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# Bangladesh and the Blue Economy: Its Prospects, Challenges and Exploring Sustainable Solutions

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***Abstract:*** *The Blue Economy (BE) is a relatively inchoate concept whose prerequisite is the sustainable use of the oceans while maintaining marine environmental integrity. Coastal countries are naturally in a relatively favorable position, as opposed to landlocked nations, in taking advantage of marine resources such as marine fisheries, oil, gas, minerals, renewable energy sources, marine biotechnology, and tourism within their maritime jurisdictions. Bangladesh, a country with a coastline of 710 kilometers, sovereignty over 354 nautical miles, and rights over the continental shelf area of 1,83,613 square kilometers, is at a similar advantage. According to 2018 World Bank report, Bangladesh's blue economy sector contributes approximately 3% to its GDP. This paper specifically focuses on Bangladesh's blue economic potential and its growth. The research discusses the prospects of the multivariate sectors within Bangladesh's Blue Economy, such as mariculture, metals and minerals, offshore oil/gas reserves, marine-derived pharmaceuticals, green energy, and tourism. Upon collecting data exclusive to the oceans/blue economy, it was analyzed and then integrated into the study to objectively evaluate the prospects of the Blue Economy sectors in Bangladesh. These prospects were then followed by addressing the existing key challenges associated with the aforementioned sectors. Finally, the paper introduces pertinent policy recommendations Bangladesh may integrate as national policies for effective sector-based blue economic growth, efficiency in blue economic diplomacy, enhancing public-private cooperation, and improving local, plus foreign investments to embolden the Blue Economy sectors of Bangladesh.*

***Keywords:*** *Blue Economy, Ocean's Economy, Marine Economy, Blue Economy of Bangladesh, Marine Sectors of Bangladesh, Oceans Economy of Bangladesh.*

## 1 Introduction

Blue Economy conceptualizes the oceans and seas as "development spaces", providing focus on ocean economic growth, and preserving the oceans' ecosystem integrity (Alam, 2014). Gunter Pauli, in his book "The Blue Economy:

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10 Years, 100 Innovations, 100 Million Jobs", brought the blue economy concept within a prominent discussion paradigm (Pauli, G., 2010). According to Pauli, the blue economy concept promotes the "optimum usage" of marine resources such as fish, corals, seaweed and related organisms, natural energy reserves (oil, gas, and minerals), shipping services, energy generation, and other similar marine/ocean-based economic sectors.

According to Pauli's definition, coastal countries are at an advantage in harvesting the marine resource deposits within their internationally recognised maritime region. However, the concept of the blue economy is yet very inchoate. Even the European Union as a whole has most recently begun to prioritize its marine fisheries sector (Cisneros-Montemayor et al., 2021). Keen et al. (2018) seconds such a statement by claiming that the blue economy concept is yet traversing its theoretical stages. However, as inchoate as the blue economic practices may be, the potential of this sector is nevertheless very promising.

Bangladesh, littoral to the Bay of Bengal, a region abundant in untapped marine resources, may be able to harness impressive tangible yields from its coastal periphery. The yields may stem from Bangladesh's Exclusive Economic Zones (EEZ), as well as from its access to the external international waters. It has been estimated that about the equivalent of 81% of Bangladesh's land resources can be found in its seas (Alam, 2019). According to experts in the field, Bangladesh's GDP could increase by 3%–4% through the proper utilization and materialization of its blue economy sectors (Syfullah, 2021).

The evident potential of Bangladesh's Blue Economy sector has given impetus to this research. The work focuses on the potential of different sectors that comprise Bangladesh's blue economy landscape; such as mariculture, offshore oil and gas, shipbuilding and scrapping, marine research and medicine, renewable resources, and tourism. The meat of the research is to explain such prospects from the growth potential of Bangladesh, address relevant challenges, and provide sustainable solutions.

### *1.1 Research Objective:*

The objective of this research is to discuss the relevant prospects of Bangladesh's Blue Economy sectors, address the blue economy's most salient challenges, and present fortified 'reality-driven' solutions.

The research aims to explore the potential of individual blue economic sectors such as mariculture, offshore oil/gas, minerals, metals, marine biotechnology, and tourism, and to address notable challenges associated with those sectors, such as lack of investments and infrastructure, absence of modern technology in those sectors as well as absence of knowledge. Through addressing said challenges, the research aims to provide policy recommendations focusing on foreign investment growth, improving research, practicing blue diplomacy, introducing advanced technology, and other similar endeavors.

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### *1.2 Literature Review*

Before proceeding with reviewing literature, we make sure to note that most recent research works conducted on the blue economy are still traversing the theoretical realm, due to the inchoate nature of the field itself.

The article by Hussain et al. (2018) discusses the multivariate nature of the blue economy while focusing on the BE's growth potential in Bangladesh. Their work discusses the potential of Bangladesh's blue economic sectors, while adequately addressing the challenges associated with the BE's growth in Bangladesh. It mentions the necessity to prioritize domestic and foreign investments, and introduces ideas such as Marine Spatial Planning (MSP), and Marine Protected Areas (MPA) to synergize economic growth with environmental sustainability. The authors recommend relevant governmental policy introduction to promote Bangladesh's BE growth. However, the authors did not elaborate or specify how Bangladesh's authorities might materialize such recommendations.

Similarly, Cisneros-Montemayor et al. (2021) explain how the majority of marine resources fall within the EEZ of a country, as opposed to international waters. Their work has shown that countries such as Bangladesh, Taiwan, and China prefer mariculture cultivation but confront limitations such as infrastructure inefficiencies and proper policy approaches. Their research elaborated on how regions such as Africa and Asia have very promising deposits of marine resources. However, these regions tend to have less enabling conditions to trade than the US or Europe. This research did not adequately address how to circumvent or solve such challenges.

Haque's (2020) work dominantly focuses on "blue diplomacy" as a prerequisite to blue economic growth. The study iterated the necessity for developing and using specific tools for cooperation between member states for mutual growth in the blue economy and improving foreign investments into Bangladesh. Haque promotes reaching solutions through diplomacy, incorporating international organizations such as UNEP, UN-Water, the World Water Council, and other synonymous offices. The research sought solutions by implementing legal frameworks at the sub-national, national, inter-basin, and global levels to improve blue economic growth in Bangladesh. The author did address insufficiencies in Bangladesh's national blue economic policies and mentioned growth stymies. However, the research did not elaborate on the challenges faced by the blue economy in Bangladesh or provide elaborate recommendations through arguments and empirical data.

Patil et al. (2019) conducted a study that supposes that industries that are growing around the oceans are growing with each other, not in isolation. The study mentions the lack of distinct national policies as stymies against blue economic expansion in Bangladesh. Furthermore, the research highlighted the unavailability of disaggregated data in the Bangladesh Bureau of Statistics (BBS) surrounding the blue economic sectors. The authors had recommended that the BBS open an "Ocean's Account" that would keep a separate account of the i)

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industries growing around the ocean area and ii) their proximity to the coastal region. Evidently, the study did not adequately focus on how to address these challenges through specific actions.

A study by Keen et al. (2018) focused on the Small Island Developing States (SIDS), and how the blue economy was germane to such countries vulnerable to climate change and ocean ecosystem degradation. The authors primarily focused on marine fisheries, where the research advocated for synergizing scientific data with local knowledge. The study recommended sustainable use of the oceans, stronger institutional frameworks facilitating the blue economy locally, and a gender-equitable approach to such an economic practice. Despite the study being substantial, the paper did not elaborate on specific actions to be taken by relevant authorities to address challenges.

It is evident that there are significant research gaps existing in these works conducted on Bangladesh's blue economy potential. And such gaps provided the determination and zeal to conduct this research.

### *1.3 Research Methodology*

The study uses the Desk Study method that incorporates the use of secondary data such as academic works, gray literature, reports, newspapers, and opinion editorial articles among other available secondary sources.

This method follows an abductive approach that re-contextualizes existing phenomena to gain a novel perspective and to generate newer theories. The approach allows researchers to generate new ideas and hypotheses, allowing them to build on existing research by providing innovative perspectives.

The information acquired from the aforementioned secondary sources is investigated scrupulously and incorporated into the study. After a thorough analysis of said information, a conclusion is formed based on their objective interpretation.

### *1.4 Research Limitations*

Due to the underdeveloped and theoretically restricted nature of BE research both in Bangladesh and globally, the researchers often failed to access relevant and updated qualitative and quantitative data. Furthermore, given the academic background and field(s) of expertise of the authors, they were limited to analyzing literature from their limited, policy-oriented views. The work was also restricted to the use of secondary data exclusively due to limitations faced by the researchers in conducting field visits and surveys.

## 2 The Significance of Bangladesh's Blue Economy

The significance of Bangladesh’s blue economy lies in factors such as strong economic ambitions, addressing national inadequacies, practicing rights over available national marine resources and exploring sustainable alternatives.

With the upward trend of global population growth, specifically in the southern hemisphere, solely relying on land-based agriculture, farming, and natural

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resources are failing to meet national requirements. Countries around the world have fallen short of ways other than to diversify their production capabilities, and this is where littorals tend to have a proverbial "ace up their sleeve". Bangladesh enjoys 200 nautical miles (NM) of ocean borders, 354 nm of seabed resources (continental shelf), and an additional 200 nm of ABNJ (Area Beyond National Jurisdictions) (Rashid, 2018; Haque, 2020; p. 1). And according to the most recent estimate by the World Bank (2018), the blue economic sectors of Bangladesh contribute 3% to the country's GDP (Patil, 2018; Ahmed, 2024). As of now, 26 areas have been declared as being part of the blue economy in Bangladesh which include marine fisheries, oil and gas extraction, minerals, marine biotechnology, shipping, tourism among others (Ziauddin, 2023; p. 40; Tahmid, 2021).

The data discussed in Table 1 makes evident how the blue economy-based sectors have had and are continuously contributing to the aggregate economy of Bangladesh.

**Table 1: Financial Evaluation of Major Blue Economy Sectors of Bangladesh from 2010-2015 (in USD Millions) (Bhuiyan, M. et al., 2021; p. 9).**

| Economic Sector | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| Marine Fisheries | 843.75 | 949.48 | 1107.42 | 1231.06 | 1384.77 | 1475.66 |
| Oil | 21.90 | 23.84 | 26.82 | 28.77 | 29.35 | 34.05 |
| Gas | 948.35 | 956.30 | 1041.35 | 1127.73 | 1158.13 | 1305.42 |
| Sea Salt | 119.25 | 123.48 | 160.90 | 206.00 | 212.35 | 214.84 |
| Sand, Minerals and Coal | 735.18 | 944.39 | 1183.79 | 1452,46 | 1644.08 | 1893.14 |
| Water Transport | 1215.14 | 1330.36 | 1450.21 | 1606.10 | 1682.31 | 1816.67 |
| Trade and Shipping | 31,390.15 | 36,178.04 | 41,728.94 | 47,156.44 | 52,078.80 | 58,466.90 |

It is evident from the data enumerated above that with the proper policies, the blue economy sectors of Bangladesh may usher in a higher influx of foreign reserves.

The blue economy has been considered as part of Bangladesh's national growth paradigm since 2015. In fact, the government had introduced specific initiatives to integrate the blue economy and its development in its 7th five-year plan for the fiscal years (FY) FY2016-FY2020. The policies targeting blue economic growth included improving mariculture capacities, extractive technological upgrades, increasing skill sector-specific skilled labour, and boosting investments among others.

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Additionally, the Government of Bangladesh (GoB) had inaugurated the "Blue Economy Cell" in 2017, under the Energy and Mineral Resources Division of the Ministry of Power, Energy, and Mineral Resources (MOPEMR) that would directly address BE necessities and assure that pertinent policies are being introduced and suggested (Islam & Shamsuddoha, 2018; Alam, 2019). Blue economy is also part of Bangladesh's more recent initiative of the 2100-Delta Plan (Sarker, 2019).

## 3 Blue Economy and its Prospects for Bangladesh

The idea of a blue economy within the relevant agencies of Bangladesh had been engendered post-resolution of the maritime disputes with neighboring Myanmar and India in 2012 and 2014 respectively. This was indeed a critical diplomatic/economic-strategic success for Bangladesh (Alam, 2019).

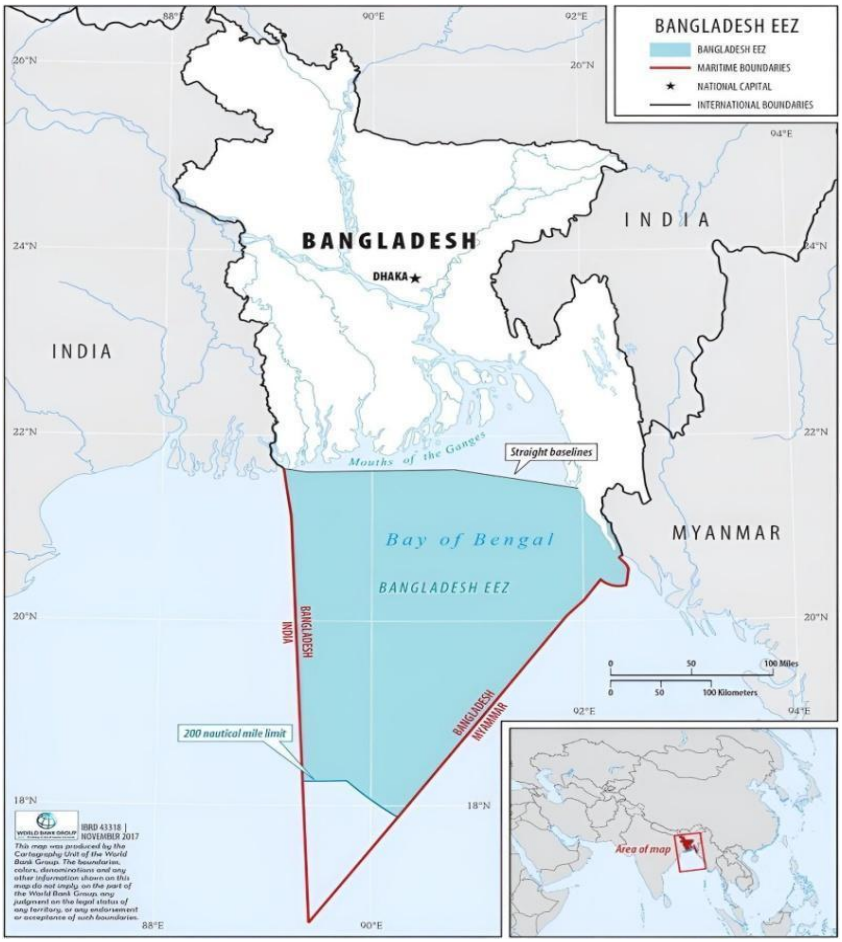


**Figure 1: The Exclusive Economic Zone of Bangladesh (Patil et al., 2019; p. 2)**

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Fig. 1 above visualizes the Bay of Bengal, where Bangladesh now has a total of 121,110 square kilometers of marine area, including the exclusive economic zone. The blueprint to "Bangladeshi" maritime aspirations was the "Territorial Waters and Maritime Zones Act-1974" (and its annexure Maritime Zones Rules-1977) (Haque, 2020; p. 2), by Bangabandhu Sheikh Mujibur Rahman, who had envisioned an exclusive maritime territory for Bangladesh after the country's independence, long before the materialization of any International Waters Governance treaties. The provisions of the 1974 Act, and its 2021 Amendment had paved the way for the proper management and protection of coastal marine resources, preservation of biodiversity, pollution control, coastal zone management, conserving marine protected areas, shipping and fisheries. Around 18.2 percent of Bangladesh's population depends on the country's ocean economy (Patil, 2018; Iqbal, 2020). To validate this data, Table 2 enumerates the annual gross value added to Bangladesh's aggregate economy from its blue economy sectors.

**Table 2: Annual Gross Value Added (GDA) from Bangladesh's Blue Economy. (Patil et al., 2019; p. 8-10).**

| Ocean economy industry/ service (Nominal USD Millions) | 2009-10 | 2010-11 | 2011-12 | 2012--13 | 2013-14 | 2014-15 |
|---|---|---|---|---|---|---|
| Marine capture fisheries | 664.00 | 777.00 | 786.23 | 907.49 | 1037.49 | 1167.79 |
| Marine aquaculture and shellfish farming (shrimps and crabs) | 78.65 | 92.48 | 99.76 | 122.05 | 144.99 | 163.20 |
| Sea salt production | 123.20 | 124.11 | 145.51 | 184.35 | 195.45 | 197.88 |
| Crude petroleum extraction | 22.42 | 23.65 | 23.69 | 25.16 | 26.40 | 30.55 |
| Natural gas (liquid) extraction | 971.13 | 948.62 | 919.94 | 986.25 | 1041.87 | 1174.58 |
| Maritime freight transportation | 307.90 | 319.55 | 295.81 | 300.33 | 327.15 | 375.58 |
| Maritime passenger transportation | 617.61 | 659.27 | 606.66 | 663.14 | 720.69 | 788.35 |
| Port and harbor operations | 104.95 | 103.29 | 135.57 | 145.32 | 172.37 | 202.17 |
| Shipbuilding and repairing | 110.32 | 114.77 | 106.68 | 109.58 | 108.59 | 387.06 |
| Ship breaking | 127.39 | 130.80 | 134.27 | 136.83 | 138.31 | 138.21 |

We now discuss the array of prospects and potential sectors under the blue economy banner that are not only promising, but have evidence supporting their potential in generating foreign revenue, and have long-term positive growth projections.

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### *3.1 Mariculture: The Economic Prospects of Marine Fisheries*

Mariculture strictly adheres to this practice of aquatic cultivation exclusive to the seas and oceans (Alam, 2019). Although fish only accounts for 5% of the entire blue economic sector worldwide, it can contribute up to 68% to a country's GDP (IMF, 2015). In Bangladesh, marine fisheries contribute at least 20% of total fish production, with 5 million people working in this sector. There are 450 species of fish that are found within Bangladesh's EEZ, compared to the 250 species cultivated inland. Additionally, Bangladesh currently tops the list of 11 Hilsa (Tenualosa Ilisha) capturing countries around the world (Bangladesh Economic Review, 2023; 102). Hilsa is the most prominent catch of fishes found in the Bay of Bengal, with over 4,96,417 mt (metric tons) catch annually (5,67,000 mt in FY 2021-2022), contributing around 44% of the marine-captured fish, 12.22% of the total annual fish capture, generating over 1% of the total gross domestic product of Bangladesh. (Asaduzzaman et al., 2020; 2; Bangladesh Economic Review, 2023; p. 104). Hilsa capture provides employment for 2–2.5 million people, worth $1.3 billion dollars per year (BOBLME, 2012; p. 3, 5; Hossain et al. 2014) Shrimp and prawns are the second major exportable items contributing to Bangladesh's foreign reserve influx (Azad et al., 2019). Furthermore, fish parts such as desiccated smaller sharks, rays and fins of larger sharks have significant international demand.

As an environmentalist move, the GoB has formulated the "Marine Fisheries Act-2020" and the "Marine Fisheries Policy 2022" to prioritise sustaining marine ecology (Bangladesh Economic Review, 2023; p. 105).

It takes a minimum of 5–12 years to bring new mariculture species into the market and 5–10 years to create genetic developments or selective breeding programs (Failler et al., 2021; p. 20). Much dedication, patience, innovation, and research need to be implemented in this sector for major improvements.

### *3.2 The Economic Potential of Sea Sand and Mining below the Seabed*

Massive sulfide deposits, cobalt crusts, and polymetallic nodules have been found lying on and beneath the seabed within Bangladesh's allocated ocean area (Bari, 2017; p. 10). The International Seabed Authority (ISA) had set up Mining Code Regulations for submarine mining while also providing licensing for these endeavors. It is being estimated that 10% of the world's minerals, including copper, zinc, and cobalt, could be extracted from the ocean floors by 2030, generating nearly 10 billion euros (Alam, 2019).

'Clay', the raw material for cement is present 30 to 80 feet deep into the Bay of Bengal (Rashid, 2018). It may be possible for Bangladesh to export cement elsewhere after meeting domestic needs if raw clay can be extracted from shallow areas of the oceans. Additionally, thorium and uranium have been found underneath the seabed in 13 places, estimated to be greater in value than gold. It is also possible for Bangladesh to explore mining possibilities beyond its EEZ, endeavors that are overlooked but permitted by the ISA (Nijam, 2022).

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Additionally, resources found in beach sand, including zircon, kyanite, garnet, magnetite, monazite, ilmenite and leucoxene, have high demand in the industries and factories of the country and abroad (Alam, 2019). Brown Monazite in particular is used in nuclear bomb and energy technology. There are 17 discovered mineral deposits in Bangladesh's coastal region, with their amount being nearly 17,50,000 tons (Bangladesh Atomic Energy Commission, 2019). A significant amount of foreign currency can be earned by exporting these mineral resources that have unremitting demand across the world (Alam, 2019; Nijam M., 2022).

### *3.3 Shipping and the Marine Ports: Their Contribution and Necessity*

The shipping and logistics sector of the economy emerged during 1991-1992, when Bangladesh was quite inept in integrating this relatively new economic concept. 80% of global trade by volume and 70% of trade by value is carried on by seas, oceans and ports (Bhuyan, 2021; p. 9). In Bangladesh, 90% of Bangladesh's freight trade is centered around coastal shipping (Alam, 2019). In fact, Bangladesh has been estimated to handle 124 million tons of cargo by 2043 (Ziauddin, 2023; p. 43). Between 2004 and 2014, Bangladesh had garnered over $95 billion dollars through shipping/freight operations, import-export, and shipping through airlines. (Alam, 2014).

Bangladesh mainly has three ports; the Chittagong Port, the Mongla Port, and the Payra Port. It has been estimated that each year these ports receive up to 3000 vessels for imports and exports (Alam, 2019). The Mangla and Chittagong ports by themselves receive 600 ships annually (Ziauddin, 2023; p. 43). The Chittagong port handles the largest portion of freight traffic, handling 98.43% of said traffic in 2017-18 (CPA, 2022).

Seaports are a very significant part of the BE. According to Mordor Intelligence (2022), Bangladesh's freight and logistics market has shown an estimated projected compounded annual growth rate of more than 6% for the next 5 years. The Matarbari Deep Seaport, being constructed by the Chittagong Port Authority (CPA) in Matarbari of Cox's Bazar, is estimated to turn Bangladesh into 'the most important export-import hub of the region'. The deep seaport will be the first of its kind in Bangladesh that will allow for larger mother vessels, specifically, ships with a capacity of carrying 8,000 TEUS (Twenty Foot Equivalent Units) containers to be able to berth (Shyamol, 2022).

Feeder services (Feeder services connect larger vessels with smaller ports by transferring cargo via smaller vessels) play a substantially large role in continuing global trade relations for Bangladesh. Feeder service relations with India, Malaysia, Singapore, Sri Lanka, Myanmar, and Thailand ports could play as a game changer in Bangladesh's transshipment sector. Until now, Bangladesh has only had active transshipment relations with India but has faced setbacks due to the onset of COVID-19 and a low profit margin from this bilateral agreement (Mamun, 2021).

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Bangladesh's inland waterways cover 24,000 km in length with approximately 1000 landing points and 21 inland river ports, making the system one of the largest in the world. Chittagong Port handles about 3 million TEUs annually, and 80% of them are bound for Dhaka. If Bangladesh were to update its inland water transportation system, it could increase its GDP by 1%, while foreign trade would increase by 20% (Alam, 2019). The same literature suggests that containers that can be carried via inland water transit would cost less than rail. The most relevant river routes in Bangladesh are situated at some of the most prominent river ports, such as Dhaka, Narayanganj, Chandpur, Bhairab, Barisal, Chittagong, and Khulna. Enhanced connectivity of Bangladesh' river ports is necessary to facilitate direct shipment of cargoes to the capital as well as other national destinations.

### *3.4 Ship Building and Ship Recycling; its Growth Potential*

The number of shipyards and workshops in Bangladesh exceeds 300 that allow the country to meet nearly 100% of its requirement of inland vessels such as dredging barges, fast patrol boats, passenger vessels etc. These shipyards are efficient in building good-quality ships, saving the Bangladesh Government a significant amount of foreign currency, while also boosting forex reserves through exporting these vessels abroad. These shipyards are constructing 10,000 DWT (deadweight tonnage) sea-going ships for exports and are expected to upgrade capacities to 25000 DWT (Alam, 2019).

Additionally, the deconstruction and scrapping of ships also facilitate the growth of Bangladesh's economy. Approximately 300 ships are recycled in Bangladesh each year, amounting to 24% of the total scrapped ships worldwide. Furthermore, 70%–75% of scrapped steel in industries and rerolling mills in the country come from scrapped ships (Bhuyan, 2021; p. 11). The Hasina administration had declared ship recycling activities as an 'industry' on 13$^{th}$ February 2011 (Mandated by the Bangladesh Ship Recycling Act-2018) (BSS, 2022).

Data suggests that Bangladesh has significant potential to be a strong ship-scrapping economy. In 2017, more than 7000 ships were scrapped for raw steel to be sent to industrial steel and re-rolling mills (Alam, 2019). These metal scraps are later repurposed into metal furniture, pipes, steel water taps, steel rods, and other similar products. Bangladesh has 124 ship-recycling yards, contributing an estimated average of 2.4 billion USD to the national economy annually (Alam, 2019). All in all, the facet of ships, through both recycling and producing, can act as an economic bastion for Bangladesh.

### *3.5 Marine Biotechnology: The Future of Modern Medicine*

The marine biotechnology sector in Bangladesh can be a powerful sector for innovative food supplies, securing green energy and environmental remediation, as well as in the developing pharmaceutical sector of Bangladesh. In 2017, there

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were over 36 marine-derived drugs under clinical development, this included 15 for cancer treatment. For instance, 'Acyclovir' and 'Zovirax', the antiviral drugs were obtained from nucleosides isolated from Caribbean sponges (Islam et al., 2024). Another drug 'Yondelis' was developed from small soft-bodied marine animals, and was the first drug of marine origin to fight cancer. Moreover, seaweed and mollusks have medicinal properties, and clams have been found to alleviate coronary issues (Ab Lah et al., 2016, Smoothey, 2013; Mahaffey et al., 2008 as cited in Hussain et al., 2019; 7). Additionally, both micro and macroalgae extracts have high value in the nutraceuticals and pharmaceutical industries. Macroalgae producers can target human food markets as a protein staple, in the animal feed industries, fish medications, and as preservatives. Polyunsaturated fatty acids such as omega-3 and omega-6, as well as other microalgae-based antioxidants are available in the market (Alam, 2019).

If such processes run as smoothly, there could be a drastic pharmaceutical evolution in the next 20–25 years with the apt acceleration of the marine biotechnological sector.

### *3.6 Offshore Oil and Gas: Untapped Potential*

With the onset of the Russo-Ukraine war, the global price of crude oil and natural gas had consequently reached unprecedented heights, despite impositions of price caps. Such volatility in fuel prices increases the cost of international trade, with the cost being transferred to individual consumers. So, the necessity to explore national fuel resources, both inland and offshore, have significantly increased for Bangladesh.

In 2009, offshore fields accounted for 32% of worldwide crude oil production, and this is projected to rise to 34% by 2025. Experts estimate that the reserves in Bangladesh's offshore marine deposits are just as vast as its onshore counterparts, which may increase the GDP of Bangladesh to $2.5 trillion (Alam, 2019).

After winning the disputes over maritime boundaries with Myanmar in 2012 and India in 2014, Bangladesh had acquired 26 blocs in the maritime boundary from its neighbors, 15 of which are deep-sea blocs, and 11 being shallow water ones. It has been estimated that there are 26 Tcf (trillion cubic feet) of natural gas deposits in Bangladesh, of which only 1 Tcf has been found offshore as of now (Alam, 2019). Noteworthy small-reserve gas wells, the Sangu and the Kutubdia, have been exploited well. Sangu's 0.8 Tcf of reserves have been fully exploited, whereas Kutubdia's 0.04 Tcf of reserves are yet to be done the same with. Furthermore, no commercial quantities of hydrocarbons have yet been produced from the drilling of the Magnama (3.5 Tcf) and Hatia (1.0 Tcf) (Alam, 2019). Some Bangladeshi gas blocks are believed to have comparable geological structures and gas/oil potential as Myanmar, given the proximity of our deposits to theirs.

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### *3.7 The Renewable Energy Dialogue: For a Sustainable Future for Bangladesh*

Recent estimates suggest, demand for renewable energy is expected to increase two and a half times by 2035 worldwide than it is today (Alam, 2019). Bangladesh, which relies dominantly on natural gas and furnace oil to generate electricity, needs sustainable alternatives to align with international sustainable energy standards. The use of wind, waves, and ocean current to generate electricity, using onshore grids for storage, is a viable solution to meet Bangladesh's ever-growing energy demands, given that the country has a potential to generate 30 GW of energy from offshore wind farms (Islam et al., 2024).

However, renewable sources only make up for 1.69% of the national power supply, mostly from solar energy (Bangladesh Economic Review, 2023; p. 147). The 500 MW offshore wind projects near Cox's Bazar portends potential, however still insufficient (Islam et al., 2024).

Nevertheless, Bangladesh does have potential to thrive in the renewable sector, mostly attributed to its geographical location and climate conditions. Moreover, initiatives as such create sector-based employment opportunities. With the right policies, the country may be able to harness maximum efficiency in the renewable sectors, reaching closer to its blue economic targets.

### *3.8 Tourism: Generating Revenue from International Vacationers*

Tourism accounts for approximately 5% of the global GDP, and in 150 nations, the tourism industry adds 6%–7% to employment (Alam, 2019). For instance, coastal tourism in the US and Australia generate an annual revenue of 129 billion USD and 20 billion AUD respectively (Islam et al., 2024). Additionally, tourism acts as the primary source of foreign revenue for half of the Least Developed Countries (LDCs).

Coastal countries lie on a bed of advantages for their proximity to the ocean line, which can be incentivized for proliferating a fruitful coastal tourism sector. Bangladesh revels in the advantage of possessing a coastline of 710 kilometers. Approximately 8.3 million USD in revenue is generated from Bangladesh' tourism sector alone (The Financial Express, 2021). Various activities surrounding its coastal areas, such as yachting, coastal travel services, and cruising. In addition, the hotel and resort sector can assist Bangladesh in generating high revenues.

However, to improve Bangladesh's tourism sector, relatively advanced infrastructure such as helipads, jetties for yachts, and cruise ship facilities are most required.

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## 4 Blue Economy and its Perils; Challenges for Bangladesh

Despite the prospects for the blue economy for Bangladesh, the sector is not without its challenges. Alongside the prospects, the researchers believe that the challenges in the blue economy of Bangladesh should be significantly discussed for multidimensional solution-making. For instance, Bangladesh is yet to achieve a more financially profitable position in shipping, with only 71 registered medium-scaled ships, which are impotent in delivering minute fractions of Bangladesh's shipped exports (Ziauddin, 2023; p. 42). Moreover, investments and incentives in shipbuilding are still not up to scale to the country's production capacity due to insufficient governmental priorities/abilities, and absence of international confidence to invest in Bangladesh's shipbuilding industry (Alam, 2019). Another prime sector would be seabed mining, which stir up ecological disturbances and threats to biodiversity, such as sediment-plume generation, release of chemicals, noise pollution, and so on (Levin et al., 2016; Gollner et al., 2017; Tilot et al., 2018). Moreover, a Norwegian study had identified overfishing as a top concern for marine environmental degradation, alongside an increase in temperature, acidification of ocean waters, and contamination (Jex, 2016). More issues as such are discussed in points.

I. Government data suggests that fishermen from other countries catch about 8 million tons of fish in the Bay of Bengal, compared to Bangladesh's 93,000 tons. This illegal fishing has depleted Bangladesh's resources. Despite Bangladesh being allowed its own 200 nautical miles of EEZ, only 30–40 nm is explored for fishing activities. Additionally, the country's fishermen cannot catch demersal fish below the 50-feet depth limit in the deep sea due lack of upgraded equipment and absence of necessary data (Alam, 2019).

II. Substantial plans for offshore oil and gas extraction are necessary for sustainable and operational marine resource exploitation. As we share marine borders with India and Myanmar, whoever taps into any gas reserves below the ocean floor, will be the one who will harness most of these reserves.

III. Bangladesh neither has a blue economy roadmap, nor does it have a specific Blue Economy Policy (Haque, 2020).

IV. Salt production in the country is yet to reach the maximum capabilities of industrial-level production. 6 million locals are associated with Bangladesh’s shipbuilding and salt industry (Failler et al., 2018). The salt production in the country is produced manually using local equipment, but on a very small scale. For instance, the salt production of Bangladesh's Cox's Bazar coastal segment is 22mt, whereas the Samut Sakhon of Thailand produces 43mt (Hossain et al., 2006; p. 163–164).

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Such production is insufficient for exporting on a large scale after pacifying domestic demand.

V. Stronger maritime research needs facilitation regarding the availability of marine resources, deep-sea fishing, biochemical innovation, biotechnology and marine genetic engineering among others. And to facilitate stronger research, Bangladesh needs a more educated and trained society of marine researchers (Syfullah, 2021; Ziauddin, 2023; p. 43; Islam et al., 2024).

VI. Maritime safety and surveillance need standard planning and execution. The UNCLOS governs the "High Seas" that extend beyond the national 200 nm but lacks efficient maritime patrolling and governance. This ineffectiveness exacerbates acts such as illegal fishing, illegal trade, slave trading, and piracy (Alam, 2019). Moreover, both the Bangladesh Navy and The Coast Guard lack sufficient patrol boats for inspecting crimes and committed pollution by ships and other vessels (Ziauddin, 2023; p. 46).

VII. The practice of ‘Blue Diplomacy’ by relevant governmental actors is a very weak Bangladesh, alongside evident insufficiencies in blue diplomacy research (Haque, 2020; p. 8).

VIII. Bangladesh’ inadequacies in blue economy-centric infrastructure has resulted in very little foreign direct investment in the BE sectors. This backtracks the country's progress quite excruciatingly.

IX. Bangladesh's human resources require relatively upgraded training to contribute resiliently to the BE. An estimated 30 million people are connected to the Oceans Economy in Bangladesh (Failler et al., 2018).

X. Unmanaged mass tourism negatively impacts coastal ecosystems, often impacting the marine protected areas. Pollutants from the industrial factories in the country's north, as well as pesticides, and insecticides used in farming travel downwards south via Bangladesh's extensive river system and pollute the marine environment, causing rapid acidification of the sea, and eventually the ocean (Iqbal, 2020).

XI. Strong similarities between SDG-14 (Sustainable Development Goal No.14, that addresses the sustainability of marine life and preserving the environmental integrity of the oceans) and Bangladesh's blue economy policies are absent.

## 5 Policy Recommendations for Bangladesh's Blue Economy

Despite evident challenges affecting Bangladesh’s blue economic growth, they are solvable through taking necessary measures. We list out a number of policy

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recommendations to expand upon and proliferate the blue economy sectors of Bangladesh. They are as follows:

I. Fishing within Bangladesh's nautical miles needs to be securely monitored to restrict illicit activities such as illegal fishing. Moreover, advanced technology for deep-sea fishing and trawlers with long-line equipment should be made available, plans that have been a part of Bangladesh's 7th Five-Year Plan. Bangladesh's foreign partners, such as Norway and Japan, both with rich coastal heritages, can assist the country in acquiring necessary technology such as advanced research vessels and sophisticated deep-sea fishing technology (Islam et al., 2024).

II. Bangladesh's EEZ abounds in jellyfish, which has high international demand. These jellyfish have the ability to adapt in warm and polluted waters (The Business Insider, 2019), which is advantageous for Bangladesh's geography and ecological status. And according to a study by the Bangladesh Oceanography Research Institute (BORI), crab farming can help generate $30 million annually (Rayhan, 2024). These endeavors should be examined initially through demonstrative small-scale trials, and going forward, integrated into our national economic practices.

III. Bangladesh must increase the facilitation of its ocean-related research. This is absolutely imperative for increased innovations, and scientific and technological advancements in the oceanic sectors. The GoB had established the Bangladesh Ocean Research Institute (BORI) for significant empirical and physical advancements in the sectors of fish, mineral extraction, underwater reserves, and other similar activities. The institute has a 10-year goal in place, with a short, medium and long-term range of goals, estimated to generate 206 billion USD by 2028 (Rayhan, 2024). Additionally, the establishment of Bangladesh Institute of Maritime Research and Development (BIMRAD) has been a massive step forward in marine research and development.

IV. Some experts recommend for the government to facilitate a separate ministry for the blue economy, aptly named "The Ministry of Ocean Affairs" (Syfullah, 2021). The government is urged to consider this idea for streamlining BE activities that are presently scattered in between different ministries. The Norwegian governance structure for marine management may be exemplary in establishing a dedicated BE governmental entity (Islam et al., 2024).

V. The practice of blue diplomacy should be made relatively more mainstream within Bangladesh's diplomatic circles. Bangladesh already maintains blue diplomatic engagements with countries such as Australia,

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Malaysia, China, the US and more. Further improvement of such engagements is advised. The Ministry of Foreign Affairs (MoFA) already has a dedicated Maritime Affairs Unit (MAU) to practice, maintain and improve upon said engagements (Haque, 2020).

VI. The High Seas need more stringent monitoring by the UN to prevent piracy similar criminal acts that might restrict states' sovereign practices in their territorial waters. Bangladesh should efficiently equip its Navy and Coast Guard with an adequate number of patrol boats and necessary equipment.

VII. Seaports in Bangladesh should be relatively digitized to facilitate the most advanced port experience for import/export vessels. The Singapore Port's digital model can be exemplary in guiding Bangladesh' port digitization process. The US, Canadian and Norwegian port models may also be observed.

VIII. Proper planning for oil and gas extraction is much needed Private investment and public-private partnerships in such projects should be promoted through creating public-private investment frameworks and facilitating stakeholder dialogue. Investments from the likes of the Netherlands, the UK, Japan, and Qatar, countries with stupendous marine resource extraction experience and technology, may be welcomed.

IX. 'Marine Spatial Planning (MSP)' is a holistic approach which introduces responsible designated human activity in the seas/oceans so that no overlapping of marine-based activities occurs, maintaining the oceans' ecological integrity (Hossain et al., 2014, p. 45; Alam, 2016; Alam, 2018; p. 68). Following the concept of MSP, plans to establish and conserve Marine Protected Areas should be a top priority. Bangladesh may collaborate with countries such as The Maldives, Singapore, Japan, South Korea, Australia, and other littoral nations with experience in MPA conservation. Moreover, private investments and public-private partnership initiatives regarding MSP should be encouraged.

X. Relatively modern initiatives should be taken in Bangladesh's tourism sector, such as upgrading the restaurant sector using state-of-the-art technology, and through developing the boating, yachting and cruise shipping facilities. The Karnaphuli Cruise Ship that goes along the Chattogram-Cox's-Bazar-St. Martin route is a step in the right direction.

XI. Given the strategic importance of the Bay of Bengal, Bangladesh and India may benefit from mutual cooperation in the maritime sector (Sakhuja, 2014). India's "Ganga Vilas", the longest cruise ship in the world, aims to travel from the Indian town of Varanasi to Northeastern Assam while traveling through most of the riverways of Bangladesh.

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Such cooperation will further boost bilateral relations between the countries and support Bangladesh in collecting passage revenue (The Daily Star, 2023).

XII. Bangladesh should emphasize marine-based education and training to churn out an adept workforce. The Bangabandhu Sheikh Mujibur Rahman Maritime University (BSMRMU), set up in 2013, is an example of the GoB's efforts to advance maritime education, research and workforce development.

XIII. More emphasis should be put on renewables. Bangladesh's foreign partners, such as France, Germany, Japan, and China can facilitate technology transfer and intergovernmental collaboration. The AtlantOS "oil spill hazard mapping and disaster risk reduction best practices" is used to create large-scale simulations of oceanic oil spills by ships, and to promote prompt responses in actual, real-time conditions (Neves et al., 2018). Bangladesh can request a transfer of such technology to equip itself for similar emergencies in its own region.

XIV. Local shipping companies need to expand their fleets by improving private investments (Hossain et al., 2014, p. 7). The government should facilitate the promotion of shipbuilding via grants, governmental subsidization and by promoting private investment through aforementioned public-private investment frameworks. This trajectory will assist Bangladesh to generate up to 435 billion USD from international shipping by 2030 (Alam, 2019).

As conceptual as they may seem, these recommendations have been formulated based on the most potential sectors under Bangladesh’s blue economy, their prospects for sustainable growth, Bangladesh’s most relevant international engagements, and how these engagements may translate to economic gains using the most relevant literature. Given that Bangladesh carries the emblematic principle of ‘friendship towards all’ as its foreign policy, these recommendations will supplement Bangladesh’s dynamic and adept external affairs, and assist the country in its goal to materialize its blue economic aspirations.

## 6 Conclusion

The purpose of this research was to elaborately explain the current reality of the Blue Economy in Bangladesh and its potential to expand Bangladesh’s aggregated economic growth.

The paper was initiated through explaining both the definition and significance of the Blue Economy and its subsequent implications for Bangladesh. Elaborating on that, the research then detailed the prospects of each individual sector relevant to the overall Blue Economy identity. While reflecting on the prospects, the

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research delved into a brief account of the most relevant challenges associated with the aforementioned sectors of the BE, and the underlying causes of such challenges. Finally, keeping up with its solution-oriented approach, the paper presents recommendations in the form of what it perceives as relevant policy approaches to supplement existing governmental blue economic endeavors.

The Blue Economy cannot be understated in its ability to improve the international status of littoral economies. Through analysis, the research has deemed that the potential of the blue economy for Bangladesh far outweighs the challenges the sector may impose. The blue economic field requires a significant increase in research, especially regarding the aggregated data; both quantitative and qualitative. This can be adequately redressed through both public and private endeavours.

We conclude with the statement that with the apt legal, political, economic and social framework, the nation will undoubtedly reap the most impressive results from its blue economic sectors.

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