



Coastal and Marine Conservation Strategy for Bangladesh in the Context of Achieving Blue Growth and Sustainable Development Goals (SDGs)

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Abstract

The coastal and marine ecosystem provides critical ecosystem services to millions of people living in a densely populated Bangladesh. In recent decades, the ecosystem faces a number of challenges derived from both natural and anthropogenic sources that put pressures on the sustainability of the social and ecological system. Moreover, the government recent initiatives to enhance the ocean-based blue economy and achieve sustainable development goals, particularly SDG 14 calls for developing a comprehensive conservation strategy for the coastal and marine environment. Based on literature review and stakeholder's consultation, this study formulated a detailed conservation strategy for the coastal and marine environment of Bangladesh. The strategy of nine interrelated sectors, their objectives and the action plan towards achieving these objectives were outlined. Implementing these strategies will play an instrumental role in enhancing blue growth and achieving sustainable development goals either directly or indirectly.

Keywords: Coastal and Marine Conservation; Sustainable Development Goals (SDGs); SDG14; Blue Economy Bangladesh

Introduction

Bangladesh has a coastline of about 710 km long and 121,110 km² Exclusive Economic Zone (EEZ) which are characterized by uniquely differentiated ecosystems having significant ecological and economic importance and potential. Following the recent international verdicts on the disputed maritime areas with the neighboring countries India and Myanmar, the coverage of Bangladesh's marine system estimated to 118,813 km², with an extended continental shelf about 37,000 km² having up to 50 m depth [1-3]. (Figure 1). The coastal and marine ecosystem of Bangladesh is a part of the Bay of Bengal Large Marine Ecosystem which is one of world's 64 Large Marine Ecosystems. Like other global coastal communities, ecosystem services from the coastal and marine ecosystem play a vital role in the livelihoods and income of millions of people living in the coastal zone of Bangladesh and beyond. For instance, about 2,70,000 fishing households directly and indirectly dependent on the marine fishery for their livelihoods [4]. Around 0.10

million people directly and 3.5 million people indirectly depend on the Sundarbans for their livelihoods and income. Particularly, the artisanal fishing is one of the most important economic activities in the region, where other livelihood options are absent or not readily available. Dependency on coastal and marine ecosystem services is likely to rise further, as the estimated 45 million people living in the coastal zone was predicted to increase to 120 million by 2015 [5]. The Bangladesh government has recently emphasized on enhancing blue growth and achieving sustainable development goals (SDGs), where ocean-based resources will play a key role. In September 2014, Bangladesh hosted a major conference in Dhaka that proposed a Bay of Bengal partnership for the blue economy [3]. The country has been working to shape the blue economy discourse within the South Asian Association for Regional Cooperation (SAARC) region for improving regional security and peace. The success of achieving most of the Millennium Development Goals in time prompted the government to start activities of achieving SDGs also by 2030. Several goals of the SDGs, particularly SDG 14 ("Con-

serve and sustainably use the oceans, seas and marine resources for sustainable development”) are explicitly related to blue growth, while its other SDGs may have implications to blue growth. The government has recently started dialogues with the stakeholders to exploit untapped potential of the marine environment using useful solutions and innovations for in- creasing food security, alleviating poverty, improving nutrition and health, creating jobs, lifting trade and industrial profiles while protecting ecosystem health and biodiversity [1].

banization, tourism and aquaculture), pollution and environmental degradation, sequential depletion of fish stocks, progressive loss of biodiversity and habitat, and loss of ecological processes. Additionally, population growth and human activities, unsustainable use of goods and services of the coastal and marine ecosystem, climate change impacts and non- compliance of legal and regulatory measures also may cause harm to the coastal and marine habitats that may limit their services to human wellbeing and overall growth and development. The Bangladesh government (GoB) took different initiatives such as the establishment of one MPA, enforcement of seasonal closures, which is insufficient considering the rapidly changing social-ecological systems of the Bay of Bengal. Bangladesh is committed to Aichi Biodiversity Targets # 11 of the Convention for Biological Diversity that set a target of 10% of the coastal and marine areas to be designated as Marine Protected Areas (MPAs) by 2020. However, the country is far behind in achieving the target. Bangladesh needs to establish more MPAs as per the provisions of Convention on Biological Diversity (CBD) and Aichi Biodiversity Targets. The GoB also declared enhancing the blue economy as a priority policy for its goal to be a middle-income country by 2021. This calls for an immediate need for transformation in coastal and marine governance that will focus on restoring ecological diversity as well as fostering blue economy in the Bay of Bengal. The Sustainable Development Goals (SDGs) also calls for conservation and sustainable use of the oceans, seas and marine resources for sustainable development (Goal 14). However, a detailed conservation strategy for the coastal and marine ecosystem of Bangladesh that explains how the SDG 14 would be achieved is lacking. This study aims at making one of the first at- tempts to connect coastal and marine ecosystem conservation strategy with achieving SDGs in Bangladesh.

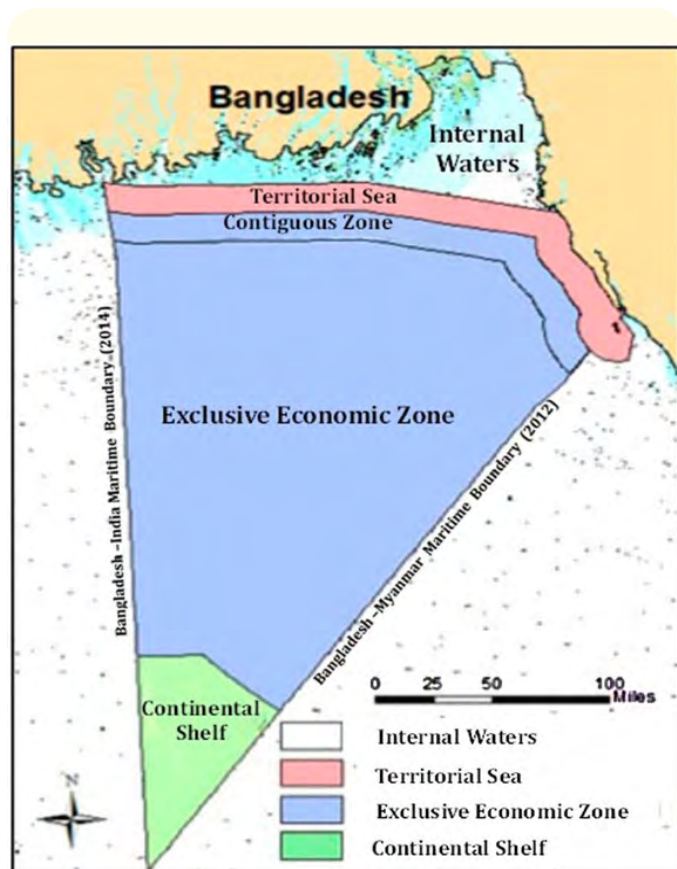


Figure 1: The permanent maritime boundary of Bangladesh after settlement with India and Myanmar [6].

As a densely populated developing nation with emerging economies, the coastal and marine ecosystem are facing a growing wave changes originated both from natural and anthropogenic sources (Table 1). The challenges are multiples and progressive that included unplanned coastal development (coastal constructions, ur-

Overview of coastal and marine ecosystem services of the Bay of Bengal related to blue growth and SDG

The concept of Blue Growth seeks to unlock “the potential of our seas and oceans for jobs and growth” [12]. To realize this potential, commercially important coastal and marine re- sources are the main components of the blue growth for Bangladesh [13]. The coastal and marine ecosystem of Bangladesh comprised of fisheries, mangroves, beaches, coral ecosystem, plankton, seagrass and seaweeds that provide a range of provisioning (biotic and abiotic) and cultural services (Table 2). Commercially important coastal and

Over-exploitation	Coastal fisheries are mostly over-exploited thus reduction of catch per unit fishing effort by overfishing by destructive and illegal gears	Hussain and liog, [7] Islam., <i>et al.</i> [8]
Constraints related to laws and policy	No clear regulation for the coastal fishery, Overlapping responsibilities between different agencies, lack of delegated clear responsibilities, and lack of resources for the implementing agencies, lack of MCS, and widespread non-compliance	Hossain and Islam [9]
Pollution	Municipal wastes from major coastal cities, oil pollution, loads of pollutants from ship-breaking activities in Chittagong pollute the marine environment	Fernandes., <i>et al.</i> [10]
Population growth IUU fishing	“The coastal population of Bangladesh has doubled since the 1980s, now reaching more than 16 million illegal fishing by foreign vessel, piracy by the local criminal gang	Islam., <i>et al.</i> [2]
Rapid environmental change	The, impacts of climate change are likely to reduce the potential fish production in the Bangladesh FF7 by 10%. Ocean acidification is another global problem that can affect coastal and marine living resources of Bangladesh.	Fernandes., <i>et al.</i> [10]. Hossain <i>et al.</i> [11]

Table 1: The major threats to coastal and marine living ecosystem in Bangladesh.

marine fishery species is an important source of animal protein, income and employment, also deserves credit in earning foreign exchange. Hilsa fishery alone generates income and employment for 2.5 million people with an annual value of USD 1.3 billion [14,15]. Different non-conventional fishery items such as seaweeds, squid and cuttlefish, jellyfish, oyster (e.g. *Crassostrea* species) also holds promise [13]. The Sundarbans mangrove ecosystem also supplies important provision services that fish, shrimp, honey, wax, wood, medicinal plants, fodder [2].

Marine provisioning services can also support blue growth areas of aquaculture (plants and animals aquaculture for human consumption) and blue biotechnology (fibers and other materials from all biota for bioprospection of active compounds for nutraceuticals, pharmaceuticals, and cosmetics) [16]. Due to the presence of diverse phytoplankton groups, the coastal waters of Bangladesh are highly productive that may support marine aquaculture [13]. Bangladesh has the highest percentage suitable areas in Asia for bivalve culture potentially suitable growing conditions and no known conflicting uses [17]. Currently, 183, 221 ha coastal land, predominantly in the south-east and south-east coastal belts, is under shrimp cultivation- the second largest foreign currency earning sector of Bangladesh [18]. In the case of blue energy generation, marine ecosystem natural capital (wind, wave, and solar energy resources as well as non-renewable abiotic energy sources like oil and gas could be an important opportunity for Bangladesh [2,13]. Marine abiotic provisioning supports the extraction of marine mineral resources that are available in the beach sands to provide for rare earth elements and other commonly used industrial metals (e.g., Cr, Ni, Zn, Mo, Pb) [16]. The coastal and marine ecosystem services also provided important cultural services such as tourism (that remain mostly untapped), as well as religious and spiritual benefits.

Methods

Review of literature was conducted to develop background information for the action plan and conservation strategy for coastal and marine conservation. A review of government gazettes, policy paper, and other official documents related to coastal and marine conservation as well as scientific article was conducted. Empirical data was collected through four consultation workshops with different stakeholders and experts held in four coastal districts: Khulna, Barisal, Chittagong and Cox’s bazaar. Approximately 40 participants were present in each workshop. Stakeholders ranged

from sectoral experts and professionals from different educational and research institutions government department and agencies (fisheries, forest, environment etc.), Civil Society Organization and NGOs, who has a stake or expertise in coastal and marine management issues. In these workshops, experts’ opinion was sought on to identify different interrelated sectors for coastal and marine conservation, what strategies are required to achieve SDGs related to coastal and marine conservation, what are the challenges ahead to realize the strategies as well as their suggestions for overcoming the challenges. Besides, one-to-one discussion was conducted with 20 key informants (who are knowledgeable in coastal and marine

conservation issues). Key informants included academicians, NGO persons; government officials, coastal managers, fisheries entrepreneur who share their own their perspectives of the conservation strategies, challenges and solutions. Content analysis was employed for the analysis of data collected by consultation workshops and key informant interviews [19-21]. Content analysis provides new insights thus enhancing a researcher's understanding of particular phenomena as well as informing practical measures [19]. The collected textual materials were coded into manageable categories of usable variables through classification, tabulation, and evaluation of its key themes [21].

Ecosystem services		Brief description of ES categories (categories according to the Common International Classification of Ecosystem Services (CICES) v4.3 (http://cices.eu/))	References
Provisioning	Food	<p>Fish, shellfish, and algae as food.</p> <p>About 475 bony fish, 50 cartilaginous fishes, 50 crab species, 7 turtles’ species, 36 shrimp and 5 lobster species, 3 starfish and 11 dolphins in the coastal and marine waters of Bangladesh.</p> <p>Non-conventional fishery items: 301 species of marine mollusks (i.e. bivalves, snails and slugs, cuttlefish, squids and octopuses). 7 species of squids and 2 species of cuttlefish, 156 algal species in the 2014-15 harvest of coastal and marine fisheries is 0.6 million MT. The harvest of hilsa shad (<i>Tenualosa ilisha</i>), as a single species, stand to 251,815 MT contributed 42% of the total catch.</p> <p>678 aquatic species (of which 210 species are fish, 59 reptiles, 8 amphibians, 11 cetaceans and 16 mollusks) are found in the Sundarbans.</p> <p>The mangrove forest produces different fruits, young shoot, fruit nectar, honey which are used as food.</p>	<p>Bangladesh Bureau of Statistics [22] Islam., <i>et al.</i> [2] Rahman [23]; Quader [24]; Islam [25]; Quddus and Shafi [26].</p>
	Biotic materials	<p>Leaves, young shoots, young leaf, bark of certain mangrove plants used as medicine by the local communities in Bangladesh.</p> <p>Parts (e.g., whole fish, skull, flesh with grey matter, cephalo-thoracic part, pointed beak, fatty tissue, spines, shell, air bladders) of different marine fish are used as medicine by traditional Hindu jaldas communities in the south-eastern coast.</p>	<p>Islam., <i>et al.</i> [2]; Deb and Haque [27]</p>
	Abiotic substances, materials, and energy	<p>With of annual sediment deposits of 665 × 10⁶ MT, the BoB is considered as having rich deposits of organic hydrocarbons, e.g., oil and gas.</p> <p>Non-living resources of the Bay of Bengal include crude oil, gas and sea salt. Of the 26 gas fields discovered in the country so far, 2 are located in offshore areas.</p> <p>About 17 heavy minerals deposits (e.g. Zircon, Rutile, Ilmenite, Leucosene, Kyanite, Garnet, Magnetite, and Monazite) have been discovered in the beach sands in the south-east coast. About 6000 ha is cultivated for sea salt production in the coastal area of Bangladesh.</p>	<p>Badrul (2015). Hossain., <i>et al.</i> [15]; Sarker., <i>et al.</i> [13].</p>
Cultural	Esthetic, religious, spiritual	<p>Bangladesh has one of the world’s longest sea beaches (i.e., Cox’s Bazar), the largest dense mangrove forest of the world (the Sundarbans) as well as different national parks and islands. The Sundarbans is a centre of belief and rituals for the local Hindu communities.</p> <p>The face of the Bengal Tiger, <i>Panthera tigris</i> ssp. <i>tigris</i> (Linnaeus, 1758) is used as the emblem of Bangladesh National Cricket Team. Hilsa shad is the national fish of Bangladesh with tremendous social and cultural values.</p> <p>Caste-based Hindu community has developed a strong religious connection with coastal and marine fishing in the Bay of Bengal.</p>	<p>Bangladesh Bureau of Statistics [22]; Islam., <i>et al.</i> [2].</p>

Table 2: The major ecosystem services (ES) from the coastal and marine environment of Bangladesh.

Results and Discussion

The analytical context within the framework of SDGs

The Sustainable Development Goals (SDGs), officially known as Transforming our world: the 2030 Agenda for Sustainable Development, are a new entrant in the policy space aimed at contributing to the objectives of a broad range of sustainable development issues, which includes ending poverty and hunger, improving health and education, making cities more sustainable, combating climate change, and protecting oceans and forests. The SDGs are comprised of 17 with 169 targets. Of the 17 goals, Goal 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) directly refers to the conservation and management of marine and coastal environment and associated resources. However, some of the targets of other goals also have both direct and indirect implications for the conservation of marine and coastal resources, also on the wellbeing of the coastal and marine resources dependent people. The other goals having targets with direct and indirect implication to Goal 14 are Goal 1 (End poverty in all its forms everywhere), Goal 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), Goal 6 (Ensure availability and sustainable management of water and sanitation for all), Goal 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), Goal 10 (Reduce inequality within and among countries), Goal 11 (Make cities and human settlements inclusive, safe, resilient and sustainable), Goal 12, (Ensure sustainable consumption and production patterns), Goal 13 (Take urgent action to combat climate change and its impacts) and Goal 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss).

Prior to the SDGs coming into effect in 2015, Bangladesh has made remarkable progress towards achieving MDGs in the areas of poverty alleviation, ensuring food security, primary school enrolment, attaining gender parity in primary and secondary-level education, lowering of infant and under-five mortality rate and maternal mortality rate, improving immunisation coverage and reducing the incidence of communicable diseases [28]. Bangladesh has integrated the 2030 Agenda in its 7th Five Year Plan (FYP) (2016-2020) that reflected the priorities of the SDGs in the national plan. In alignment with 7th FYP, action plan is developing for the

implementation of SDGs. The government of Bangladesh (GoB) has adopted an inclusive “Whole of Society” approach that facilitated wider participation of NGOs, development partners, private sector, media and CSOs in the process of formulation of the action plan and implementation of the SDGs. In this process, ‘SDGs Implementation and Monitoring Committee’ has been formed at the Prime Minister’s Office to facilitate an implementation of SDGs Action Plan. Bangladesh Planning Commission has analyzed the data gap to develop indicators for all goals. The government is also to finalize a Monitoring and Evaluation Framework for SDGs implementation. Towards implementation of the action plan, Bangladesh has clearly identified the responsibilities of the ministries and government agencies to achieve the SDGs. Bangladesh has mapped out lead, co-lead and associate ministries against each target of the SDGs. Further, Bangladesh has introduced Annual Performance Agreement (APA), across the whole spectrum of public sector assessing individual and ministries/agencies performance [29].

Conservation initiatives in the coastal and marine environment

The GoB has declared four different areas covering 204 sq nautical miles of the fishing ground of the south patches and the middle ground as marine reserve to provide safe breeding ground for fishery species inside Bangladesh territory to conserve and develop marine fisheries resources [30]. To protect the single largest hilsa fishery from recruitment overfishing and growth overfishing, the GoB has declared five sanctuaries in the Meghna-Padma Rivers, other tributaries and inshore waters. The Department of Fisheries (DoF) in cooperation with law enforcement agencies and local government administration initiated a countrywide ban for eight months from November to June every year on catching, carrying and sale of jatka (juvenile hilsa less than 25 cm in size). Another restriction is placed on the catching of brood (mature and about to spawn) hilsa for 22 days during the peak breeding season in October [31,32]. In October 27, 2014, the GoB has declared 1738 km² kilometers of the Swatch of No Ground (SoNG-MPA) as country’s first MPA for the long-term protection of cetaceans (dolphins, whales, sharks and turtles) that inhabit offshore waters of Bangladesh. Furthermore, following the provisions of the Marine Fisheries Ordinance, 1983, all industrial trawlers in the Bay of Bengal must use Turtle Excluding Devices. To conserve the nature sustainably, control and mitigate pollution, the GoB declared a total of four sites in the coastal zone as Ecologically Critical Areas (ECAs). There are five wildlife sanctuaries in the coastal zone

of which three in the Sundarbans, one in Char Kukri Mukri Island and one in Chunati in the south-eastern coast. There is one game reserve in the coastal zone at Teknaf peninsula, Cox’s bazaar. There are two national parks in the coastal zone: Himchari in Cox’s bazaar district and Nijhum Dwip in Noakhali district. The Sundarbans Mangrove forest has been declared as a RAMSAR Site in 1992. In case of open seas, the Department of Fisheries (DoF) has declared 65-days ban period from (May 20 to July 23) for trawl fishing and shrimp harvest in the Bay of Bengal.

The progress and outcomes of these conservation initiatives are mixed. The establishment of hilsa sanctuaries has helped ecological conservation and halted the decline of hilsa stock which reflected in enhanced hilsa production in Bangladesh. However, the establishment of sanctuaries led to some negative socio-economic consequences such as loss of income, seasonal unemployment, increased poverty, and decreased food security [2]. Non-compliance of conservation rules is common in the protected areas. Poverty, insufficient incentives for compliance, political interference, mismanagement and corruption, limited capacity of the government often makes it difficult for law enforcement towards conservation efforts. Consequently, illegal fishing practices raise concern in the

context of achieving SDGs, which Bangladesh aims to achieve by 2030 [2]. A lack of clear legislation and definitions often creates challenges in protected area management. Recently (in 2016) after years of procrastination, GoB has formally approved the ECA Rules that provides legal basis for a clearer and stronger approach to regulating harmful activities within ECAs [33]. Bangladesh has adopted 7th FYP that has also emphasized to achieve some goals of SDGs as well as marine conservation and blue growth. The government put the informed use of ocean resources for development is an important part of the 7th Five Year Plan strategy. The government also provides priority to enhance blue economy during the 7th FYP period [28].

Strategies and action plan towards achieving blue growth and sustainable development goals (SDGs)

Based on stakeholders’ perception and expert opinion, this section presents different strategies and actions plan towards achieving blue growth and some of the sustainable development goals (SDGs). Given that, the SDGs are too elaborate, thus meaningful partnerships is necessary and that is why this is a specific goal in the SDGs [34] (Figure 2).

Coastal and marine conservation strategy	Strategic objective	National and regional institutions/actors ^a	Linked with SDGs
Fisheries stock assessment	Fisheries stock assessment for sustainable resource management	MFL, DoF, U/R, MFA, NIOR, BN	SDG 14
Legal measures and social safeguards for resource conservation and management	Ensure effective implementation of legal measures and social safeguards for coastal and marine resources conservation	MFL, DoF, U/R, MFA, NIOR, BN	SDG 14
Establishment of Marine Protected Areas (MPAs)	Marine protected areas to restore habitat of the endangered/ and critically important coastal and marine resources.	DoE, DoF, U/R, MFA, NIOR, BN	SDG 14
Co-management approach in hilsa sanctuaries	To enhance production and socio-economic benefits from this critical fishery resource	DoF, U/R, MFA, NIOR, BN	SDG 14
Protection of mangrove forests	To safeguard mangrove forest ecosystem from natural environmental changes and from undue human activities to ensure long-term sustained socio-economic and cultural benefits]	MoEF, MoL, MoWR, MoF, MoS, MoT, MoCA, DoE, FD, DoF, U/R	SDG 15
Land reclaiming and coastal land management	To ensure sustainable utilization of coastal land	MoL, MoWR, MoFL, FD, DoF	SDG15
Green coastal and marine tourism	To make tourism green and pro-poor	MoCAT, MoWR, MoEF, DoF, BTB, BTC	SDG8
Climate resilience coastal and marine environment	To undertake appropriate measures (policies, plans and actions) to build resilience against the impacts of climate	MoP, MoDMR, MoEF, MoL, FD, DoE, DoF	SDG 13
High Seas governance	To contribute efficiently to the production and management of open seas resources for the interest of national growth and development	MoFA, MoEF, MoP, MoS, BSC, DoF, MoPEMR	SDG 14, SDG 8
Enhancing blue economy	To enhance sustainable use of marine resources for the national growth and development	MoP, MoFA, MoPEMR, MoEF, MoS, BSC, DoF, U/R	SDG 14, SDG 8

Figure 2: Coastal and marine conservation strategies, their objectives and implementing partners in Bangladesh.

aMFL: Ministry of Fisheries and Livestock; DoF: Department of Fisheries; U/R: Academic and Research Institution; MFA: Ministry of Foreign Affairs; NIOR: National Institution of Oceanographic Research; BN: Bangladesh Navy; MoP: Ministry of Planning; MoL: Ministry of Land, MoEF: Ministry of Environment and Forest, FD: Forest Department; BSC: Bangladesh Shipping Corporation; MoDMR: Ministry of Disaster Management and Relief; MoCAT: Ministry of Civil Aviation and Tourism; MoWR: Ministry of Water Resources; BTB: Bangladesh Tourism Board; BTC: Bangladesh Tourism (Parjaton) Corporation; MoPEMR: Ministry of Power Energy and Mineral Resources.

Strategy 1: fisheries stock assessment

Until recently started exploratory survey by a research vessel, Meenshandani, there has been a long gap in the exploratory survey on fisheries stocks assessment. Hence, the standing stock and maximum sustainable yield values are unknown. Official statistics reveal that marine and inland fish catches in Bangladesh have doubled since 1995 reaching 1.6-million-ton year of which Hilsa has contributed ca. 350 000 ton. Over the same period, the number of marine fishing boats and gears has increased ≈ 4 times resulting in tremendous pressure on fisheries populations (Figure 3). In addition, the intensity of marine catches has increased due to the introduction of nylon twine and mechanized boats [10,31]. In this context, fisheries stock assessment in the Bay of Bengal is a pre-requisite strategy for sustainable resource management. Thus, it will help to achieve the SDG 14: conserve and sustainably use the oceans, seas and marine resources for sustainable development.

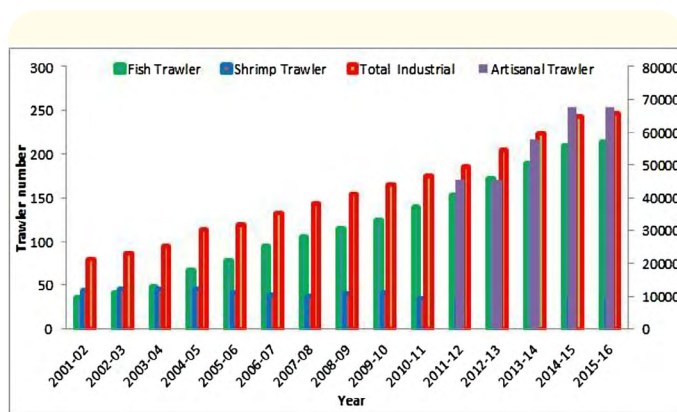


Figure 3: The increase in the number of fish, shrimp and artisanal trawlers operating in the Bangladesh marine waters. (Source: Department of Fisheries).

Action plan

- Exploratory survey to the stock assessment of all major species of commercial importance to determine Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY).
- Some commercially important fish stocks are believed to be overfished, hence assess the stock of untapped/less explored pelagic fishery resources, like tuna and other non-traditional fishery resources, such as squid, cuttlefish, octopus, oysters, mussels, lobsters, crabs, sea cucumbers and seaweeds to their sustainable exploitation within the EEZ of Bangladesh.
- Undertake appropriate legal framework to prevent over-exploitation.

- Introduce catch monitoring system at landing centers to assess the status and trends of resources for effective management decisions.
- Develop capacity of a dedicated institution to conduct the assessment at regular intervals, monitor catch and fishing efforts and generate research-based data/information to conserve and manage fishery resources on a sustainable basis.

Strategy: legal measures and social safeguards for resource conservation and management

Despite having a number of laws, rules and policy in place, unsustainable fishing practices, especially in the near-shore areas are continuing to grow due to non-compliance. The enforcement of fishing rules and regulations very often foreclose livelihoods earnings of the poor fishers, who undertake desperate attempts of fishing even in the ban period [2]. Besides, uncontrolled expansion of small-scale coastal fishery, particularly fine-meshed estuarine setbag net fisheries (ESBN) cause harm to coastal resource base of the Bay of Bengal [7]. Hence, Bangladesh needs to undertake a mixed approach e.g. enforcing fishing rules and regulation along with introducing social safeguard measures for the affected communities. The effective implantation of legal framework will curb IUU fishing (SDG 14).

Action plan

- Bring the small-scale fishery under monitoring, control and surveillance (MCS). The operations of ESBN should be banned in less than 10 m deep and mesh size (14-18 cm) should also be controlled strictly.
- Undertake stock recovery plan for the overexploited fishery by adopting comprehensive measures including the reduction of fishing effort, conservation of fishing grounds and actively monitoring of the compliance measures.
- Ensure proper implementation of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (the SSF Guidelines) adopted in 2015.
- Ban shrimp post-larvae (PL) collection from specific ecologically sensitive areas near the Sundarbans and other ecologically sensitive areas since the complete ban on shrimp post-larvae collected hasn't implemented effectively.
- Ensure necessary technical and financial support for establishing high-tech shrimp hatchery to ensure supply of pathogen-free (SPF) shrimp PL.

- Upscale post-harvest technology with appropriate infrastructure facilities, such as cold storage, ice plants, insulated and refrigerated systems etc. to prevent spoilage and quality deterioration during different stages of handling, transportation, processing and preservation.
- Introduce seasonal closure of fishing in selected estuarine and coastal habitat.
- Adopt economically viable alternative fishing methods such as crab- fattening, hook-and-line fishing and other non-farm occupations such as small cash crops, tree crops, and livestock rearing.

Strategy: establishment of Marine protected areas (MPAs)

MPAs are particularly important for protecting critical habitat and species from degradation and over-exploitation [35]. In Bangladesh, there are no explicit marine protected areas by name as defined through legislation [33]. However, as per Target 11 of the Strategic Plan for Biodiversity 2011-2020 (Aichi Targets), Bangladesh needs to make coverage of MPAs to at least 10% of coastal and marine areas. Thus, this study will foster one target of SDG 14 (By 2020, conserve at least 10 percent of coastal and marine areas).

Action plan

- As per Aichi Targets, conserve at least 10% of coastal and marine areas as protected areas.
- Develop a long-term plan and building institutional capacity to achieve 10 percent target with proper compliance and monitoring in place.
- Social policies such as job retraining and relocation assistance may be required to support fishing communities. The affected communities should be adequately supported by subsidy and existing welfare schemes, for example, Vulnerable Group Feeding program.

Strategy: co-management approach in hilsa sanctuaries

The establishment five hilsa sanctuaries and the adoption of hilsa conservation initiatives became a biological success, but it has negative social consequences such as tensions and dissatisfaction among artisanal fishers due to loss of income [2,36]. The compensation scheme by the government is insufficient and not inclusive. Hence, the hilsa fishers should be supported with appropriate compensation measures. Strategy needs to develop to make the compensation scheme inclusive, sufficient and transparent. It is also necessary to introduce participatory management approach,

rather than imposing of a hierarchical decision, so that local communities could value the long-term benefit of the sanctuaries and undertake a sustainable harvesting practice [2]. This strategy will be a step forward to achieve a few targets of SDG 14 (fostering ecological restoration, provide access for small-scale artisanal fishers to marine resources).

Action plan

- Introduce participatory and co-management approach to decision making and management of hilsa sanctuaries.
- The existing 22-day ban on catching brood hilsa should be expanded to one month in all waters of Bangladesh.
- Develop institutional capacity for monitoring of hilsa pawning behavior, and breeding and nursing areas to undertake management decisions regarding boundary of the hilsa sanctuaries, and temporal and spatial shifting of ban period.
- Effective surveillance to prohibit production, transport, and use of all destructive gears Build a hilsa conservation fund to support hilsa fishers.
- Increase existing support (e.g. 40 kg rice) on the basis of household size. To avoid leakage, rice support could be provided in a pre- packed sac.
- Cash support also could be provided through mobile banking to meet the cost of non-food expenses.
- Facilitate access of the coastal fishing communities to formal credit to reduce the dependency of fishers on informal exploiting credit system of money lenders.
- Undertake regional initiative for transboundary cooperation on hilsa
- fishery management.

Strategy: protection of mangrove forests

The Sundarbans and other mangrove areas in the coast provide ecosystem services. Particularly, provisioning services from the Sundarbans help to ensure employment, income, and food security and constitute a last resort activity when all other livelihood options are lost. However, a number of threats and stressors such as over-exploitation, pollution, development activities etc. continue to affect the flow and quality of the ecosystem services due to overuse and de- gradation [8]. Thus strategy needs to develop the mangrove ecosystem from degradation and destruction. Implementation of this action plan will help towards achieving SDG 15 by providing sustainable management, halt deforestation, restore de- graded forests and substantially increase afforestation and re-forestation as well as ending of poaching.

Action plan

- Undertake an economic evaluation of the mangrove resources and establish an optimum limit of sustainable yield while revising revenue-oriented management system currently in place.
- Develop a special joint force to monitor as well to take legal actions for illegal exploitation.
- Capacity building in terms of personnel and logistic support for the Forest Department to enforce conservation regulations.
- Involve communities through co-management approach, rather than imposing of a hierarchical decision.
- Assess the areas with thin canopy and bought them under mangrove rehabilitation program.
- Undertake long-term plan and strategies to protect the Sundarbans from the predicted impacts of climate change especially form sea level rise by facilitating gradual elevation by silt deposition and management and enhance freshwater outflow through the rivers and creeks.
- Undertake immediate measures to clean-up pollutions close to ecologically sensitive areas, particularly in ship-breaking yards in Chittagong coast.
- Strict enforcement of the Environmental Impact Assessment (EIA) rule while undertaking development activities in the coast.

Strategy: land reclaiming and coastal land management

The characteristic coastal morphology of Bangladesh causes accretion in some places and erosion in other areas. Over the period from 1973 to 2010, Bangladesh's net land gain estimated to 139 km² [37]. However, the newly accreted land initially enlisted as government-owned 'khas land' is often grabbed by the local influential, usually for shrimp cultivation. Hence, the government should formulate a strategy regarding newly formed coastal land. Once stabilized, the land should be used for mangrove afforestation and resettlement of the poor landless people. This strategy will favor in achieving SDG 15 for sustainable use of terrestrial ecosystems.

Action plan

- Develop a land use planning for the coastal areas to protect coastal lands from other uses like agriculture shrimp culture, industries etc.
- Undertake appropriate legal measures to protect newly formed coastal lands from illegal grabbing and bring them under mangrove plantation and resettlement of landless people.

- The Ministry of Land should follow the guidelines prescribed in the Coastal Zone Policy, 2005 through strict enforcement of existing laws.
- Take special measures to protect the Sundarbans by ensuring adequate water flow through dredging of accreted rivers and canals, necessary institutional support and appropriate management regime.
- Undertake long-term strategies to trap silt deposition for land reclamation.

Strategy: green coastal and marine tourism

The coastal and marine environment offers a prospect of tourism expansion and employment generation. However, with an increased number of domestic tourists in the recent years during a shorter time span e.g. usually in the winter season and long national holidays the spots of tourist attractions are becoming polluted by human residues, in some cases (e.g. Saint Martin's Island) resources are being over-exploited leading to ecosystem degradation and destruction. Hence, coastal and marine tourism development should be guided by proper planning, management standards and guidelines of green tourism so that the threat to biodiversity and cultural heritage are reduced. The tourism development policy should be pro-poor ensuring that tourism growth also contributes to poverty reduction in the coastal areas. This strategy will foster economic growth by devising and implementing policies to promote sustainable tourism that creates jobs and supports local culture and products (SDG 8).

Action plan

- Develop eco-friendly tourism policy from the coastal tourism hot-spots.
- Adequate facilities regarding accommodation transport and personal security should be developed in those areas.
- Develop infrastructure along with proper security measures for beach and cruise tourism.
- Pro-poor tourism (PPT) intervention should be adopted to increase net benefits to the poor and ensure that tourism growth contributes to poverty reduction in the coastal zone.
- A private-public partnership could be adopted in the process PPT development.

Strategy: climate resilience coastal and marine environment

The coastal zone of Bangladesh is very much vulnerable to climate change impacts. Since 1980, Bangladesh has experienced over 200 natural disasters leaving a total death toll of approxi-

mately 200,000 people and causing economic loss worth nearly \$17 billion [38]. Increased number of climate-induced disasters in the form of extreme hydro-meteorological events such as flood, cyclones, drought, salinity ingress, river bank erosion and increased tidal surge are already observed leading to human casualties, destruction of infrastructure, crop production, natural resources, livelihoods and of course the national economy [25,39]. Therefore, effective and adaptive conservation management plans and actions are required including the identification of especially important marine areas. This strategy is required for achieving SDG 13 to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters.

Action plan

- Institutional and human resource capacity building to research the impacts of climate change on the coastal and marine systems and associated resources.
- Promote eco-system-based adaptation measures through resource conservation and reducing anthropogenic stress to the climate change exposed ecosystems.
- Undertake measures to limit marine pollution and curtail over-fishing which might have a positive effect on the ability of marine ecosystems to adapt to climate change impacts.
- Policy instruments to reduce pressure on fisheries include a limit on license or vessel buyouts and local fishery closures to make fishery system more resilient to climate change.

Strategy: High seas governance

The 'High Seas', the marine areas beyond 200 nautical miles from the mean sea level, are governed by an international Convention called UN Convention on the Law of the Sea (UNCLOS) came into force in 1994. Representing about 60 percent of the ocean and deep seabed beyond of State's national jurisdiction, this High Seas is under worrying situation not only for fast degradation of its common resources but also for increasing of illicit activities. Since the enforcement of the Convention though much has been achieved in resource conservation and management through different regional initiatives, such as, Large Marine Ecosystems (LMEs) projects, however little has been achieved in combating illegal/illicit activities e.g. illegal fishing, transportation of slaves and sea piracy (as enshrined in Article 99 and Article 100 of the Convention). The recent horrific evidence of the transportation of 'illegal migrants' from Bangladesh and 'inhuman violence on the migrants' onboard demands rights-based and equitable im-

plementation of UNCLOS. Given the scope of UNCLOS Bangladesh, along with its neighbouring coastal countries, can undertake a regional initiative to stop the transportation of 'illegal migrants' and other illicit activities in the 'High Seas'. This strategy will help to achieve SDG 14 (sustainable use of ocean), SDG 8 (promoting safe and secure working environments for migrant).

Action plan

- Develop a comprehensive policy framework by revising the constraints of the existing laws and regulations (i.e. The Marine Fisheries Ordinance 1983; The Territorial Waters and Maritime Zones Act, 1974 etc. for improved governance of 'High Seas' of the Bay of Bengal.
- The high seas are governed by UNCLOS. Hence steps should take to enhanced cooperation with the regional countries and international organization.
- Enhance institutional capacity and establish coordination among institutions to control illegal and illicit activities in the high seas.
- Establish effective regional cooperation for strengthening, monitoring, and controlling and surveillance mechanisms to prevent illegal fishing.
- Undertake coordinated research both nationally and regionally on selected resources and other transboundary issues like pollution, habitat degradation, and fish migration.
- Undertake strict measures and vigilance to prevent foreign vessels using the Bay of Bengal as dumping place of hazardous wastes.
- Develop mechanisms to inspect pollutant free status of ships in the open seas before beached in Chittagong Ship breaking yards for scrapping.
- Ensure rights-based and equitable implementation of UNCLOS to tackle illegal transportation of migrants from Bangladesh and in-human violence on the migrant on board.

Strategy: enhancing blue economy

The blue economy offers enormous potentials to Bangladesh with the increase of country's Exclusive Economic Zone and associated resources and potential reserve of untapped resources within the national jurisdiction. Aside with resource utilization, the blue economy also refers to utilize other potentials of coastal and marine sectors, which includes shipping, marine construction, energy development, mariculture, coastal aquaculture, tourism etc. that also can increasingly contribute to growth, development and poverty alleviation. Bangladesh should develop a long-term action

plan and strategies to for sustainably utilizing 'blue resources' in the context of 'Blue Economic Growth' and tying together to the Goal 14 of the SDGs [3,13]. This strategy will also help to achieve SDG 8 of economic growth.

Action plan

- Develop a spatial mapping of the marine resources of the Bay of Bengal with possible projections for future resource extraction in a sustainable manner.
- Invest in research to assess vast potential "blue energy" generation from wind, wave, tidal, thermal and biomass sources from the BoB.
- Undertake measures to harvest export-oriented large pelagic species, such as, tuna within the EEZ of Bangladesh and higher seas, as Bangladesh recently becomes a member of the Indian Ocean Tuna Commission (IOTC).
- Provide incentives for developing fishing fleet for demersal and open ocean fish harvesting. Similarly, undertake artisanal fishery with efficient technology.
- Undertake measures and technological innovation for mariculture and sea ranching in the continental shelf of the Bay of Bengal. The potential of such practice would release pressure of overexploitation on fisheries and improved well-being of the population.
- Export-oriented maricultural of non-conventional species such as mollusk could be introduced.
- Invest in human resource capacity building in diverse fields of marine economic activities as well as environmental and biodiversity issues which needs to address through appropriate training and skill development.
- Mobilize resources for exploration of oil, gas and methane hydrates in the deep seas and valuable minerals deposited in beach sands.
- Mobilize investment for ports and shipbuilding to become a pioneer in emerging global market.

Conclusion

Until recent years, the conservation and management of coastal and marine living resources have received lower priority in comparison to inland fisheries and other land-based ecosystems. With the advent of the blue economy concept and SDGs targets, the government has emphasized on the exploitation of coastal and marine resources. At the same period, the Bangladesh government has emphasized environmental conservation. The government's commitment towards sustainable environmental management is reflected in the 15th amendment of the Constitution in which ar-

ticle 18 A calls for the protection and improvement of environment and biodiversity in Bangladesh. So, economic prosperity based on ocean resources should not gain at the expense of environmental sustainability. Achieving the targets related to SDG 14 will ensure sustainability of the coastal and marine environment for which an appropriate legal framework is a necessary tool. Achieving the goal of sustainable development by developing the blue economy will not be possible without enacting an integrated maritime policy. Thus, setting the appropriate legislative framework is fundamental to the effective implementation of the marine resources policy. In achieving all targets related to SDG 14, the importance of strengthening the implementation of legal and policy instruments was also underlined in the 'calls for action' document of the United Nations Ocean Conference 2017.

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