks have been overfished; (3) subsidies that contribute to overcapacity and overfishing. Doing away with subsidies that promote unsustainable fisheries practice could be a step in the direction of a more sustainable transition. However, the withdrawal of these subsidies would require a nuanced approach, especially because livelihoods in the artisanal and small-scale fishing sector could be heavily impacted as a result.

Bolstering community adaptation to global change

Considering the impact on local communities, including displacement, any management/ conservation intervention in an MPA to draw up new fisheries regulations including the withdrawal of harmful fisheries subsidies can have a huge social cost that is often felt the most by the poorest and most marginalised sections.

Any new plan, whether it involves large-scale coastal/ ocean development, ports, or the implementation of new management/ conservation regulations, should also include strategies that are just and equitable and will enable local communities to adapt in a nature-positive way. However, context is key when it comes to implementing any such development intervention. Identifying and building on the capacity assets and innovations that exist in the region, rather than introducing models that are alien, are the most likely to yield the best results and be sustainable.

Restorative ocean farming for ecosystems and communities

Mentioned below are a few development interventions that hold great promise when it comes to safeguarding natural resources, while providing sustainable livelihoods to local communities. While aquaculture is the fastest-growing food producing sector in the world, the dominant intensive model can do with some significant changes that restore ecosystems, promote biodiversity, and improve the lives and livelihoods of poor coastal communities. New research shows that it is possible to produce high quality nutritious seafood while contributing to the recovery of ecosystems and biodiversity. Farming of species such as shellfish and seaweed with the right practices and places can help restore ocean health. Production of species such as these require near zero inputs in terms of feed, freshwater or land area, and results in minimum GHG emissions.

Seaweed mariculture is already showing promise in the region—in Cox's Bazar in Bangladesh and the Palk Bay and Gulf of Mannar regions of India. The USAID funded ECOFISH II project being currently implemented by WorldFish (an international

non-profit research institution), piloted a community-led seaweed culture project in Bangladesh. This project is showing good results in terms of providing livelihoods to fisher communities (especially women and youth), weaning them off declining fisheries and providing them with an important source of nutrition.

Another example of restorative ocean farming is silvo-aquaculture, a form of aquaculture where controlled mangrove growth is promoted in the pond. Versions of silvo-aquaculture exist in several parts of Asia and can be a great climate adaptation strategy while promoting biodiversity. These methods are often based on traditional technologies, they promote biodiversity, and the mangroves perform additional services in that they stabilise the coast and sequester carbon. However, these traditional technologies are not considered attractive as short-term returns can be low. Traditional coastal communities can be encouraged to take up such initiatives provided they are supported with capital, technology, and know-how. "Trap and Hold" is one such traditional silvo-aquaculture model practised in Myanmar, which was incentivised by the government through a performance-based compensation scheme in which Community Forest Groups were awarded a long-term lease if they restored abandoned aquaculture ponds using this approach. The abandoned ponds were previously intensive shrimp ponds, and in most cases were cleared of mangroves. The restored areas were incentivised to grow a polyculture of native species that included giant tiger prawns, mud crabs, and Asian sea bass. Through government and development aid funds, hatcheries were set up to incentivise farmers who undertook mangrove restorative activities by providing post-larvae of several species including mud crab and tiger shrimp to stock their ponds and avoid overharvesting from the wild.

We now have the necessary tools to identify and scale up good practices within a particular context. This would no doubt require appropriate resources in terms of funding. Identification of such restorative models that are context specific, along with appropriate capacity development interventions that build on the necessary skills of the community as well as government and non-governmental actors, can help develop sustainable pathways going forward.

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