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RESEARCH ARTICLE

Towards a Sustainable Blue Economy: Prospects and Challenges for Marine Fisheries in Bangladesh's Bay of Bengal

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Abstract
Bangladesh's Bay of Bengal and its 118,813 km² Exclusive Economic Zone (EEZ) play a vital role in ensuring national food security and economic growth. The blue economy was introduced in 1994. It offers significant opportunities for sustainable development through marine fisheries, shipbuilding, coastal tourism, as well as renewable energy. This study analyzes the prospects and challenges of developing a sustainable blue economy in Bangladesh is crucial for sustaining economic growth in line with SDG 14 (Life Below Water). For analyzing the data, the study uses secondary data from government reports, international databases, and relevant literature. To assess economic contributions, employment potential, as well as marine resource utilization, a descriptive analytical approach was applied. The findings show strong growth potential in shipbuilding, fisheries, coastal tourism, as well as renewable energy. It will benefit from generating employment and poverty reduction in coastal regions. The findings reveal that inadequacy in infrastructure, limited capacity in research, overfishing, and environmental degradation are the major barriers to sustainable marine development. To address these challenges, the study recommends establishing an inter-ministerial Blue Economy Coordination Council and adopting a national Marine Spatial Planning framework. Investment in marine research infrastructure, like a fisheries research vessel and promotion of public–private partnerships in renewable energy, along with biotechnology, are essential. Strengthening data systems, stakeholder participation, and regional cooperation will ensure inclusive and climate-resilient blue growth for Bangladesh.

Keywords: Bay of Bengal; Blue Economy; Employment Opportunities; Marine Fisheries; Life Below Water; SDG 14

Introduction

Bangladesh, a coastal country in South Asia, depends significantly on marine resources for its economic development, livelihoods as well as food security. The idea of the 'Blue Economy' has taken center stage in Bangladesh's long-term development plans. The blue economy, which was first presented at the 2012 Rio+20 Conference, places a strong emphasis on using ocean resources sustainably for increased economic growth, better livelihoods and environmental health.

It offers Bangladesh a way to turn its maritime and coastal industries into catalysts for equitable and long-term prosperity. Nearly 52% of the nation's supply of animal-based protein comes from marine fisheries. It helps to sustain millions of coastal people's livelihoods. Furthermore, there are new jobs and investment prospects in developing industries. It includes shipbuilding, offshore renewable energy, coastal tourism, and aquaculture. Notwithstanding these opportunities, Bangladesh still faces a number of obstacles. These obstacles are poor marine infrastructure, excessive use of marine resources, a lack of research resources and institutional flaws in marine governance (Rahman & Hossain, 2024; Islam et al., 2023). Marine biodiversity and the long-term sustainability of the blue economy are at risk because of the misalignment between resource use and conservation.

Professor Gunter Pauli first introduced the concept of the "blue economy" in 1994. He showed blue economy as a way to achieve sustainable economic growth that strikes a balance between long-term prosperity, environmental preservation, and social welfare (Pauli, 2010). The blue economy has its roots in the green economy. It emphasizes the fair and responsible use of ocean and coastal resources to improve human well-being and maintain natural balance (Bianchi et al., 2014; Sarker et al., 2018). In order to preserve the productivity and status of marine ecosystems for future generations considering a broad range of commercial activities that are either directly or indirectly dependent on the ocean. Such activities include shipping, fishing, marine biotechnology, tourism and renewable energy (Morrissey et al., 2010). Bangladesh's 710 km coastline is home to mangroves, estuaries, and coral reefs that sustain millions of people. Nearly 20 million people depend directly or indirectly on marine and coastal resources for their subsistence, food security, and employment through industries like fishing, salt production, shipbuilding, and coastal tourism (Hussain et al., 2018; Azad et al., 2022). The oceans are crucial for regulating the global climate system in addition to preserving biodiversity. They produce more than half of the oxygen on Earth, absorb large amounts of carbon dioxide, and affect the balance of global temperatures (UNCSD et al., 2016). Recent empirical studies emphasize that the success of blue economy strategies in developing coastal states depends not only on resource endowments but also on institutional readiness, policy coherence, and investment prioritization. In the context of Bangladesh, weak inter-ministerial coordination and limited marine research infrastructure continue to constrain sustainable exploitation of marine resources despite growing policy attention (Rahman & Hossain, 2024; Sultana & Das, 2024).

Bangladesh's attempts to lessen climate-related problems like cyclonic disasters, coastline erosion, as well as increasing sea levels depend on these ecological services (World Bank, 2024). Therefore, ensuring the nation's food security and economic resilience is closely related to maintaining the health of the marine ecosystem. Recently, the government has prioritized blue economy sectors, particularly marine fisheries, aquaculture, shipbuilding, tourism, and offshore energy, in an effort to diversify growth and reduce the burden on land-based resources (MoFA, 2016; Motaher & Khaled, 2025). The Delta Plan 2100 and the Perspective Plan 2041 both accept the blue economy as a vital element of sustainable development and important to achieve SDG 14 (Life Below Water) by 2030. However, problems persist, like inadequate infrastructure, a lack of integrated spatial planning, and a lack of maritime research capabilities (Majumder et al., 2024).

Figure 1 shows the Exclusive Economic Zone (EEZ) of the Bay of Bengal. It also shows the maritime boundary of Bangladesh as defined by the maritime boundary settlements with India (2014) and Myanmar (2012). Over the region highlighted on the map, or approximately 118,813 km² of maritime territory, Bangladesh has the sovereign right to explore, use, and manage marine resources. Bangladesh's vast marine jurisdiction in contrast to its land area is depicted by the fact that the country's whole maritime domain (about 207,000 km2) is 1.4 times larger than its terrestrial territory.

Figure 1: Major Sectors related blue economy in Bangladesh (Hussain et al., 2018)

Such a large marine zone allows for the growth of fisheries, exploration of offshore energy, shipping, mineral exploitation, and coastal tourism. Therefore, Figure 1 gives a fundamental picture of the geographical and economic foundations of Bangladesh's blue economy activities. It frames the study's investigation into the sustainable use of these resources.

Bangladesh's marine area is 1.4 times larger than its landmass, with a 200-nautical-mile Exclusive Economic Zone (EEZ) in the Bay of Bengal. Tidal, wave and offshore wind are marine renewable energy sources that offer promising clean energy options. But they are yet underdeveloped due to a lack of infrastructure and unclear laws (Motaher & Khaled, 2025). Moreover, a lack of institutional coordination and a lack of research capacity continue to be obstacles to integrated ocean governance (Majumder et al., 2024; Bohrium, 2023). Even with these advancements, there are a lot of unsolved issues regarding how Bangladesh may reconcile social inclusion, ecological sustainability and the rapid utilization of maritime resources.

Although prior research has focused on sector-specific opportunities, few studies have examined the structural, institutional, and policy concerns that impact the overall sustainability of the blue economy. This paper tries to bridge that gap by analyzing the key opportunities, challenges, and legislative requirements for developing a sustainable blue economy in Bangladesh's Bay of Bengal region. Previous research on Bangladesh's blue economy has mostly focused on sector-specific elements such as marine trade or fisheries production, but infrequently offers an integrated analysis. It connects economic prospects with ecological sustainability and institutional preparedness (UN ESCAP, 2025).

The study is showing an analysis of the prospects and challenges of creating a sustainable blue economy in Bangladesh. The study uses descriptive analytical methodology. It identifies key sectors for blue economic growth. It prioritizes governance hurdles that need to be eluded to preserve ecological balance. This analysis aims to add to the continuing conversation on sustainable ocean governance. It is suggested that the results will

direct the creation of coordinated policy frameworks, investment priorities as well as research agendas. It complements the Sustainable Development Goals (SDGs) of the UN and national development goals. Globally, the blue economy discourse has shifted in recent years toward climate-resilient and inclusive ocean governance, highlighting marine spatial planning (MSP), data-driven decision-making, and regional cooperation as critical policy instruments. Evidence from South and Southeast Asia suggests that countries integrating blue economy strategies with climate adaptation and institutional reforms achieve more durable economic and environmental outcomes (World Bank, 2024; UN ESCAP, 2025). Bangladesh's growing engagement with offshore renewable energy, sustainable fisheries, and marine tourism reflects this evolving global agenda; however, translating policy commitments into measurable outcomes requires strengthened governance frameworks and enhanced research–industry linkages (Motaher & Khaled, 2025; Majumder et al., 2024).

Literature Review

The blue economy combines economic expansion with the sustainability of marine ecosystems. It has become a paradigm shift in development. On a global scale, it prioritizes the prudent use of ocean resources. It guarantees environmental preservation, poverty alleviation and food security (FAO, 2023; OECD, 2022). The blue economy provides coastal poor nations like Bangladesh a framework for policy. A calculated chance to match ocean-based enterprises with the Sustainable Development Goals (SDGs). The blue economy concept was first introduced by Gunter Pauli (2010). Later emphasized during the Rio+20 UN Conference on Sustainable Development. It links ocean-based economic growth to ecological integrity and social inclusion (Smith-Godfrey, 2016). Fisheries, shipping, energy, biotechnology and tourism are all included in a sustainability framework (Bari, 2017; Mittra, 2017). UN ESCAP (2025) reports that institutional fragmentation and a lack of adequate marine data systems continue to be important obstacles. The blue economy makes a substantial contribution to the regional GDP in South and Southeast Asia. According to Rahman and Hossain (2024) and Islam et al. (2023), successful blue growth necessitates an integrated strategy that combines investment in research capability. Chowdhury and Kabir (2022) point to inadequate infrastructure and poor ministry cooperation as enduring barriers in Bangladesh's maritime industries. Following the 2012-2014 period, maritime boundary settlements extended national authority over 118,813 km² of marine territory. The blue economy framework gained traction in Bangladesh (Hasan et al., 2018; Sadekin et al., 2021). According to Failler et al. (2019), institutional coordination and governance quality have a greater impact on the coastal and marine sectors' success than the quantity of natural resources.

Recent research expands the conversation to include new blue industries, including biotechnology, tourism, and sustainable ocean energy. Motaher and Khaled (2025) point out Bangladesh's potential for offshore wind and tidal energy, but they also point out significant infrastructure and regulatory barriers. The necessity of marine spatial planning (MSP) to resolve sectoral conflicts and direct sustainable investment is also emphasized by Majumder et al. (2024). Comparisons at the regional and international levels demonstrate that successful ocean governance dramatically increases national GDP and employment, as demonstrated in Australia, Mauritius, and China (Coffin, 2013; Degnarain, 2014; Zhao, 2013). Social inclusion as well as climatic vulnerability are highlighted as major issues in more recent publications. Gender engagement, equitable benefit sharing and the resilience of coastal communities must all be incorporated into the blue economy (Ahmad, 2019; Doyle, 2018; Hussain et al., 2018). According to recent governance studies, the state continues to dominate decision-making and civil society and small-scale fishermen do not participate enough (Leibniz-ZMT, 2024). According to the literature, the main industries propelling blue growth include aquaculture, shipbuilding, marine fishing, coastal tourism and renewable energy. More than half of Bangladesh's animal-based protein comes from marine

fisheries, which also offer significant job possibilities (FAO, 2023). Marine biodiversity is still in danger due to irresponsible fishing methods and lax implementation of regulations (Banik & Saha, 2023). Despite being known for its potential for exports, the shipbuilding sector confronts difficulties with capital investment, a lack of skilled workers, and restricted access to green technologies (JESCAE, 2024).

Another growing industry that supports local livelihoods is coastal and marine tourism. But it is frequently limited by inadequate infrastructure and environmental degradation (UNDP, 2023). The studied research reveals that resource potential, technological innovation and environmental stewardship are the interconnected elements. It determines the blue economy's sustainability. Few studies have examined the blue economy's entire sustainability trajectory by combining economic, ecological, and policy factors.

By creating a thorough framework that connects sectoral potential and institutional preparedness with sustainable outcomes, this study fills that gap. For clarity and publishing acceptability, the updated conceptual model (Figure 3) is now shown in an editable, high-resolution version. The literature as a whole has three persistent flaws: (1) a lack of institutional and technological competency; (2) a lack of coordination between environmental and economic goals; and (3) insufficient participation of local stakeholders. These issues need to be fixed in order to transform Bangladesh's ocean potential into a just and sustainable blue economy.

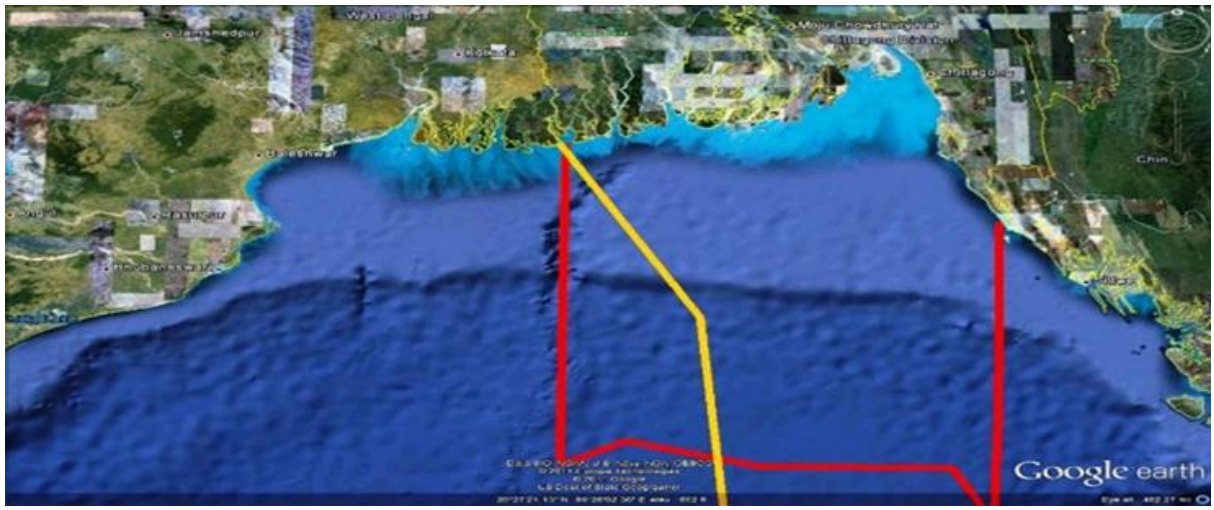

Figure 2: Blue economy area in Bangladesh (Source: Newsnine24, 2017)

Figure 2 depicts the primary economic sectors linked to Bangladesh's blue economy, per Hussain et al. (2018). These sectors include aquaculture, marine biotechnology, shipbuilding and shipbreaking, mineral extraction, coastal tourism, renewable energy and marine fishing. The figure reveals how these diverse but related companies collaborate to boost employment, diversify resources, and boost the wealth of the country

Conceptual framework

The conceptual framework of the study expounds on how Bangladesh could operationalize a sustainable blue economy through a multi-sectoral approach. It recognizes that sustainable ocean development requires collaboration among a number of disciplines and stakeholders. It includes marine biologists, economists, aquaculture specialists, lawmakers, and environmental scientists, as well as private sector partners. These actors

work together to develop and implement policies that balance economic growth, ecological protection, and social advancement.

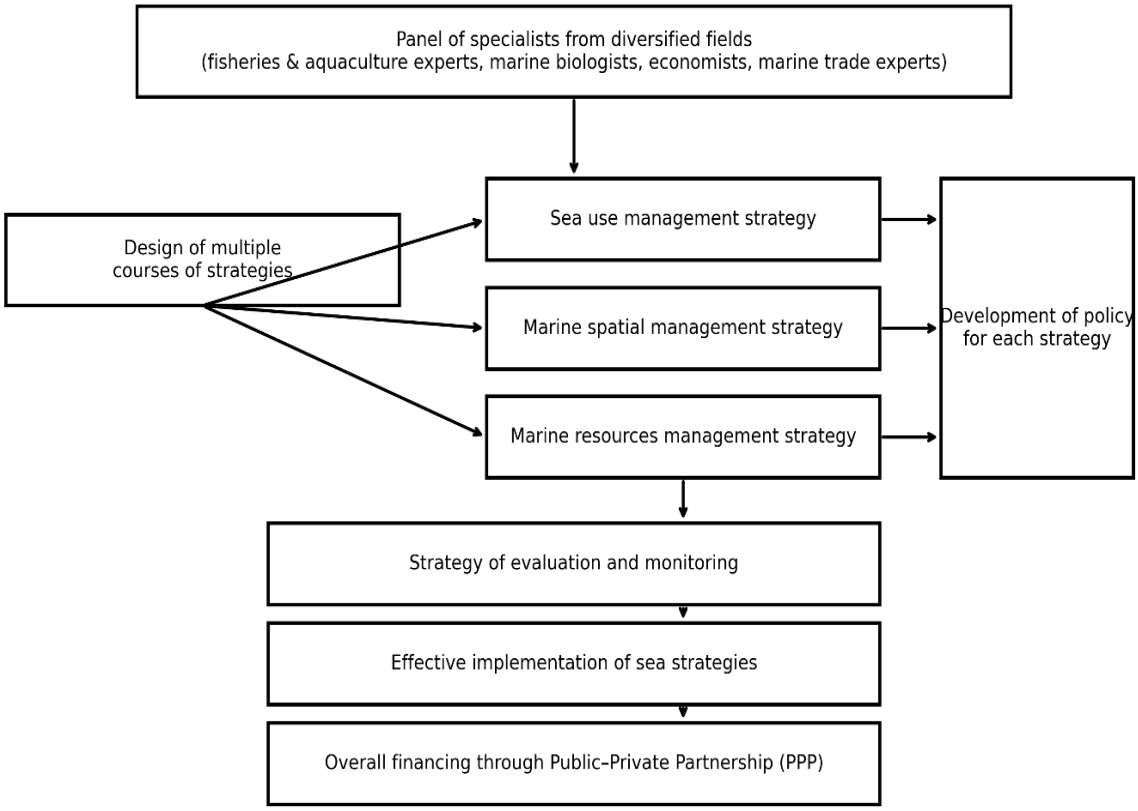

Figure 3: Conceptual Frameworks for Sustainable Blue Economy in Bangladesh

Figure 3 depicts this integrated framework for Bangladesh's sustainable blue economy. It demonstrates the dynamic interaction between policy inputs like research, regulation, technology, and investment. A robust system of policies and governance underpins this architecture. Public-private partnerships, or PPPs, are a key funding and implementation strategy that encourages technological innovation, efficient infrastructure development, and shared investment risk. These partnerships have the potential to accelerate research collaboration and enhance human resource capabilities across marine industries (Jafrin et al., 2016). This conceptual framework concludes by emphasizing that sustainable blue growth is a result of the combined efforts of economic productivity, environmental stewardship, and participatory governance, all of which have their roots in inclusive institutional collaboration and science-based policymaking.

Methodology

This study employs a descriptive and analytical approach using secondary data. The study uses statistical information and policy documents so that it can evaluate the opportunities and challenges in developing a

sustainable blue economy in Bangladesh. It gives particular attention to marine fisheries and related coastal sectors of the Bay of Bengal

Data Sources

The analysis relies fully on secondary data. Data collected from the Bangladesh Bureau of Statistics (BBS), Department of Fisheries, Bangladesh Bank, Planning Commission and Ministry of Foreign Affairs. These sources provided official statistics and policy information. Data has also been collected from the Food and Agriculture Organization (FAO), World Bank, United Nations Development Program, United Nations Environment Programme and International Maritime Organization (IMO). To add depth to the analysis, academic sources were also searched, including conference papers, peer-reviewed journal articles. The data was cross checked across these several sources to guarantee its accuracy, consistency and dependability.

Analytical Framework

This study's analytical approach is arranged around three interconnected aspects of the establishment of a sustainable blue economy.

Table 1: Dimensions of Sustainable Blue Economy

Dimension	Key focus area	Indicators
Economic	Resource diversification, trade, employment, and sectoral output.	Data on the salt, shipbuilding, tourist, and fish production trends.
Environmental	Climate vulnerability, resource extraction, and the sustainability of marine ecosystems.	The findings addressed overfishing, habitat deterioration, and pollution indicators.
Institutional and Governance	Stakeholder participation, intersectoral coordination, and policy frameworks.	Examination of PPP projects, fishery regulations, and Delta Plan 2100.

The results and discussion sections analyze fisheries growth, coastal tourism and resource management gaps. This tripartite approach enables the integration of data on economic performance, ecological sustainability aspects and governance efficacy.

Methodological Framework

The methodology depicts descriptive statistics, trend analysis. It also analyzes econometric assessment of sectoral and institutional performance. The study uses quantitative and qualitative methods to determine the economic, environmental and governance aspects of Bangladesh's blue economy.

Empirical Model Specification

To assess the determinants of blue economy performance, the following empirical model was estimated:

$$BEGDP_t=\beta0+\beta1FISH_t+\beta2TOUR_t+\beta3SHIP_t+\beta4RENEW_t+\beta5INST_t+\varepsilon t$$

Where:

$BEGDP_t$= Blue Economy–related Gross Domestic Product at the time t
β_0= Constant (intercept term)
β_1–β_5 = Estimated coefficients
$FISH_t$= Marine fisheries and aquaculture
$TOUR_t$= Marine tourism
$SHIP_t$= Marine trade, shipping, and transport
$RENEW_t$= Marine renewable energy
$INST_t$= Institutional quality
ε_t= Error term
t= Time period

STATA 18 was used to analyze data from 2000 to 2023 using Ordinary Least Squares (OLS).
The model evaluates sectoral contributions and governance efficiency using Ordinary Least Squares (OLS) regression. The details of the variables are given in Table 2.

Table 2: Variables and Descriptions

Variable Code	Variable Name	Definition / Measurement	Source
BEGDP	Blue Economy GDP Share	Share of blue economy sectors in national GDP (%)	World Bank (2024), BBS (2023)
FISH	Marine Fisheries Output	Annual marine and coastal fish production (metric tons)	DoF (2023), FAO (2023)
TOUR	Tourism Revenue	Coastal and marine tourism receipts (million USD)	UNDP (2023), BPC (2024)
SHIP	Shipbuilding Output	Value of ships exported and coastal vessel production (million USD)	JESCAE (2024), MoI (2024)
RENEW	Renewable Energy Investment	Investment in marine-based renewable energy (solar, wind, tidal) (million USD)	World Bank (2024), Khatun & Roy (2024)
INST	Institutional Quality Index	Composite index of governance indicators and policy coherence (0–1 scale)	UN ESCAP (2025), Rahman & Hossain (2024)

Tools and Techniques

To analyze the data, STATA 18 and Microsoft Excel were used. Among the analytical steps are descriptive trends for blue economy metrics from 2000 to 2023. To assess the associations between variables, the study used a correlation matrix. OLS estimation has been applied to find the sectoral factors influencing the GDP share of the blue economy. Bangladesh's performance is compared to that of its regional peers, which include

Sri Lanka, India, and the Maldives. To evaluate institutional as well as policy integration, policy documents (such as Delta Plan 2100, Perspective Plan 2041, and National Fisheries Policy 2020) are subjected to content analysis. A thorough grasp of the numerical trends as well as governance frameworks affecting Bangladesh's maritime development trajectory is ensured by the application of quantitative data and qualitative content analysis.

Results and Discussion

This section discusses the results of the study and provides an interpretation of the key findings. It begins with an examination of the descriptive statistics to summarize the key characteristics of the data and to provide an initial understanding of the distribution, central tendencies, and variability of the main variables. The analysis then presents the correlation matrix to explore the direction and strength of relationships among the variables and to identify potential associations. Building on these preliminary analyses, Ordinary Least Squares (OLS) regression models are estimated to examine the impact of the explanatory variables on the dependent variable. The regression results are interpreted in terms of statistical significance, magnitude, and expected signs of the coefficients. Finally, the empirical findings are discussed in relation to the study's research questions and objectives. Moreover, the descriptive statistics of the variables, the correlation matrix of the key variables, the OLS regression results, and the summary of findings are presented in Tables 3, 4, 5, and 6, respectively.

Table 3: Descriptive Statistics of Variables (2000–2023)

Variable	Description	Obs.	Mean	Std. Dev.	Min	Max	Source
BEGDP	Blue Economy GDP Share (%)	24	3.82	0.87	2.1	5.4	World Bank, BBS
FISH	Marine Fisheries Output ('000 metric tons)	24	685	140	410	910	DoF, FAO
TOUR	Coastal Tourism Revenue (million USD)	24	640	195	350	980	UNDP, BPC
SHIP	Shipbuilding/Export Value (million USD)	24	120	62	25	230	JESCAE, MoI
RENEW	Renewable Energy Investment (million USD)	24	80	35	20	150	World Bank, Khatun & Roy
INST	Institutional Quality Index (0–1 scale)	24	0.56	0.09	0.42	0.72	UN ESCAP, Rahman & Hossain

Source: Author's computation based on data from FAO, BBS, World Bank, and other sources.

Table 4: Correlation Matrix of Key Variables

Variables	BEGDP	FISH	TOUR	SHIP	RENEW	INST
BEGDP	1	0.84	0.78	0.62	0.55	0.69
FISH	0.84	1	0.73	0.58	0.49	0.64
TOUR	0.78	0.73	1	0.66	0.52	0.7
SHIP	0.62	0.58	0.66	1	0.61	0.57
RENEW	0.55	0.49	0.52	0.61	1	0.45
INST	0.69	0.64	0.7	0.57	0.45	1

Source: Author's estimation using STATA 18.

From Table 4 it can be seen that all variables show positive correlations with BEGDP. It suggests the sectoral interlinkages. Correlation coefficients are below 0.85, which indicates no serious multicollinearity concerns.

Table 5: OLS Regression Results: Determinants of Blue Economy GDP Share

Variable	Coefficient (β)	Std. Error	t-Statistic	p-Value	Significance
FISH	0.0045	0.0018	2.53	0.019	** (5%)
TOUR	0.0021	0.0009	2.33	0.028	** (5%)
SHIP	0.0012	0.0007	1.71	0.101	* (10%)
RENEW	0.0009	0.0008	1.12	0.276	ns
INST	1.842	0.732	2.52	0.02	** (5%)
Constant	-0.948	0.556	-1.7	0.103	
R-squared	0.842				
Adjusted R-squared	0.811				
F-statistic (Prob > F)	27.64 (0.000)				
No. of Observations (N)	24				

Source: Author's estimation using STATA 18.

Table 6: Summary of Empirical Findings

Variable	Relationship with BEGDP	Significance	Interpretation
FISH	Positive	**	Marine fisheries output significantly enhances the blue economy's GDP share, confirming the sector's central role in marine growth.
TOUR	Positive	**	Coastal tourism has a strong positive influence, highlighting potential for employment and foreign exchange earnings.
SHIP	Positive	*	Shipbuilding contributes modestly, reflecting its emerging potential but limited scale.
RENEW	Positive (weak)	ns	Renewable energy investment shows a positive yet statistically insignificant relationship, likely due to low sectoral maturity.
INST	Strong Positive	**	Institutional quality significantly improves blue economy performance, underscoring governance importance.

Interpretation and Findings

The regression results (Table 5) show that coastal tourism (TOUR) and marine fisheries (FISH) are statistically significant contributors to Bangladesh's blue economy at the 5% level. The blue economy's GDP share increases by 0.0021 percentage points for every 1% increase in tourism revenue, compared to 0.0045 percentage points for every 1% increase in fisheries output. A strong positive as well as significant impact is also shown by institutional quality (INST). It suggests that efficient governance, coordination, and regulatory frameworks are essential for long-term blue growth. Investments in shipbuilding and renewable energy have favorable but less pronounced benefits. It indicates that these industries are still in their infancy and need specific legislative incentives in technology.

The reliability of the model is validated by the high R-squared value (0.84), which shows that it explains a significant amount of variation in Bangladesh's blue economy performance. These results are consistent with research by Rahman & Hossain (2024) and Islam et al. (2023). It highlighted technological innovation and institutional preparedness as the primary drivers of blue growth in emerging coastal economies. This section critically analyzes the opportunities and challenges of Bangladesh's blue economy using descriptive and trend analysis of secondary data. The current status of the blue economy sectors, the function of marine fisheries and associated businesses, the readiness of institutions and policies, and environmental sustainability are the four interrelated concerns that are emphasized.

The current status and Bangladesh's Blue Economy

A broad foundation for ocean-based development is provided by Bangladesh's maritime area, which is anticipated to be 118,813 km² after the maritime boundary settlements in 2012–2014 (Hasan et al., 2018; Sadekin et al., 2021). The nation's coastal and marine industries make major contributions to trade, employment, and food security. However, unplanned extraction, climate vulnerability, and a lack of institutional capacity continue to limit sustainable exploitation (World Bank, 2024).

The status of the blue economy of Bangladesh

Table 7: Major maritime-based economic resources within the identified branch (Hussain et al., 2018, modified after Anon, 2016)

Marine resources	Economic sectors	Past and present status and trends	Future potentials
Living Resources	Marine Non-Non-Traditional Species	Marine algae culture absents, no marine oyster, seaweed, sea urchin, sea cucumber, mussel, etc.	Marine algae culture and initiation of seaweed; culture and initiation of shellfish.
	Marine Biotechnology	Biotechnology has not yet fulfilled any biological resources and marine life	Application of marine biotechnological instruments for other products, such as human food and developing pharmaceutical drugs/ chemicals
Non-living Resources	Gas, Oil, and Mineral	Gas and oil extraction and inquiry are narrow; begetting and coastal sand mining	Intensify gas and oil extraction; update and explore effective mining
	Sea Salt	Volatilization of solar	Marketing using modern

Marine resources	Economic sectors	Past and present status and trends	Future potentials
		evaporation	technologies and salt refinement
Marine resources	Economic sectors	Past and present status and serves	Future effective
Potential	Marine Renewable Energy	Limited use of wind energy and solar	Implementation of using solar, wind, tide, wave, and water current, as maritime renewable energy
	Shipping, Marine Trade, Transport and	Transport limited and port shipping	Fleet and seaborn trade use needs to be enlarged
	Tourism	Limited coastal tourism	Existing, expanded tourism in sea beaches, and newly exhibited islands
Other resources	Maritime Surveillance	Bangladesh Coast/Navy sentinel watches the marine resources	Those services spread to secure all marine resources of the extended boundaries
	MSP	No MSP has been implemented, formulated, and designed yet	MSP will be the guiding the tool for the blue economy to establish the strategy for maritime resources

The main maritime resources of Bangladesh, related economic sectors, and their present and potential futures are compiled in Table 7. It emphasizes that despite the abundance of the nation's offshore and coastal resources, the majority are still underdeveloped because of a lack of funding, technology, and governance capabilities. Seaweed, shellfish, and marine algae are examples of living resources that are mainly unexplored. A lost chance to diversify the food, pharmaceutical, and export industries is reflected in the lack of extensive marine aquaculture and biotechnology. Prospects for the future include embracing marine biotechnology advancements to produce value-added goods and growing seaweed and shellfish aquaculture (Azad et al., 2022; Motaher & Khaled, 2025). Because of financial and technical limitations, non-living resources such as minerals, oil, and offshore gas have not yet been thoroughly investigated (Hasan et al., 2018). Comparably, the coastal economy is dominated by conventional salt production, which needs to be modernized in terms of marketing and refining in order to boost productivity (Hossain et al., 2018). Although it presents a chance to diversify the country's energy mix and help achieve the objectives of the Delta Plan 2100 and Perspective Plan 2041, Bangladesh's marine renewable energy potential comes from solar, wind, and tidal sources, which remain underdeveloped (World Bank, 2024). Unplanned development and poor port infrastructure are impeding the slow growth of supporting industries like shipping, marine trade, and coastal tourism. If directed by ecological planning, sustainable coastal tourism might greatly increase employment and regional growth (Sarker et al., 2018). The above table shows that Bangladesh's blue economy is still in its early stages and has a lot of potential. But development is hampered by a lack of institutional capacity and creativity. To achieve this, potential technological investments, integrated governance and regional cooperation are required. Supporting businesses, including shipping, marine trade and coastal tourism, are growing slowly due to unplanned construction and inadequate port infrastructure. Sustainable coastal tourism has the potential to significantly boost employment and regional growth if guided by ecological planning (Sarker et al., 2018).

The table essentially shows that Bangladesh's blue economy is still in its infancy, with a lot of potential but hindered by a lack of innovation and institutional ability. Investments in technology, integrated governance, and regional collaboration are necessary to realize this potential.

Table 8: Basic resources of the blue economy in Bangladesh

Resource Type	Examples	Beneficiary groups
Resources for living	Mangrove, fisheries, seaweeds, plankton, corals, seagrass	Fishermen and the General population
Non-living resources	Sea, salt, oil, gas, minerals, and fresh water	Entrepreneurs, Government, General population.
Renewable resources	Tidal energy, solar energy, wind energy	Entrepreneurs, Government
Trade and commerce	Agriculture, ports, aquaculture, industries, tourism, shipbreaking, transport, and shipyards.	Government, General population, tourists, entrepreneurs
Regulation and supporting services	Waste disposal, carbon storage Coastal protection.	General population

The many types of Bangladesh's blue economy resources and the people who benefit from them are listed in Table 8. In order to sustain fishermen and provide food security for the general populace, the nation's living resources such as mangroves, fisheries, seaweeds, plankton, corals, and seagrass that are essential. Sea salt, oil, gas, minerals, and freshwater is examples of non-living resources that greatly increase national wealth and benefit residents, business owners, and the government. Under government and private sector initiatives, renewable resources such as wind, solar, and tidal energy show increasing promise for producing sustainable energy. Employment and economic diversification are also fueled by the trade and commerce sectors, which include ports, aquaculture, industries, tourism, and shipbuilding. Last but not least, regulatory and auxiliary services such as carbon storage, waste management, and coastal protection that improve climate resilience and preserve ecosystem stability.

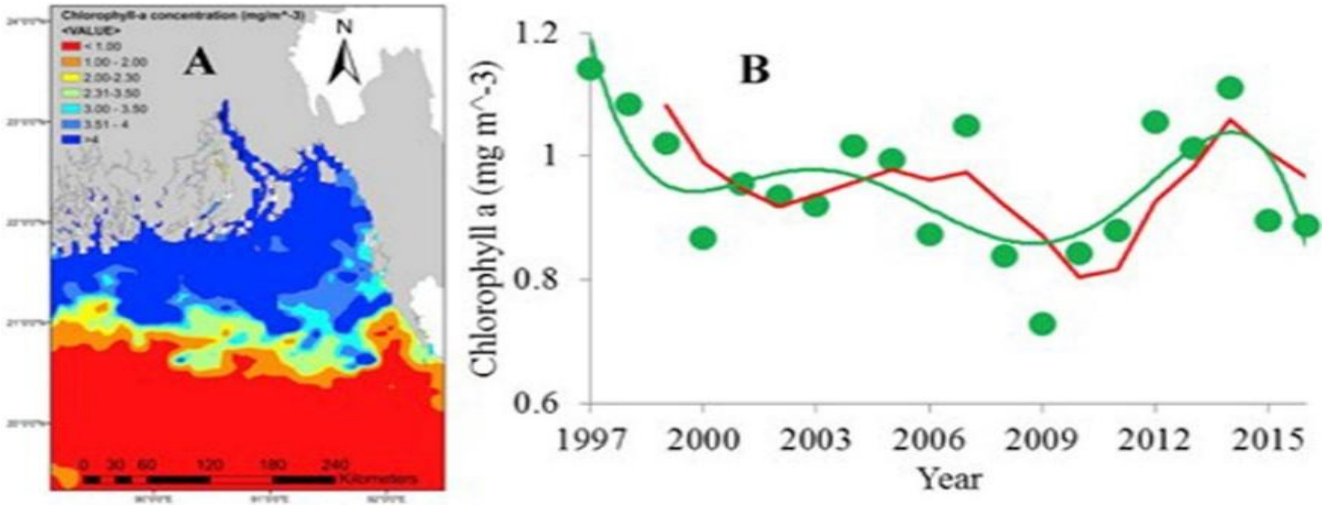

Figure 6: Distribution of chlorophyll a in the in-shore waters of Bangladesh

The green line in Figure 6 implies that the smooth trend and the red line imply that there is a three-year moving three years average. Chlorophyll a data was picked from AQUA MODIS and SeaWiFS.

Table 9: Geographical location and the major commercial species of fish production

Fishing ground	Area (km^2)	Depth (m)	Geographical location	Major commercial species
Middle Ground Southwest of South Patches	4600	80–100	20°45′N-21°10′N, 91°30′E-91°40′E	Red snappers (Lutjanuscampechanus), Shrimp (Penaeid species), Pomfret
East of Swatch of No- ground			21°00′N-21°25′N, 90°00′E-90°40′E	Ribbonfish, Silver jew, Snappers, Jewfis, Groupers, Indian mackerel (Rastrelligerkanagurta)
South Patches	6200	60–80	21°10′N-21°40′N, 91°10′E- 91° 50′ E	Pomfret (Pampuschinensis), Ribbonfish (Trachipteridaelepturus), Indian salmon (Eleutheronematetradactylum), Hilsa (Tenualosailisha), Bombay duck (Harpadonnehereus), Sharks (Selachimorpha), Jewfish (Epinephelusitajara), Catfish (Siluriformes), Eel(Anguilliformes spp.), and Rays (Batoidea)
Swatch of No-ground	3800	800–1000	90°00′E,21°00′N-21°40′N 89°00′E	Hilsa, Pomfret, Bombay duck, Ribbonfish, Jewfish, Shrimps,

Bangladesh's top fishing industries are distinguished by their ground, main commercial fish, depth ranges, and geographic locations. Bangladesh's trawl fisheries industry is well-known. Long-term fish catches have grown for both marine and inland species. Trawl fisheries additionally contribute to 85,000 MT and roughly 600,000 MT in the long run, as well as to artisanal fisheries accounts (DoF, 2013; Hussain et al., 2018). Currently, our nation accounts for 50–60% of the world's hilsa catch in marine and coastal seas, followed by Myanmar (20–25%), India (15–20%), and other nations (5–10%). Additionally, compared to 250 species on our land, about 475 kinds of fish are taken in our EEZ.

Nearly 0.5 million people in Bangladesh work directly or indirectly in the maritime industry. These individuals depend on marine fisheries for both employment and a living (DoF, 2013). Approximately 68 thousand non-mechanized and mechanized boats, as well as nearly 225 industrial trawlers, 24 of which are mid-water, are now exploiting Bangladesh's maritime waters to gather fish. Through those fish, we fulfilled our country’s demand as well as exported fish around the world (DoF, 2013; Sarker et al., 2018).

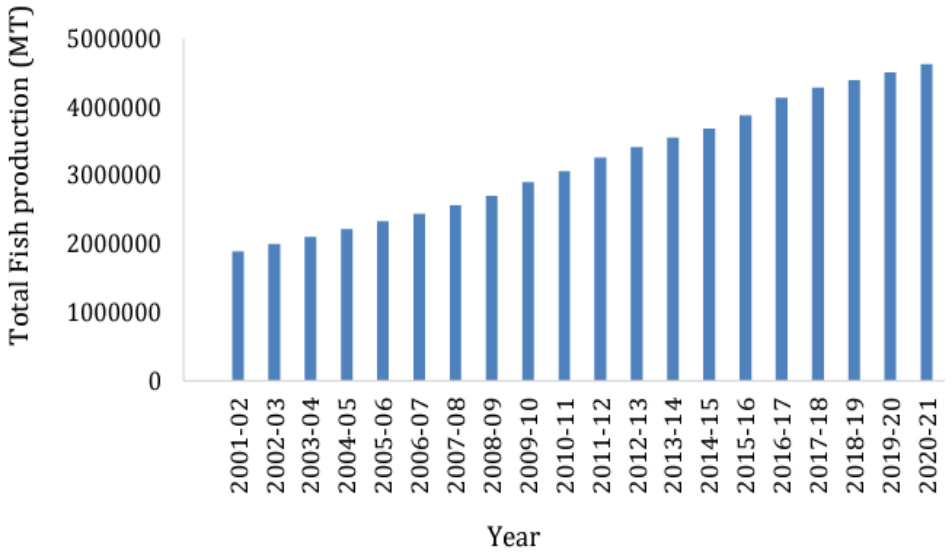

Figure 7: Upward trend of total fish production in Bangladesh during the last two decades (Khairun, 2022)

The graph shows a steady increase in Bangladesh's overall fish production between 2001–02 and 2020–21. Production has more than doubled during this time, increasing gradually from less than 2 million metric tons to around 4.8 million metric tons. This ongoing growth is a result of inland aquaculture's expansion, better fisheries management, and a greater use of contemporary farming and harvesting methods. In addition to supporting a variety of livelihood possibilities for the indigenous people living in our country's southwest coastal region, the Sundarbans mangrove forest boosts the national economy. The Sundarbans mangrove forest provides us with a variety of goods, including honey, timber, wax, major economic fishing, and tourism. In addition, Bangladesh's Sundarbans mangrove forest serves as a vital habitat for wildlife. We are also protected by the mangrove forest from a variety of natural calamities, including Sidor, bulbul, and the most recent cyclone Amphan. Inshore tourism is one of the biggest markets in the world, accounting for 5% of global GDP and 6–7% of all job opportunities. This is the first of five major export accomplishments, with a global reach of about 150 nations. In LDCs, tourism is the main source of foreign exchange earnings. Coastal tourism includes: a) beach-based recreation and marina tourism; and b) tourist activities that mostly take place in maritime environments. With one of the world's longest beaches in Cox's Bazar and abundant mangrove forests, Bangladesh offers a plethora of opportunities for the tourism sector. Tourism can directly employ tour guides and hotel staff.

In this sector, Bangladesh is now employing over 1 million people and also making a total value of 8.4 million US dollars.

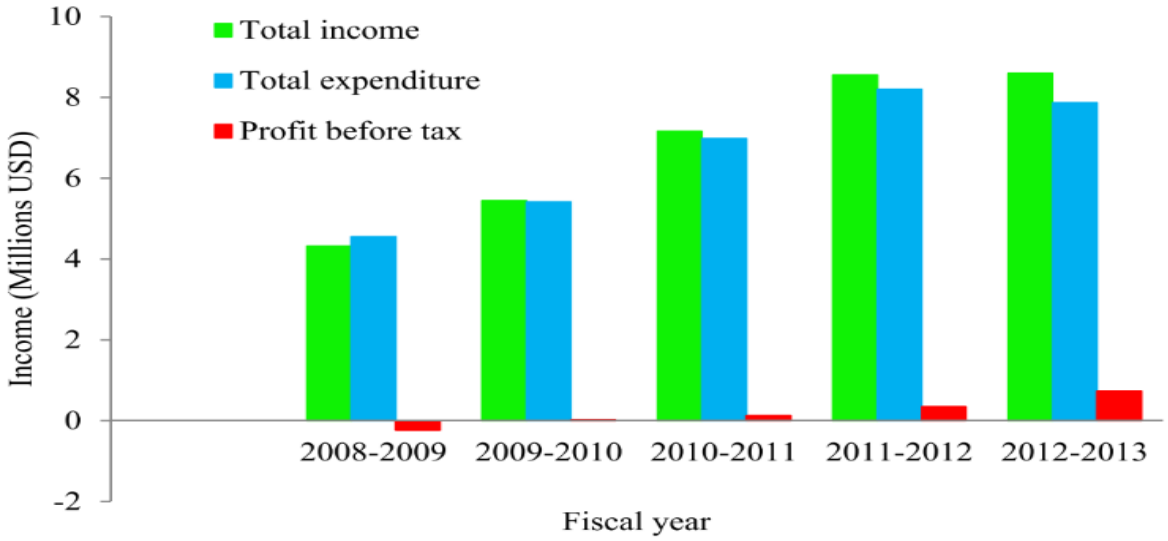

Figure 8: Revenues of Bangladesh Parjatan Corporation (BPC), expenditure, and Income for 2008–2013 (Sarker et al., 2018)

During the fiscal years 2008–2009 and 2012–2013, the Bangladesh Parjatan Corporation (BPC) saw a steady increase in both income and expenditure, with total income rising from approximately USD 4.5 million in 2008–2009 to over USD 8 million in 2011–2012 and 2012–2013. The figure also illustrates the BPC's profit before tax, which gradually improved due to increased operational efficiency and rising revenue from coastal and marine tourism activities. The statistic highlights the potential of tourism as a major driver of inclusive blue growth, job creation, and foreign exchange profits in Bangladesh's coastal regions, which is consistent with the study's goal.

Table 10: The situation of Salt Production in the coastal area of Bangladesh

Fiscal year	Listed salt farmers (n)	Demand for salt (million MT)	Target (million MT)	Actual production (million MT)	Salt imported (million MT)
1996–97	34170	7.98	8.00	8.98	–
1997–98	33269	8.19	8.50	8.00	–
1998–99	35112	8.53	8.75	11.79	–
1999–00	38194	8.72	9.00	8.24	0.50
2000–01	37293	8.91	9.00	9.90	–
2001–02	36285	8.82	9.00	7.75	1.00
2002–03	38328	9.00	9.20	8.10	1.00
2003–04	40595	9.18	9.50	9.15	0.50
2004–05	42000	11.44	11.50	9.35	0.50
2005–06	44574	11.70	11.70	15.75	–
2006–07	45000	12.20	13.00	10.54	–

Source: Bangladesh Small and Cottage Industries

Currently, salt is produced in Bangladesh on around 263 square kilometers of land in Cox's Bazar and about 20 square kilometers in Chittagong. Additionally, as indicated in Table 4 and Figure 9, this industry creates more than 5 million job possibilities and contributes between 35.5 million and 41.2 million US dollars to the national economy annually. Our goal is to produce 1.8 MT of salt from 247 square kilometers of land in Cox's Bazar between December 2015 and April 2016. It can be met by the domestic need for salt. Through the favorable effects shown table below, the government's 2011 National Salt Policy suggested the detrimental effects of salt importation.

Actual salt production is more than the salt we need because salt farmers have increased day by day in recent years. Along the Cox's Bazar coastal area, sea salt has been produced traditionally in Bangladesh for generations. The salt peasant can produce more than 20 tons/ha of salt in the long dry season. Annually in Cox's Bazar coastal areas, salt production in Bangladesh is 22MT, whither Thailand has produced 43MT. All of the salt pasant are small-scale and use hand-made local tools for cultivation.

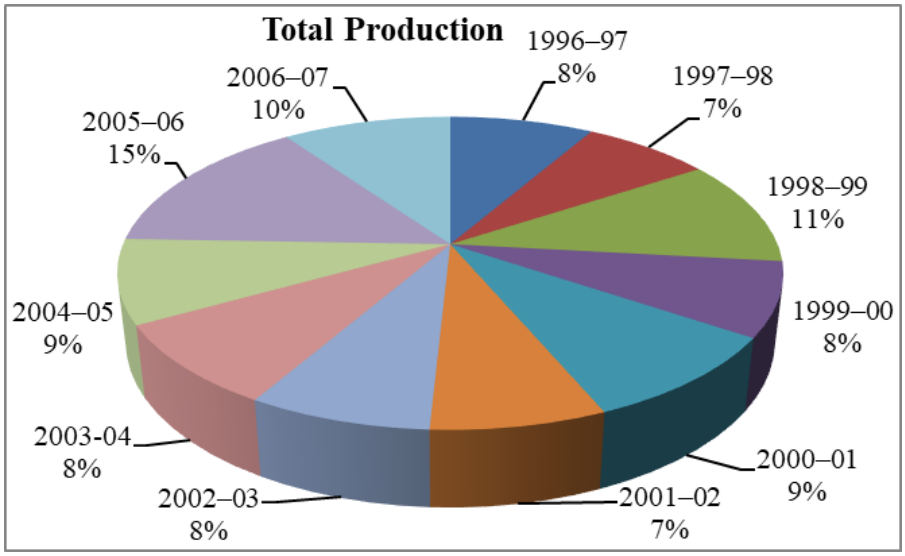

Figure 9: Salt Production by economic year

The shipbuilding department remains committed to a future enlargement place for the national economy our country. There are two major shipyards in our country which delivered over 20 vessels to European customers in 2005 and also generate job employment for around 0.2 million people (Hossain et al., 2010). Nowadays coastal ships, 36 sea-going ships, and 10,000 inland are passing all over the country.

The Petroleum Exploration and Production Company Limited (BAPEX) of Bangladesh is the only company in our country which endorsed forward exploitation, gas, and oil exploration. The Ministry of the government should recognize face more efficient gas and oil reserve and strategic tools of action needs to be consecrated. Depending on this, a survey of the present border of BoB should be guided, then capable foreign companies should be employed to enlarge maritime drilling activities and exploration to confirm future energy safety in our country. At present Bangladesh Govt. has inspired in many division, that could be useful for this case and monitoring, best exercise, and information, as well as monitoring, results, and assessment protocols.

Marine biotechnology analyses the sea to create chemical products, processes, enzymes, other industrial products, and novel pharmaceutical drugs. It played an important role in the progress of bio-fouling

biomaterials, seafood safety, fisheries and aquaculture, bioremediation, and healthcare diagnostics (Thakur & Thakur, 2006). In other countries of the world, the scope for application of marine biotechnology is greatly hopeful in Bangladesh. There is no suspicion that marine organisms, and living resources can be applied especially for human health care (nutritional supplements, bioactive compounds, antibiotics and other pharmaceutical drugs, etc.), nutritionally balanced food.

Recommendations

Several specific policy measures are suggested to guarantee sustainable and equitable marine development in light of the study's findings regarding the present state, prospects, and difficulties of Bangladesh's blue economy: Firstly, to create a single Marine Spatial Planning (MSP) framework, the Ministries of Fisheries, Shipping, Energy, Tourism, and Environment should form an interministerial "Blue Economy Coordination Council." The efficient use of marine resources inside the Exclusive Economic Zone (EEZ) and the reduction of overlapping mandates are two benefits of this coordination. Secondly, for sustainable fisheries management, it is needed to increase the mariculture of non-traditional species like seaweed, shellfish, and marine algae while stepping up enforcement of fishing laws to minimize overexploitation of marine species.
Moreover, for increasing marine biotechnology and value-added production**,** encouraging research on applied marine biotechnology to employ marine species for nutraceuticals, biochemicals, and medications is needed. This will diversify export portfolios and reduce reliance on exporting raw fish. Additionally, building capacity and marine education, developing a trained workforce for new blue economy sectors, and national universities and technical institutes should improve their marine science, oceanography, and coastal management curricula.
Finally, to help guide policy decisions and increase resource management transparency, establish a national database on oceanographic, ecological, and socioeconomic variables that is openly accessible. Last but not least, the Development of environmentally friendly tourism infrastructure in Cox's Bazar, Kuakata, and St. Martin's Island that complies with environmental regulations and helps coastal communities by means of training, microenterprise, and gender-inclusive employment initiatives is needed. This will support sustainable coastal tourism and livelihood diversification.

Conclusion

With a focus on the functions of marine fisheries, coastal tourism, shipbuilding, and renewable energy inside the nation's Exclusive Economic Zone (EEZ), this study has explored the opportunities and difficulties of creating a sustainable blue economy in Bangladesh. The blue economy's portion of GDP is mostly derived from marine fisheries, tourism, and institutional quality, according to the econometric analysis. This highlights the significance of robust governance, efficient coordination and data driven resource management. Positive but minor effects are also shown in shipbuilding and renewable energy. It highlights their developing potential and the need for focused funding and technological development.All of the results point to the enormous unrealized potential of Bangladesh's blue economy to boost inclusive economic growth along with creating jobs and improve food and energy security. However, overcoming structural flaws including poor infrastructure, limited research capacity, poor institutional coordination and a lack of technical innovation is crucial to achieving this potential. In order to avoid overexploitation and guarantee intergenerational justice, the report emphasizes that environmental sustainability and resource conservation must continue to be at the forefront of policy initiatives.The findings highlight the necessity of an inter-ministerial Blue Economy Coordination Council. It integrated Marine Spatial Planning (MSP) framework from a policy standpoint in order to coordinate sectoral initiatives in the areas of environment, energy, tourism and fisheries. Enhancing community involvement in

coastal governance and research infrastructure, and growing public-private partnerships (PPP) in marine biotechnology and renewable energy are also necessary. Additionally, funding for marine education and capacity building will support innovation-led growth by producing a trained labor force for new ocean-based sectors. This study admits some shortcomings in spite of its contributions. Because it mostly uses secondary data, it is unable to use field-level evidence to capture sectoral linkages or the dynamics of marine resource governance in real time. Deeper comparison study was hampered by the lack of consistent indicators and data disparities between national and foreign sources. Therefore, quantitative and field-based studies on sector-specific productivity, environmental trade-offs, and livelihood outcomes should be the focus of future study. Using panel models or spatial econometrics with disaggregated regional data could improve comprehension of causality and the efficacy of policies. To sum up, the blue economy is a revolutionary new direction for Bangladesh's long-term growth. In the Bay of Bengal region, it may be a pillar for growth that is equitable, climate resilient, and driven by innovation if it is backed by well-thought-out policies, scientific research, and inclusive governance. This study was unable to adequately capture the dynamics of marine resource governance and consumption in real time since it mostly relied on secondary data sources. The absence of field-based primary data and stakeholder involvement restricted the scope of empirical validation. Sectoral data disparities between government and international sources further hindered comparative research.

A quantitative assessment of the economic contributions made by each sector of the blue economy to Bangladesh's GDP should be the main goal of future study. The possibility of implementing renewable marine energy technologies, such as solar, wind, and tidal power, in coastal regions also requires feasibility studies. Lastly, comparative policy evaluations that look at how well marine spatial planning (MSP) frameworks are implemented in Bangladesh. Moreover, the South Asian nations would offer insightful information for enhancing regional collaboration and promoting sustainable ocean governance.

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