

October 2019

## Future Importance of Maritime Activities in Bangladesh

M Gulam Hussain  
*Bangladesh Ministry of Foreign Affairs*

Pierre Failler  
*University of Portsmouth*

Subrata Sarker  
*Shahjalal University of Science and Technology*

Follow this and additional works at: <https://cbe.miis.edu/joce>



Part of the [Economic Policy Commons](#), [Environmental Policy Commons](#), [Environmental Studies Commons](#), [Growth and Development Commons](#), and the [International Economics Commons](#)

---

### Recommended Citation

Hussain, M Gulam; Failler, Pierre; and Sarker, Subrata (2019) "Future Importance of Maritime Activities in Bangladesh," *Journal of Ocean and Coastal Economics*: Vol. 6: Iss. 2, Article 3.

DOI: <https://doi.org/10.15351/2373-8456.1104>

This Research Article is brought to you for free and open access by Digital Commons @ Center for the Blue Economy. It has been accepted for inclusion in *Journal of Ocean and Coastal Economics* by an authorized editor of Digital Commons @ Center for the Blue Economy. For more information, please contact [ccolgan@miis.edu](mailto:ccolgan@miis.edu).

## 1.1 INTRODUCTION

The concept of the Blue Economy has become synonymous with the “greening” of the ocean economy or one that more broadly aligns economic growth and job creation with the health of the world’s oceans (Monnereau and Failler, 2014). More specifically the Blue Economy is a concept of economic growth through the sustainable utilization of ocean resources with technological inputs to improve livelihoods and meet the growing demands for jobs without hampering the health of the ocean ecosystem (Sarker et al., 2018). Discussions on Blue Economy started in Bangladesh after the settlement of maritime boundary delimitation dispute with Myanmar (2012) and India (2014). So, the Government has recently started dialogues with the stakeholders to adopt the concept of Blue Economy across relevant policies and plans (Hussain et al. 2017a; Hussain et al. 2017b). Blue Economy comprises activities that directly or indirectly take place in the seas, oceans and coasts using oceanic resources and eventually contributing to sustainable, inclusive economic growth, employment, well-being, while preserving the health of ocean. It includes activities such as exploration and development of marine resources, appropriate use of ocean and coastal space, use of ocean products, provision of goods and services to support ocean activities and protection of ocean environment. It is needless to say that for most developing states particularly for Bangladesh, making the transition to a blue economy would entail fundamental and systemic changes in their policy-regulatory–management–governance framework(s) and identification of various maritime economic functions (GED 2015 cited by Patil et al. 2018). The Blue Economy conceptualizes oceans and seas as “development spaces” where spatial planning integrates conservation, sustainable use of living resources, oil and mineral wealth extraction, bio-prospecting, sustainable energy production and marine transport (Alam 2014). Thus Blue Economy requires a balanced approach between conservation, development and utilization of marine and coastal ecosystems, all oceanic resources and services with a view to enhancing their value and generates decent employment, secure productive marine economy and healthy marine ecosystems (GED 2015).

So far very limited national and international documents are available on the detailed concept and implementation of blue economy in Bangladesh. Therefore, this paper aims to highlight and describe in detail the future importance of maritime activities in Bangladesh and extend on current maritime key issues and future of sector wise activities including major challenges and constraints.

## 1.2 Overview of Current Maritime Key Activities

At present, key maritime activities include extraction of living and non-living resources, land based activities, trades and transportation, shipbuilding and ship breaking, tourism and recreation, man-made structures, energy production and, research and survey.

*Extraction of living resources:* Marine living resources in the maritime zone of Bangladesh consist of fisheries, mangrove forests, coral ecosystems, plankton, seagrass and seaweeds. However, currently fisheries resources and mangrove forests are directly used for economic purposes. Other living resources i.e. coral ecosystem, seagrass and seaweeds are used indirectly and have potential for further development in Bangladesh. Major fisheries resources include bony fishes, cartilaginous fishes, shrimps, crabs, lobster, mollusks, starfish, whales/Dolphins and squids (Table 1). Mangrove forest provides foods, honey and wax, thatching materials, medicine and fuel wood and timber for constructions.

**Table 1 : Coastal and marine fisheries resources of Bangladesh**

Category	Number of species		
	Hossain, 2001	Islam, 2003	Ahmed et al. 2008
Bony fish	475	475	442
Cartilaginous fish	50	-	-
Shrimp	25	24	56
Crab	15	50	16
Lobster	5	-	3
Mollusk (Oyster)	301	301	336
Whale/Dolphin	11	-	-
Squids	-	7	-

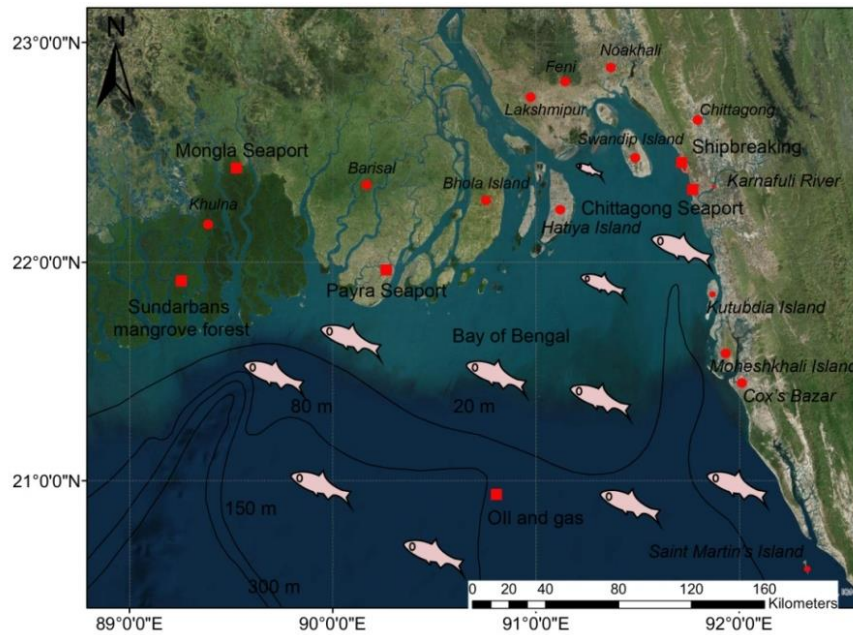
Source: FAO (2014)

*Extraction of non-living resources:* Potential non-living ocean resources in Bangladesh include gas, crude oil and sea salt. Development of these resources could have a huge positive impact on national economy. Twenty six gas fields have been discovered in Bangladesh and 2 of them (i.e. Kutubdia and Sangu gas field; are located in the offshore areas (Badrul, 2015). In addition to natural gas, deposits of several commercially important heavy minerals (i.e. Zircon, Rutile, Ilmenite, Leucoxene, Kyanite, Garnet, Magnetite and Monazite) have been in the Bay of Bengal.

*Land based activities:* The principal land based activities include urbanization, tourism and seaport development (i.e. Chittagong and Mongla sea port as well as the newly established Payra seaport). Small and large scale industries in the coastal cities (i.e. Chittagong and Khulna industrial zone), shipbuilding (i.e. Khulna shipyard) and shipbreaking (i.e. Sitakunda shipbreaking area in Chittagong) industries also provide important economic returns for Bangladesh.

*Man- made structures and energy production:* Conventional barrier techniques such as concrete blocks, earthen dike sand filled tubes, and wind mills for electricity typify the manmade structures in region.

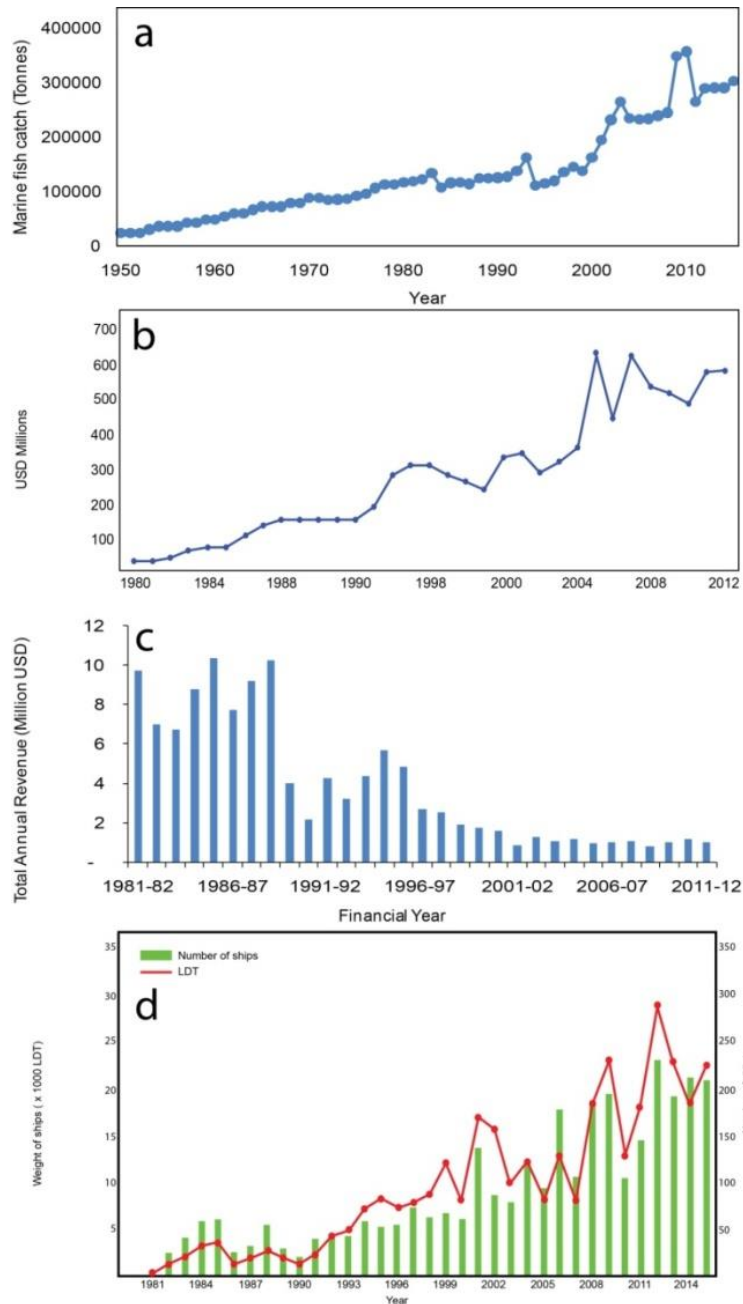
*Research and survey:* Currently different types of research activities are conducted by different research organizations, universities and Bangladesh Navy. This research activity includes hydrographic data collection and biodiversity and fish stock assessment.



**Figure 1 : Geographical location of the coastal area of Bangladesh.**

### 1.3 MAJOR TRENDS AND SCENARIOS

Data availability limits the scenarios and trends considered in this study to fisheries, mangroves, tourism, salt production and shipping industries. The total fish landing and total export income from fisheries has been showed an increasing trend during the present decade in Bangladesh (Figure 2b). The trend of fish catch, export income, number of fishing trawlers, fishing days and Catch Per Unit Effort (CPUE) were gradually increased until 1990s and then the trend was sharply increased (Department of Fisheries 2013). Data on mangrove revenue (Figure 2c) suggest that in recent years, revenues from this forest are comparatively less than the revenues from the 1980s and the 1990s. The tourism sector in Bangladesh is now employing over 1 million people and this sector generates a total value of 8.4 million USD. In Cox's Bazar about 263 sq. km area of land and in Chittagong around 20 sq. km are currently being used for sea salt production. This sector employs over 5 million workers and contributes about 35.5 million to 41.2 million USD each year to the national economy (Ahammad, H., Sujauddin, M., 2017). Bangladesh was the top ship recycling nation from 2004-2009, only slipping to second place in 2012. The industry scrapped around 270 ships and dismantled 210 ships in 2013. This made Bangladesh the third largest ship breaking nation in the world (Sujauddin, M., Koide, R., Komatsu, T. et al. 2015). The ship breaking industry in Bangladesh has an estimated worth 1.5 billion dollars annually (Figure 2).



**Figure 2 : Long-term marine fish catch (a), export income from fisheries (b), revenue from the Sundarban mangrove forest (c) and LDT (LDT) in Bangladesh (d).**

## 1.4 FUTURE BLUE ECONOMY DEVELOPMENT ACTIVITIES (2030 AND BEYOND)

Currently and beyond the year 2030, the following major development and economic activities have emphasized to implement under the concept of ocean or blue economy development in Bangladesh. In this section we are summarizing the future potentials of marine based economic resources (Living, non-living and potential other resources) within the identified sectors.

### 1.4.1 Marine Fisheries and Aquaculture

In Bangladesh to harvest and exploit marine fish resources, which consist of multiple species, various fishing nets and gear are used at different level water depths. Bangladesh's fisheries sector must move beyond traditional fishing practices to harvest large pelagic fishes from deeper zones within 200 nautical miles of EEZ and even up to the high seas (Hussain et al. 2017a). The most essential and important task is to conduct a thorough survey assess stock of marine fishes in Bay of Bengal area to explore more new fishing ground(s). For harvesting large pelagic fish, the country should have to adopt appropriate deep sea fishing technologies i.e. long line and hook fishing and using supporting craft, gear and vessels (Hussain et al. 2017a). Rehabilitation of Hilsa fishery is another important task that must be addressed as a trans-boundary issue. Hilsa are a transboundary species of Bay of Bengal, thus a joint effort between Bangladesh, India and Myanmar might be effective to prevent the harvest of Hilsa juveniles and protect the mature brood stock during the spawning period (Hussain et al. 2017a). In respect of indiscriminate harvesting of gravid mother shrimp, *P. monodon*, similar regulation can be adopted to avoid trawling at the depth of 10 – 40 meters of inshore marine waters.

#### **1.4.2 Marine Aquaculture of Fin Fish and Shellfish species**

Breeding and farming of sea bass, *Lates calcarifer*, need to be initiated as an important high value aquaculture species. Production of seabass, hilsa, mullet, pomfret etc. in near shore ponds and offshore cages may be an interesting option locally as well as commercially. Soft shell crab farming is an innovative and new technology, which could extensively be practiced in other coastal areas.

#### **1.4.3 Mariculture of Non-Traditional Species**

There are enormous opportunities for mariculture of non-traditional marine species like seaweed, macro algae, shellfish (i.e. mussel, oyster etc.), sea urchin and sea cucumber. There are 168 species of sea weed and other macro algae and some of them are commercially important in Bangladesh. Identification of suitable species and development of commercial culture techniques of sea weed might benefit the country. Mussel, Oyster and other shellfish culture could also be included. Sea urchin, sea cucumber etc. living habitat can also be explored in particularly at Inani of Cox's Bazar and St. Martins island as coral basements.

#### **1.4.4 Marine Biotechnology**

Unlike other countries of the world, Bangladesh has no doubt that existing living resources in particularly the marine organisms can be used as a source of new materials/products especially for application in human health care (antibiotics, anti-cancer, bioactive compounds and other pharmaceutical drugs, nutritional supplements, etc.) and nutritionally balanced food (marine fish, shrimps, crabs, mollusks, seaweed etc.).

#### **1.4.5 Oil, Gas and Minerals Mining**

Despite significant potential, relatively little oil and gas production has occurred to date within the maritime territory of Bangladesh. After the settlement of maritime boundary

disputes in 2012 and 2014 have generated new interest in offshore exploration (Petrobangla 2016). Apart from oil and gas, several studies have found sands containing valuable heavy minerals intermittently over the 250 km of coast from Patenga to Teknaf. If extractable, these minerals could contribute to a range of existing industries such as paper, glass, chemical, ceramic, and welding electrodes (Hossain et al. 2014).

**Table 2 : Sectors to develop and way to do it**

What to develop?	How to do?
Marine fisheries	Explore pelagic fishery, Explore new fishing grounds, Adopt deep sea fishing techniques, Rehabilitation of hilsa fishery, Adopt mariculture and conservation measures
Non-traditional species	Identification of suitable species, Development of culture technique, Identification of site, implementation of culture
Marine biotechnology	Basis research, applied research, implementation of applied research, commercialization
Oil, gas and minerals mining	Intensification of gas, oil and minerals exploration
Renewable energy	Use of wind, wave, tide, current and heat stored in water for energy production
Marine trade and transport	Creation of hub within the Bay of Bengal, Attraction of international market, Reduction of pollution
Marine tourism	Sole tourist spot declaration, attract international tourist, providing facilities
Marine spatial planning	Object identification, object wise zone selection, planning, implementation of plan and monitoring

Source: Own conception

#### **1.4.6 Marine Renewable Energy**

In view of this naturally available energy sources viz. marine wind, wave, solar radiation, tide, water currents, etc. could be utilized through the available and developing technologies to produce renewable energy.

#### **1.4.7 Marine Trade, Shipping and Transport**

The country's ports are not located close to main international shipping lanes which is a constraint, however serving as a hub within the Bay of Bengal (along with Kolkata or Chennai) could be an opportunity. Local shipping companies needs to come forward to add more fleets including the expansion of fleet in terms of size and capacity to lift the economic face of the country in a short time (Hossain et al. 2014).

#### **1.4.8 Marine Tourism**

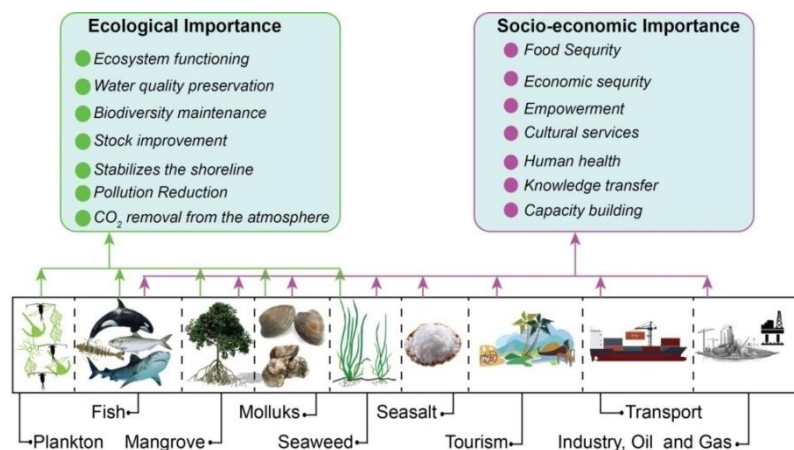
Bangladesh should process to enter global ocean cruise map for opening a new era in tourism industry. Cruise tourism acts as another valuable travel proposition bringing the people of the world closer together through connection of wishes and waterways.

### 1.4.9 Marine Spatial Planning (MSP)

MSP is the first step towards ecosystem-based management of the sea and its resources. MSP implementation will facilitate an improved planning and management systems for protecting marine ecosystem health and services, which will emphasize a balance between economic development and marine environmental conservation (Hassan 2013). The time is extremely crucial to formulate an effective policy and strategy for MSP at national level with the initiative of an authorized body under the auspices of PM's office for sector by sector planning of the blue economy of Bay of Bengal (Hossain et al. 2014).

### 1.5 Economic and Social Importance

Marine resources are playing an important role in national economy and to the society by providing food and employment opportunities (Figure 3). Fisheries resources are important to the individual for food security, economic security, empowerment, and to society for cultural services, recreational services, human health and well-being, knowledge transfer and capacity building. The Sundarban mangrove forest in the south-west coastal zone offers diverse livelihood options to the local people and contributes to the national economy. Mangrove wood is resistant to rot and insects, making it extremely valuable. As seaweeds have medicinal and food values, they offer potential for export as seafood to earn substantial foreign revenue. Mollusks species have medicinal values, for example clams are supposed to be good for heart trouble (Ab Lah et al., 2016; Smoothey 2013; Mahaffey et al. 2008). Tourism can provide direct jobs to the community i.e. tour guides and hotel housekeeping. Oil and gas sectors are also contributing in national economy through creating job opportunities.



**Figure 3 : Socio-economical and ecological importance of marine resources and activities**



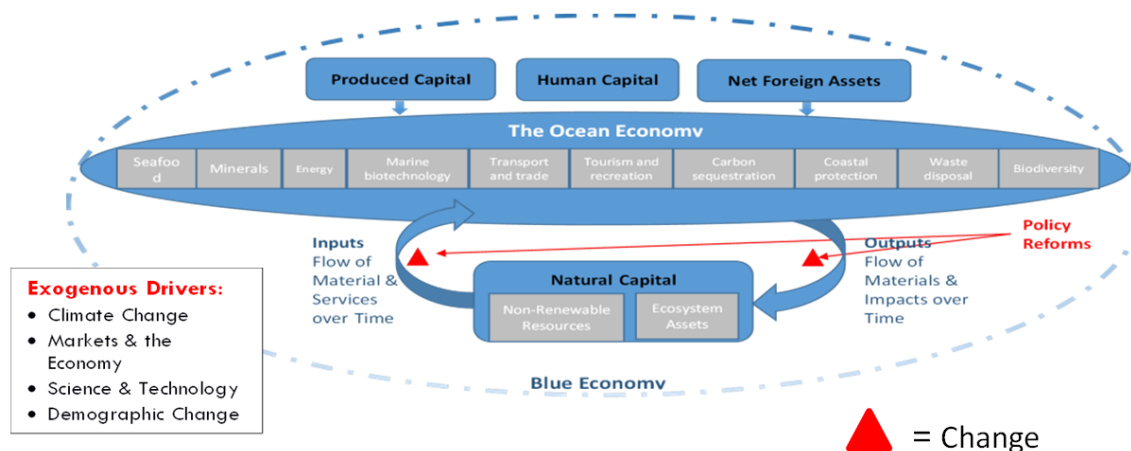
## 1.6 Ecological Importance of Natural Resources

Marine natural resources which have ecological importance (Figure 3), especially in Bangladesh coast, include plankton, fish, mangrove, seagrass, seaweeds, mollusk and coral reef. Plankton forms the foundation of food chain by serving as food source for other organisms. Fishes are ecologically important for their role in ecosystem functioning and biodiversity maintenance, and also as indicators of ecosystem change (Allan, 2004). Mangrove forest ecosystem provides an irreplaceable habitat for many diverse species of birds, mammals, crustacean and fish (Lee et al., 2014). Seaweeds beds serve as the habitat and shelter ground for many coastal and marine organisms for their whole life span or for a part of their life cycle. Oysters and other suspension-feeding bivalves help estuaries and coastal oceans against developing and sustaining excessive phytoplankton blooms (Officer et al., 1982). Coral reefs are important for many different reasons aside from supposedly containing the most diverse ecosystems on the planet (Komyakova et al., 2013).

## 1.7 Way Forward to Apply the Blue Economy Concept in Bangladesh

### 1.7.1 Blue Economy Conceptual Framework

The Blue Economy concept defines a pathway over time: for an ocean economy that transitions towards a “Blue Economy” where ecosystem service flows are sustainable inputs to ocean-based industries and the impacts from these industries upon the ecosystems are reduced – via policy reforms. Patil et al. (2016) suggested and proposed an updated conceptual framework for the blue economy in Figure 15, in order to help illustrate the circularity of the ocean economy system, and transition of this system towards a “blue economy” via the introduction of policy instruments that enhance the sustainability of natural capital inputs and reduce the impacts of ocean industries on the underlying ecosystems. The intention is to provide an organizing framework for policies that simultaneously promote economic development and environmental management (Colgan CS. 2017).



**Figure 4 : Blue Economy Conceptual Framework. Source: Adapted from Patil et al. (2016)**

The conceptual framework supports consideration of the ocean economy and ecological systems together as the blue economy, recognizing the relationship between the natural capital and the economic activity, as well as produced capital, human capital and net foreign assets (Patil et al. 2016; Patil et al. 2018). The framework also includes drivers of change external to the blue economy, such as climate change, larger markets and the economy, science and technology and demographic change. In essence, Figure 15 provides a conceptual framework for the Government of Bangladesh (Patil et al. 2018) to: a) think about economic activity in the ocean as a discrete and unique segment of the larger economy, with shared risks and opportunities (including cluster opportunities within the ocean space); and b) measure and incorporate natural capital into accounting and supporting policies for this ocean economy.

### 1.7.2 Blue Economy Policy Framework

The growth in the country's ocean economy is contingent upon the status of ocean ecosystems has been emphasized in the Seventh Five Year Plan, which also suggested that while “there are some prospects for oil and gas resources, the potential is most promising for marine fishing, transportation and tourism (GED, 2015). The plan is centered around three themes, of which aims to implement “a sustainable development pathway that is resilient to disaster and climate change; entails sustainable use of natural resources; and successfully manages the inevitable urbanization transition” – consistent with the definition of the blue economy concept (GED, 2015). The Plan suggests articulation of an integrated Coastal and Ocean Management Policy under this concept and describes the following actions/programs (among others) to promote the transition to a blue economy during the FY2016 – 2020 period in Bangladesh (recently stated by Patil et al. 2018):

- Protecting and managing the fisheries for the present and future generations,
- Developing a strong renewable energy sector using ocean and atmospheric forces,
- Maintaining existing (e.g. ship building) and developing new maritime industries,
- Extending fishing areas using new technologies and methods even beyond EEZ in the international waters,
- Developing a strong human resource base for domestic utilization, and export to foreign job markets,
- Substantially increasing fisheries production and export earnings through improved inland aquaculture and introduction of marine aquaculture,
- Creating a competitive tourism industry, including ecotourism and marine cruises,
- Further increasing revenue from shipping and commerce by the expansion of domestic fleet and destinations, transshipment and transit provisions, linking neighboring states to the sea-ports, etc.,

- Give special priority to anticipated Climate Change impacts on all relevant matters, and adjust policies and plans,
- Maintain the inland river systems and ecosystems for fishery, sediment transport, and inland shipping,
- Building a solid science, research and education base, and
- Along with other coastal areas, establishment of marine academy in Khulna may be considered (GED 2015).”

In summary, the Government of Bangladesh has articulated a clear policy objective to apply the blue economy concept to the ocean economy in the Bay of Bengal, as well as identified a number of initial activities and programs to start down this pathway (Patil. et al. 2018).

## **1.8 Challenges and Constraints**

### **1.8.1 Inability to Implement and Enforce Management Measures**

In Bangladesh, many opportunities in marine resources development remain untapped due to lack of effective management measures and the means to enforce them. To minimize these issues by the respective ministry/departments, no regulation and enforcement measures have yet been implemented. Until today another management issue remains an obstacle. Namely, that marine fish stocks are being assessed on fragmented and less reliable catch data from commercial vessels. Due to lack of modern craft and gear, incapability in regard to harvesting and catching of large pelagic fish stocks in deep sea areas already exists in the country.

### **1.8.2 Lack of Planning**

In Bangladesh, Marine Spatial Planning (MSP) has not been designed and implemented in coordination of various stakeholders. MSP should be integrated and multi-objective, strategic and future oriented, and continuous and adaptive to use all marine resources for sustainable blue growth (Hossain et al., 2014; Alam, 2016). No straight forward planning has yet been made to declare and establish specific Marine Protected Areas (MPA) in the country. To implement Ecosystem Approach to Fisheries Management (EAFM) planning has not yet been made in the country according to United Nations Food and Agriculture Organization (FAO) Code of Conduct of 1995 laid out as broad principles and approaches for effective and responsible fisheries management, which embody the concept of EAFM (FAO, 2003).

### **1.8.3 Lack of Coordination**

The lack of coordination between and among the partners is presently considered as one of the most important gaps for development of marine based economic sectors in the country. In that case public private partnership is seriously hampering the development in particularly in the sectors like trade, shipping, tourism, oil and gas field exploration, fish preservation and marketing, ecosystem services, social welfare related to coastal dwellers etc. (Husain et al. 2017a; Husain et al. 2017b).

## 1.9 Conclusion

This paper attempts to highlight and describe in detail the future importance of maritime in Bangladesh and deepen on current maritime key issues and future of sector wise blue economy activities including the major challenges and constraints. In this process, a coordinated approach with concerned stakeholder's groups is required to determine the extent to which these constraints can be turned into opportunities, and to ensure that development of the blue economy does not result in unsustainable and damaging practices for the benefit of short term economic gains over longer terms sustainable economic and social benefits. In particular, for Bangladesh, this involves developing a maritime/marine spatial planning directive to detail coordination between blue economy sectors and stakeholders to ensure sustainable development. Better linking research activities and sectoral development is required to provide a coordinated approach to development of the blue economy in Bangladesh, which is currently lacking. Lessons can be learned from developments in marine spatial planning, which are currently ongoing in developed nations such as the EU to ensure that developments in the blue economy lead to sustainable outcomes in line with the country's current and future development objectives (Hussain et al. 2017a; Hussain et al. 2017b).

## 1.10 References

- Abdullah, A.N.M., Stacey, N., Garnett, S.T. and Myers, B., 2016. Economic dependence on mangrove forest resources for livelihoods in the Sundarbans, Bangladesh. *Forest Policy and Economics* 64:15-24.
- Ab Lah, R., Smith, J., Savins, D., Dowell, A., Bucher, D. and Benkendorff, K. 2016. Investigation of nutritional properties of three species of marine turban snails for human consumption. *Food Sci Nutr* 5:14-30.
- Ahammad, H. and Sujauddin, M. 2017. Contributions of Ship Recycling in Bangladesh: An Economic Assessment, IMO-NORAD SENSREC Project, London, UK, 78.
- Ahmed, N. and Glaser, M. 2016. Can “Integrated Multi-Trophic Aquaculture” adapt to climate change in Coastal Bangladesh. *Ocean and Coastal Management* 132:120-131
- Allan, J. D. 2004. Landscapes and Riverscapes: The Influence of Land Use on Stream Ecosystems. *Annual Review of Ecology, Evolution and Systematics* 35:257-284.
- Alam, M. K. 1997. Regional maritime cooperation under the auspices of SAARC. *BISS Journal* 19-41.
- Alam M. K. 2014. Ocean/Blue economy for Bangladesh. In: Proceedings of International Workshop on Blue Economy. Dhaka, Bangladesh: Bangladesh Ministry of Foreign Affairs. [accessed 2017 Dec 18]. <http://www.mofa.gov.bd/content/about-blue-economy>.
- Alam, M. A. 2016. Marine spatial planning: Bangladesh perspective. *Asia Pacific Journal of Energy and Environment* 3: 21-28. <http://journals.abc.us.org/index.php/apjee/article/view/870>

- Al Mamun M. A., Raquib M, Tania T. C. and Rahman S. M. K. 2014. Salt Industry of Bangladesh: A Study in the Cox's Bazar. *Banglavisision* 14:7–17.
- Andreae, M. O. and Crutzen, P. J. 1997. Atmospheric aerosols: Biogeochemical sources and role in atmospheric chemistry. *Science* 276: 1052-1058.
- Asia-Pacific Fishery Commission (APFIC). 2014. Regional overview of aquaculture trends in the Asia-Pacific Region 2014, RAP Publication 2014/26, 45p.
- Badrul, I. 2015. Bangladesh falls behind Myanmar in offshore gas exploration. *The Daily Star*.
- Banerjee, S. 2013. Vanishing Islands of Bangladesh. Retrieved from Down to Earth: <http://www.downtoearth.org.in/content/vanishing-islands-bangladesh>.
- Barua, S., Karim, E. and Humayun, N. M. 2014. Present Status and Species Composition of Commercially Important Finfish in Landed Trawl Catch from Bangladesh Marine Waters. *International Journal of Pure and Applied Zoology* 2(2):150-159.
- bdnews24.com. 2017. Bangladesh discovers new gas field in southern district of Bhola. bdnews24.com. [accessed 2017 Dec 18]. <https://bdnews24.com/bangladesh/2017/10/23/bangladesh-discovers-new-gas-field-in-southern-district-of-bhola>.
- BOBLME. 2012. Transboundary Diagnostic Analysis (TDA). 52
- Charlson, R. J., Lovelock, J. E., Andreae, M. O. and Warren, S. G. 1987. Oceanic phytoplankton, atmospheric sulphur, cloud albedo and climate. *Nature* 326:655-661.
- Chowdhury, S. R., Hossain, M. S., Sharifuzzaman, S. M. and Sarker, S. 2015. Blue Carbon in the Coastal Ecosystems of Bangladesh. Project Document, Support to Bangladesh on Climate Change Negotiation and Knowledge Management on Various Streams of UNFCCC Process Project, funded by DFID and Danida, implemented by IUCN Bangladesh Country Office.
- Colgan C. S. 2017. Climate Change and the Blue Economy of the Indian Ocean.???
- Detsch, J. 2014. Bangladesh: Asia's New Energy Superpower? *The Diplomat*.
- Department of Fisheries. 2013. Fishery Statistical Yearbook of Bangladesh (2011-12). Fisheries Resources Service System, Department of Fisheries (Department of Fisheries). Ministry of Fisheries and Livestock, Dhaka, Bangladesh.
- Department of Fisheries. 2016. National Fish Week 2016 Compendium. Department of Fisheries, Ministry of Fisheries and Livestock in Bangladesh. 148.
- Duarte, C. M., Wu, J., Xiao, X., Bruhn, A. and Krause-Jensen, D. 2017. Can Seaweed Farming Play a Role in Climate Change Mitigation and Adaptation? *Marine Science* 4:356-36.
- El Gamal, A. A. 2010. Biological importance of marine algae. *Saudi Pharmaceutical Journal* 18:1-25.
- Failler, P., Hussain, M. G., Karim, A. A., Alam, M. K. and Drakeford, B. 2017. Opportunities and Constraints of Blue Economy Development in Bangladesh. Paper presented at

International Workshop on Blue Economy Dialogue, 22– 23 November 2017; Hotel Pan Pacific Sonargaon, Dhaka, Bangladesh

Falkowski, P. G., Barber, R.T. and Smetacek, V. 1998. Biogeochemical controls and feedbacks on ocean primary production. *Science* 281:200-206.

Follows, M. J., Dutkiewicz, S., Grant, S. and Chisholm, S.W. 2007. Emergent biogeography of microbial communities in a model ocean. *Science* 315:1843-1846.

FAO. 2014. The state of world fisheries and aquaculture (opportunities and challenges) Food and Agricultural Organization of the United Nations, Rome.

FAO. 2016. Global aquaculture production dataset 1950-2014 (Fishstat), Fisheries and Aquaculture Department. Rome, Italy..Available at: [www.fao.org/fishery/statistics/software/fishstatj/en](http://www.fao.org/fishery/statistics/software/fishstatj/en)

FRSS. 2017. Yearbook of Fisheries Statistics of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 33: 124.

General Economics Division (GED). 2015. Seventh Five Year Plan (FY2016 – 2020): Accelerating Growth, Empowering Citizens. Dhaka, Bangladesh: Planning Commission, Government of the People’s Republic of Bangladesh.

Golder, M. I., Failler, P., Hussain, M. G., Sen, A. and Alim, M. A. 2017. Fisheries and Aquaculture Trends in Bangladesh: Potentials and Challenges of Marine Fisheries and Mariculture under the Concept of Blue Economy Development, organized by Maritime Affairs Unit, Ministry of Foreign Affairs, Government of Bangladesh with the support of the European Union in association with Department of Fisheries, Cox’s Bazar, Bangladesh. 26.

Haamer, J. 1996. Improving Water Quality in a Eutrophied Fjord System with Mussel Farming. *Ambio* 25:356-362.

Hassan, D. 2013. The Great Barrier Reef: Maritime spatial planning, *Environment Policy and Law* 43:4-5.

Hassan, D. and Haque, E. 2015. Marine spatial planning in the Bay of Bengal sub-region in South Asia. In: D. Hassan, T. Kuokkanen and N. Soininen (eds), Transboundary marine spatial planning and international law. Abingdon, Oxon ; New York, NY : Routledge/Taylor and Francis Group, 2015. pp. 203 – 218.

He, X. and Kitchell, J. F. 1990. Direct and Indirect Effects of Predation on a Fish Community: A Whole-Lake Experiment. *Transactions of the American Fisheries Society* 119, 825-835.

Hossain, K.H., Iqbal, K.S. and Zakaria, N. 2010. Ship Recycling Prospects in Bangladesh. Proceedings of MARTEC 297–302.

Hossain, M. S., Chowdhury, S. R., Navera, U. K., Hossain, M. A. R., Imam, B. and Sharifuzzaman, S. M. 2014. Opportunities and Strategies for Ocean and River Resources Management, Background paper for preparation of the 7th Five Year Plan. FAO, Bangladesh Country Office, Dhaka, Bangladesh.

- Hossain, M. S., Lin, C. K., Tokunaga, M., Demaine, H. and Hussain, M. Z. 2003. Land Use Zoning for Integrated Coastal Zone Management: Remote Sensing, GIS and RRA Approach in Cox's Bazar Coast, Bangladesh. ITCZM Monograph No. 3. 25.
- Hoq, M. E., Haroon, A. K. Y. and Chakraborty, S. C. 2013. Technical outcomes of the BOBLME project in Bangladesh. Support to sustainable management of the BOBLME project (SBOBLME Pub./Rep. 09). Bangladesh Fisheries Research Institute. 32.
- Hussain, M. G. and Rahman, M. J. 2010. Marine fisheries resources of Bangladesh: Stock status and management issues. pp 37-51. In Sustainable Management of Fisheries Resources of the Bay of Bengal (eds. M.G. Hussain and M.E. Hoq.). Support to BOBLME Project, Bangladesh Fisheries Research Institute, Bangladesh.
- Hussain, M. G., Failler, P, Karim, A. A. and Alam, M.K. 2017a. Review on opportunities, constraints and challenges of blue economy development in Bangladesh. *Journal of Fisheries and Life Sciences* 2(1): 45-57.
- Hussain, M. G., Failler, P, Karim, A. A. and Alam, M. K. 2017b. Major Opportunities of Blue Economy Development in Bangladesh. *Journal of Indian Ocean Region*: DOI: 10.1080/19480881.2017.1368250.
- Islam, M. M., Shamsuzzaman, M. M., Hoque Mozumder, M. M., Xiangmin, X., Ming, Y. and Abu Sayed Jewel, M. 2017. Exploitation and conservation of coastal and marine fisheries in Bangladesh: Do the fishery laws matter? *Mar. Pol.* 76: 143-151.
- Islam, M. M, Sunny, A. R., Hossain, M.M. and Friess, D. A. 2018. Drivers of mangrove ecosystem service change in the Sundarbans of Bangladesh. *Singapore Journal of Tropical Geography* 39:244 - 265
- Khan, M. G. 2008. The status of coastal and marine fishing fleet in Bangladesh and preparedness for a monitoring, control and surveillance regime, National workshop on monitoring, control and surveillance in marine fisheries-Bangladesh in Cox'sbazar, Bangladesh. GoB/DANIDA/BOBP-IGO, Cox'sbazar, Bangladesh, pp. 77-79.
- Khan, S. 2015. Making IOCs interested in the bidding for hydrocarbon exploration. The Financial Express.
- Komyakova V, Munday PL and Jones G. P. 2013. Relative Importance of Coral Cover, Habitat Complexity and Diversity in Determining the Structure of Reef Fish Communities. *PLoS ONE* 8(12): e83178. doi:10.1371/journal.pone.0083178
- Lee, S.Y., Primavera, J. H., Dahdouh-Guebas, F., McKee, K., Bosire, J.O., Cannicci, S., Diele, K., Fromard, F., Koedam, N., Marchand, C., Mendelssohn, I., Mukherjee, N. and Record, S. 2014. Ecological role and services of tropical mangrove ecosystems: a reassessment. *Global Ecology and Biogeography* 23:726-743.
- Lynch, A. J., Cooke, S. J., Deines, A. M., Bower, S. D., Bunnell, D. B., Cowx, I. G., Nguyen, V. M., Nohner, J., Phouthavong, K., Riley, B., Rogers, M. W., Taylor, W. W., Woelmer, W., Youn, S. J. and Beard, T. D. 2016. The social, economic, and environmental importance of inland fish and fisheries. *Environmental Reviews* 24:115-121). 10.1080/19480881.2017.1368250.

Mahaffey, K. R., Clickner, R. P. and Jeffries, R. A. 2008. Methylmercury and omega-3 fatty acids: Co-occurrence of dietary sources with emphasis on fish and shellfish. *Environ. Res.* 107:20–29.

Ministry of External Affairs (MEA). 2015a. Joint Declaration between Bangladesh and India during Visit of Prime Minister of India to Bangladesh. [accessed 2017 Dec 18]. [http://www.mea.gov.in/bilateral-documents.htm?dtl/25346/Joint\\_Declaration\\_between\\_Bangladesh\\_and\\_India\\_during\\_Visit\\_of\\_Prime\\_Minister\\_of\\_India\\_to\\_Bangladesh\\_quot\\_N](http://www.mea.gov.in/bilateral-documents.htm?dtl/25346/Joint_Declaration_between_Bangladesh_and_India_during_Visit_of_Prime_Minister_of_India_to_Bangladesh_quot_N).

Ministry of External Affairs (MEA). 2015b. Memorandum of Understanding between the Government of the Republic of India and the Government of the People's Republic of Bangladesh in the field of Blue Economy and Maritime Co-operation in the Bay of Bengal and the Indian Ocean Region.

MoFA. 2016. Press Release: Press statement of the Honorable Foreign Minister on the verdict of the Arbitral Tribunal/PCA, Dhaka.

Monnereau, I., Failler, P. 2014. Unlocking the full potential of the blue economy: Are African Small Island Developing States ready to embrace the opportunities? African Climate Policy Center and Economic Commission for Africa, [http://www.climdev-africa.org/sites/default/files/DocumentAttachments/Blue%20Economy\\_19Sept14.pdf](http://www.climdev-africa.org/sites/default/files/DocumentAttachments/Blue%20Economy_19Sept14.pdf)

Muller-Karger, F. E., Varela, R., Thunell, R., Luerssen, R., Hu, C. and Walsh, J. J. 2005. The importance of continental margins in the global carbon cycle. *Geophysical Research Letters* 32:1-4.

Nellemann, C., Corcoran, E., Duarte, C.M., Valdés, L., De Young, C., Fonseca, L. and Grimsditch, G. 2009. Blue Carbon. A Rapid Response Assessment. United Nations Environment Programme, GRIDArendal, [www.grida.no](http://www.grida.no) Ocean, P.P., 2017. Why are oceans important?

OECD. 2016. The Ocean Economy in 2030. OECD Publishing.

Officer, C. B., Smayda, T. J. and Mann, R. 1982. Benthic Filter Feeding: A Natural Eutrophication Control. *Marine Ecology Progress Series* 9:203-210.

Orr, S., Pittock, J., Chapagain, A. and Dumaresq, D. 2012. Dams on the Mekong River: Lost fish protein and the implications for land and water resources. *Global Environmental Change* 22:925-932.

Parvez, M. S. 2012. Bay of Bengal prospects towards national flourishing. Retrieved from BD Fish: <http://en.bdfish.org/2012/03/bay-of-bengalprospects-towards-national-flourishment/>

Patil, P. G., Viridin, J., Colgan, C. S., Hussain, M. G., Failler, P., and Vegh, T. 2018. Toward a Blue Economy: A Pathway for Bangladesh's Sustainable Growth. Washington, D.C., The World Bank Group.

Patil P. G., Viridin J, Diez S. M, Roberts J, Singh A. 2016. Toward a Blue Economy: A Promise for Sustainable Growth in the Caribbean. Washington, DC: The World Bank Group.

Petrobangla. 2016. Annual Report: 2015.



- Premarathne, D. M. U. 2010. Non-living ocean resources. *Vidurava* 27(2): 20 - 23.
- Rahman M. M. 2006. A study on coastal water pollution of Bangladesh in the Bay of Bengal. [Dhaka, Bangladesh]: BRAC University.
- Rahman, M. R. 2013. Regional cooperation in maritime security: A view from the Bay of Bengal. Annual International Studies Convention 2013, organized by Jawaharlal Nehru University (JNU), New Delhi, India, 10-12 December, 2013. <https://ssrn.com/abstract=2369076>
- Sarker, S., Bhuyan, A. A. H., Rahman, M. M., Islam, M. A., Hossain, M. S., Basak, S. C. and Islam, M. M. 2018. From science to action: Exploring the potentials of Blue Economy for enhancing economic sustainability in Bangladesh. *Ocean & Coastal Management* 157:180-192.
- Shamsuzzaman, M. M., Islam, M. M., Tania, N. J., Abdullah Al-Mamun, M., Barman, P. P. and Xu, X. 2017. Fisheries resources of Bangladesh: Present status and future direction. *Aquaculture and Fisheries* 2:145-156.
- Smoothey, A.F. (2013) Habitat- associations of turban snails on intertidal and subtidal rocky reefs. PLoS ONE 8:e0146911.
- Sujauddin, M., Koide, R., Komatsu, T., Hossain, M. M., Tokoro, C. and Murakami, S. 2015. Characterization of ship breaking industry in Bangladesh. *Journal of Material Cycles and Waste Management* 17:72-83.
- Tedesco, K. and Thunell, R. 2003. High resolution tropical climate record for the last 6,000 years. *Geophysical Research Letters* 30(17): 1891 - 1894.
- Thakur, N. L. and Thakur, A. N. 2006. Marine biotechnology: An overview. *Indian Journal of Biotechnology* 5:263-268.
- Thilsted, S. H., Roos, N. and Hassan, N. 1997. The role of small indigenous fish species in food and nutrition security in Bangladesh. *Naga* 20.
- Trumper, K., Bertzky, M., Dickson, B., van der Heijden, G., Jenkins, M. and Manning, P. 2009. The Natural Fix? The role of ecosystems in climate mitigation. A UNEP rapid response assessment. UNEP, UNEPWCMC, Cambridge, UK, 65pp. [http://www.unep.org/pdf/BioseqRRA\\_scr.pdf](http://www.unep.org/pdf/BioseqRRA_scr.pdf).
- Valiela, I., Bowen, J. L. and York, J. K. 2001. Mangrove forests: One of the worlds threatened major tropical environments. *BioScience* 51:807-815.
- WFO. 2008. Towards sustainable coastal and marine capture fisheries in Bangladesh: initiating a precautionary approach. Ministry of Fisheries and livestock, 86p.
- Wipfli, M. S. and Baxter, C. V. 2010. Linking Ecosystems, Food Webs, and Fish Production: Subsidies in Salmonid Watersheds. *Fisheries* 35:373-387.
- World Bank. 2017. Bangladesh Trade Summary: WITS Data. [accessed 2017 Dec 19]. <https://wits.worldbank.org/CountryProfile/en/Country/BGD/Year/LTST/Summary>.

World Bank, United Nations Department of Economic and Social Affairs (UNDESA) (2017) *The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries*. Washington, DC: The World Bank Group.

World Commission on Environment and Development (WCED) (1987) *Our Common Future*. New York, NY: United Nations.

Zilinskas, R. A., Colwell, R. R., Lipton, D. W., Hill, R. T. (1995) *The Global Challenge of Marine Biotechnology: A Status Report on the United States, Japan, Australia and Norway*. University of Maryland Sea Grant. UM-SG-TS-95-01. 372p