Marine Economics and Management

Evaluating blue economy strategies of Bangladesh: a Kellogg Foundation logic model approach

Naurin Nur Sabah
Department of Environmental Science & Management, North South University, Dhaka, Bangladesh, and
Sakif Al Ehsan Khan
Department of Political Science & Sociology (PSS), North South University, Dhaka, Bangladesh

Received 1 September 2024
Revised 29 October 2024
6 March 2025
Accepted 6 April 2025

Abstract

Purpose – This paper aims to explore the current scenario and potential for the development of Bangladesh's blue economy, focusing on key sectors such as fisheries, maritime transport, renewable energy, minerals and tourism.

Design/methodology/approach – This research employs the Kellogg Foundation logic model to methodically examine the connections among resource inputs, activities that are planned and intended results in these industries.

Findings – According to the findings, fostering sustainable economic growth while preserving environmental integrity requires smart infrastructure, technology and human capital investments. A longer list of benefits, such as improved livelihoods, economic resilience and environmental sustainability, is ensured by capacity-building programs and sustainable practices, as the study also emphasizes.

Originality/value – This paper argues for a balanced approach to resource utilization that is in line with both economic and environmental goals by providing a thorough evaluation of Bangladesh's blue economy initiatives. It also provides insightful information for policymakers and stakeholders. A strong framework for future policy formulation and strategic planning is provided by the research, which highlights the blue economy's potential for promoting sustainable development in Bangladesh.

Keywords Blue economy, Marine, Fisheries, Bangladesh, Tourism, Policy evaluation,
Contemporary marine policy analysis

Paper type Research article

1. Introduction

The term "blue economy" refers to a novel approach to describing the economic growth that has emerged between numerous island nations, especially small emerging states. To stimulate the production of their plentiful ocean and coastal resources, several of the most powerful and largest nations in the world, like China and the United States of America, are beginning to embrace the concept of the "blue economy." Eventually, the focus on the blue economy will pay off by making it possible for economic growth to coexist with environmental sustainability. Making appropriate use of natural resources urgently is required for sustainable development. The 21st-century blue economy is a replication of the

Conflict of interest statement: In this paper, no conflicts of interest are reported by the authors. This paper presents the authors' objective and unbiased analysis based on independently conducted research. The work reported in this paper was not influenced by any personal, financial or professional relationships.

Marine Economics and Management
Emerald Publishing Limited
2516-158X
DOI 10.1108/MAEM-09-2024-0015

fundamental concept of sustainability. The idea of sustainably generating economic value from the untapped potential of marine resources to improve food security, nutrition and health; reduce poverty; create jobs; increase trade and industrial profiles; preserve biodiversity and ecosystem health and uphold regional peace and security is promoted by the blue economy through innovative and sustainable solutions. The blue economy sees the oceans and seas as "development spaces" where bioprospecting, renewable energy production, marine transportation, resource extraction (including oil and mineral wealth), conservation and sustainable resource use are all incorporated into spatial planning concerns.

Blessed with the Bay of Bengal, Bangladesh is considered to be one of the promising nations in terms of elaborating on the strategies of a blue economy among South Asian countries. In 2012 and 2014, Bangladesh was granted entitlement to 118,813 km^2 in the Bay of Bengal. Its territorial waters were expanded by more than 30% due to favorable resolutions to disputes over its maritime boundaries with India and Myanmar. The decision was rendered on March 14, 2012, by the International Tribunal for the Law of the Sea in Germany regarding the delimitation dispute with Myanmar. The award assisted Bangladesh in establishing sovereign rights over the Bay of Bengal's living and non-living resources in the continental shelf beyond 200 nautical miles and the Exclusive Economic Zone (EEZ) within 200 nautical miles. Similarly, the July 7, 2014, judgment with India recognized Bangladesh's sovereign rights over all living and natural resources on the Continental Shelf, which reaches up to 354 nautical miles.

Bangladesh is getting the advantage of the Bay of Bengal, and although it has historically used the water for both domestic and international trade, there is still much to learn about the maritime sector and how to responsibly utilize marine resources. One of the most important things it has contributed to is the socioeconomic development of coastal nations. The initiatives and relevant stakeholders need to have a proper evaluation to accelerate the prompt of blue economy in Bangladesh. Bangladesh's past initiatives, which ignored the concepts of wider ocean resilience and environmental sustainability in favor of resource extraction and financial gain, contributed to the country's failure to successfully implement the blue economy. While there is a short-term advantage, overuse has led to resource depletion and, in certain circumstances, irrevocable changes to precious aquatic resources. Many prospects were unexplored as a result of management methods and a lack of technology.

This article particularly focuses on evaluating the blue economy initiatives of Bangladesh by applying the methodology of the Kellogg Foundation logic model. The model had been a pioneer in terms of addressing definite objectives and result-based management with the possible need for the identification of improvements in several sectors. Using a five-step framework, this paper evaluates the five most significant blue economy components of Bangladesh. Fisheries, maritime transport, renewable energy, minerals and tourism are the fundamentally selected components for Bangladesh for this article although there is a scope for adding further components for additional research.

2. Literature review

The blue economy, as defined by the European Commission, encompasses all economic activities directly connected to the oceans, seas and coasts. It includes a broad spectrum of interconnected well-established and growing industries. The source of this information is the European Union in 2018. The Earth's oceans, coastal areas and seas are the most extensive ecosystems on the globe, encompassing two-thirds of the Earth's surface. These ecosystems are crucial for the well-being of both the earth and human beings. Oceans serve as a crucial buffer against the impacts of climate change and also serve as habitats for a vast number of species, while also providing sustenance for over one billion individuals (Parletta, 2019). Oceans are crucial for the economic well-being of the majority of nations. Although oceans are a valuable component of our natural heritage, a mere 7% of the Earth's oceans have been thoroughly investigated. Given the worldwide megatrends of migration to coastal cities, population expansion, energy needs and climate change, the interaction between mankind and the oceans is becoming increasingly

intricate. Due to the fast rate of urbanization, climate change, population expansion and other land-related problems, global policy talks are gradually moving their focus toward the world's aquatic resources. When these resources are handled sustainably, there will be favorable economic and environmental consequences (as referenced in Alharthi and Hanif, 2020). The blue economy concept, as defined by the World Bank in 2017, aims to achieve economic growth, social inclusion and the preservation or enhancement of livelihoods while also guaranteeing the environmental sustainability of oceans and coastal areas. Essentially, it means separating the progress of socioeconomic growth in ocean-related sectors and activities from the harm caused to the environment and ecosystems. A crucial obstacle in the blue economy is the recognition that achieving sustainable management of ocean resources necessitates worldwide collaboration across nation-states and the public-private sectors. The blue economy encompasses commercial activity centered around the transfer of goods and services from rivers to oceans, with a strong emphasis on maintaining environmental sustainability. The economy diversifies beyond port sand terminals to encompass fishing, coastal tourism, transportation, renewable energy and marine biotechnology.

The term "blue economy" emerged from the United Nations Conference on Sustainable Development in 2012, which took place in Rio de Janeiro. The conference centered around two main themes: establishing a comprehensive structure for sustainable development and promoting the growth of the green economy. Nevertheless, the coastal and emerging nations took a leading role and vigorously advocated for the blue economy right from the outset of the conference. The concept of the blue economy was officially acknowledged and incorporated into the United Nations Conference on Environment and Development process, the Johannesburg Plan of implementation, and confirmed in the outcome document of the Rio + 20 Conference. Although the phrase "blue economy" is commonly used in worldwide law and policy texts, there is currently no widely agreed-upon description for it. The term "blue economy", as defined by the World Bank report, pertains to the responsible utilization of oceanic resources to foster economic development, enhance living standards, generate employment opportunities and maintain the health of marine ecosystems (World Bank and United Nations Department of Economic and Social Affairs, 2017). Ocean economy encompasses economic activities that occur in or are related to the oceans, including the utilization of ocean resources and the provision of goods and services. These activities contribute to economic growth, as well as the well-being of society, culture and the environment (Roberts, 2016). The objectives of the blue economy encompass enhancing human welfare and promoting fairness, while substantially mitigating environmental hazards and ecological scarcities. It also advocates for low-carbon practices, resource efficiency and social inclusivity (Smith-Godfrey, 2016).

In recent years, the study of Oceanic histories has sparked a thought-provoking philosophical discussion among historians. Bose (2009) characterizes the Indian Ocean as a complex network of economic and cultural connections, with fluid boundaries both internally and externally. He argues that port cities played a crucial role in facilitating interchange and interaction. These port cities can also be seen as important hubs that played a crucial role in connecting land and sea in Asia through maritime networks throughout the history of the Indian Ocean. The rivers of Asia, which extended far inland, were the origins of civilizations (Wink, 2002, p. 2). Ducruet *et al*. (2018) analyze the network structures formed at the ocean and/or land interface, focusing on the interconnectedness between ports and cities. They emphasize the significance of "network nodes" in understanding the link between marine strategies and urban networks. The authors highlight the concept of a "system of cities" to illustrate the interconnectedness of cities worldwide and how these horizontal links, which are successful and parallel, challenge traditional hierarchical patterns of connectivity between different locations.

"The productive economic sectors of the blue economy area unit are emphasized and regarded as harnessing the total utilization of ocean-based resources primarily within the current maritime boundary of Bangladesh. Suppose this ocean mostly based on resource area units managed by correctly coming up with an inter-sectoral coordination of public-private

partnership and investment. In that case, it'll generate a sturdy foundation for earnings and economic advantages below the approach of the blue economy. On the opposite hand, if marine primarily based financial resources with potential sectors are managed and ruled by principles of diversity protection, conservation and efforts for care area units tangled with a vision of scientific understanding, the blue economy will produce some opportunities to resolve the problems of climate changes at the coastal areas. It would additionally generate jobs, convey tangible changes within the lives and keep off the immeasurable folks living on the outline, in islands and across Bangladesh" (Islam *et al*., 2018). Furthermore, Bangladesh has only described the political dynamics involved in discussing the economic possibilities of the blue economy. In addition to the mineral potential, there are numerous sectors in which participation is possible with respect to the blue economy. The prospective sectors encompass shipping, fishing, blue tourism, power generation and other related areas. Nevertheless, in order to comprehensively understand the entire environment, the country must also develop individual work plans and strategies for each prospective industry that may arise from a blue economic perspective.

2.1 Comparison of Bangladesh's blue economy strategies with other South Asian nations

The blue economy is a key factor in the regional cooperation and sustainable development of the countries that make up the South Asian Association for Regional Cooperation (SAARC) in several areas. For example, India is using its strategic maritime location and long 7,516-km coastline to boost its economy. The country's ocean economy generates about $200bn a year, or 4% of its gross domestic product (GDP). This covers industries like shipping, fishing and coastal tourism – fisheries, in particular, provide a living for 14 million people. Bangladesh is working to improve its marine fisheries, which yield roughly 0.6 million tons of fish annually and sustain 2 million people in the coastal regions. Bangladesh's Bay of Bengal coastline stretches for 710 kilometers (Mukherjee, 2018). The Maldives, a nation of 1,192 islands, is a well-known example of a nation where coastal tourism alone accounts for 80% of GDP. Owing to its strategically important port of Gwadar, which is a part of the China–Pakistan Economic Corridor and is expected to significantly increase economic activity and trade, Pakistan is experiencing growth in its blue economy. When taken as a whole, the SAARC countries' blue economies are expected to expand due to investments in environmentally friendly maritime operations and the construction of infrastructure that supports international sustainable development objectives (Alharthi and Hanif, 2020).

The nations that make up the SAARC have formulated all-encompassing policies related to the blue economy in order to responsibly utilize their marine resources. For example, India has developed a draft National Blue Economy Policy that prioritizes sustainable development by means of coastal management, marine spatial planning and the growth of marine industries like aquaculture and marine biotechnology. In order to reduce carbon emissions and increase economic growth from marine resources, the policy outlines how to promote ocean energy sources that are renewable, like tidal and offshore wind (Government of India, 2020). To encourage economic activity along the coast and enhance trade efficiency, India is also moving forward with its Sagarmala Project, which focuses on port modernization, enhancing logistics and establishing special economic zones connected to port cities (Alharthi and Hanif, 2020). The Maldives, a nation that is primarily dependent on its marine environment, has developed strategies that incorporate climate resilience, fisheries and marine tourism into its national development agenda. The strategy seeks to manage and preserve marine biodiversity and coral reefs in a sustainable manner, which is important for the region's fisheries and tourism sectors. In order to improve food security and economic resilience, the National Fisheries Policy places a strong emphasis on the development of marine culture and sustainable fishing methods. Initiations such as the Indian Ocean Tuna Commission, which guarantee sustainable fishing methods and the preservation of marine ecosystems throughout the Indian Ocean and Bay of Bengal, demonstrate how important regional cooperation is (The World Bank, 2019).

Sri Lanka has been actively developing policies to take advantage of its abundant marine resources by implementing a broad blue economy plan. The "Vistas of Prosperity and Splendour" policy, which places a strong emphasis on sustainable ocean resource management with the goal of promoting a blue-green economy, serves as the main framework for this endeavor. The goal of this policy is to balance environmental stewardship with economic growth by concentrating on ocean-based industries like fisheries, aquaculture, renewable energy and maritime tourism. Adopting a Marine Spatial Plan, which is intended to coordinate the use of marine resources to prevent conflicts and ensure sustainability, is a key component of this strategy. seeks to balance economic gains with conservation objectives by advancing human-centric design and establishing accountability (Ministry of Environment, 2012). With the help of its blue economy roadmap, Bangladesh has made great progress in developing its maritime industries, especially offshore energy, fisheries and marine tourism. The roadmap stresses the significance of defining maritime borders to protect rights over its EEZ and contains strategies for the sustainable management of marine resources. By establishing rules for environmentally friendly fishing methods and expanding the potential for deep-sea fishing, the National Marine Fisheries Management Plan contributes even more to these initiatives. In order to support economic growth and regional connectivity, Bangladesh is also encouraging foreign investment in port development and maritime infrastructure (Alharthi and Hanif, 2020).

Due to their lack of direct access to the ocean, the landlocked SAARC nations of Afghanistan, Bhutan and Nepal face significant obstacles when attempting to develop blue economy policies. These nations can still implement elements of the blue economy framework, such as encouraging inland fishing, aquaculture and environmentally friendly travel along rivers and lakes, that are related to sustainable freshwater and riverine management. With their abundant freshwater ecosystems, Bhutan and Nepal, for example, should investigate policies that promote the sustainable use of their water resources to boost regional economies and biodiversity preservation. Even though these countries are landlocked, the idea of a "blue economy" can encourage them to concentrate on the sustainable management of their aquatic resources and look into creative ways to collaborate and share resources with their coastal neighbors in order to gain from regional and global blue economy initiatives (Sakhuja, 2015). See Table 1 below.

Table 1. Comparison of Bangladesh's blue economy strategies with other South Asian nations

Country	Key strategies	Focus area
Bangladesh	Blue Economy Roadmap and National Marine Fisheries Management Plan	Offshore energy, fisheries, maritime infrastructure and EEZ management
Maldives	National Fisheries Policy and Climate Resilience Strategies	Sustainable fisheries, marine biodiversity conservation and tourism
Pakistan	Gwadar Port Development under China-Pakistan Economic Corridor (CPEC) and Maritime Trade Expansion	Trade, port development, shipping and fisheries
Afghanistan	Landlocked terrain limits the scope, but riverine management strategies could be implemented	Sustainable water resource management and cross border collaboration
Bhutan and Nepal	Sustainable freshwater management policies and Eco tourism development	Inland fisheries, riverine ecosystem conservation and biodiversity preservation
Sri Lanka	Vistas of Prosperity and Splendour Policy and Marine Spatial Plan	Ocean resource management, fisheries, aquaculture and renewable energy
India	Draft National Blue Economy Policy and Sagarmala project	Port modernization, renewable ocean energy, fisheries and marine biotechnology

Source(s): Authors' compilation based on Alharthi and Hanif (2020), Government of India (2020), The World Bank (2019) and Sakhuja (2015)

3. Methodology

3.1 Considered key factors of Bangladesh's blue economy

3.1.1 Fisheries. The Bangladeshi fisheries sector's blue economy initiative makes use of a number of crucial inputs, including financial support from the government, international organizations and private sector investments, as well as human resources like policy analysts, marine biologists and experts in fisheries and marine biology. Utilizing sophisticated instruments for stock assessment and refrigerated storage facilities, as well as having access to extensive data on fish stocks, fishing methods and global best practices, the initiative has carried out a number of initiatives to support sustainable fisheries. According to Mahmud *et al*. (2020), these activities include the use of 250 industrial steel body trawlers and approximately 70,000 artisanal mechanized and non-mechanized wooden boats for fishing; the temporary fishing bans that are imposed to allow for the breeding of important species such as Hilsa; the gradual installation of vessel tracking and monitoring systems (VTMS) in fishing vessels and the creation of Ecologically Critical Areas (ECA) to preserve biodiversity and critical habitats. Fishing ban compliance rates have increased, more fish have been caught, more local fishermen are employed and fish population monitoring reports have been improved as a result. As a result, there is now more fish available in neighborhood markets, fishermen make more money, fish species are recruited and reproduce more successfully, and the amount of illegal, unreported and unregulated (IUU) fishing has decreased. Long-term effects include the development of both direct and indirect employment opportunities, increased local community awareness of sustainable fishing methods and efficient monitoring and control of fishing operations, which support the preservation of vital marine habitats and biodiversity, thereby enhancing the general economic and social well-being of coastal communities and guaranteeing the fishing industry's long-term viability in Bangladesh (Mahmud *et al*., 2020).

3.1.2 Maritime transport. Since seaborne routes account for over 90% of Bangladesh's external freight trade, maritime transport is a key component of the country's blue economy. This industry contributes significantly to wealth creation, international trade facilitation and the creation of a diverse range of jobs on land and at sea. Bangladesh has a long history of maritime navigation and a strategic location, but its merchant fleet is small – as of 2018, there were only 42 registered ships – and cannot keep up with the nation's expanding trade demands. As a result, Bangladesh has been shelling out billions of dollars a year to international shipping companies in freight charges. Bangladesh needs to build strong coastal and regional feeder services, encourage local shipping companies and increase its fleet size in order to meet the expected growth in trade. By complying with international regulatory frameworks and improving the effectiveness of its trade infrastructure, Bangladesh will be able to retain more economic value domestically, lessen its reliance on foreign operators and promote long-term sustainable development through the strengthening of its maritime transport sector (Hossain, 2006; Sinha, 2023).

3.1.3 Renewable energy. Bangladesh's future energy strategy must incorporate renewable energy since it provides a means of achieving sustainable development and lowering dependency on fossil fuels. Bangladesh is ideally situated to take advantage of marine-based renewable energy sources like wind, wave and tidal power because of its long coastline. These resources offer a low-carbon substitute for conventional energy sources, which can make a substantial contribution to the nation's energy mix. Furthermore, the construction of renewable energy infrastructure can help coastal communities diversify their economies and lessen the effects of declining fisheries by generating new job opportunities. Bangladesh will need to put supportive policies into place, offer financial incentives and make investments in the infrastructure required to get past technical obstacles and encourage the expansion of this crucial industry if it is to fully realize the potential of renewable energy (Hossain, 2006).

3.1.4 Tourism. Given that tourism, especially coastal tourism, contributes significantly to the global GDP and employment, it is an essential component of the blue economy. With its long coastline, Bangladesh stands to gain economically greatly from coastal tourism, which encompasses beach activities, activities by the sea and nautical boating. In 150 countries

worldwide, tourism is one of the top export industries. It is essential to foreign exchange earnings, particularly for Least Developed Countries. By integrating communities in the tourism value chain, sustainable tourism can help Bangladesh reduce poverty, generate new jobs and strengthen the local economy. This industry has enormous growth potential, offering chances to expand marina infrastructure, water sports and cruise tourism. But in order to fully reap these rewards, the private sector must be involved, infrastructure must be invested in and financing for sustainable practices must be available. Bangladesh can take advantage of its natural coastal assets to drive economic growth, create jobs and raise its profile as a global tourism destination by incorporating tourism as a key component of its blue economy strategy (Nur Nobi and Majumder, 2019).

3.1.5 Minerals. Across a 250 km coastal belt, valuable heavy minerals like rutile, ilmenite and zircon have been discovered in Bangladesh's coastal sands. With the increasing demand for marine minerals worldwide and the potential for economic growth in this sector, the exploitation and mining of marine minerals present a significant opportunity for Bangladesh's blue economy. The marine mineral mining sector is expected to experience significant growth, with estimates stating that by 2020, five percent of the world's minerals – including cobalt, copper and zinc – may originate from the ocean floor. By 2030, this percentage is expected to increase to ten percent. It is anticipated that this industry will generate up to €10bn in revenue by 2030, having grown from negligible amounts to €5bn over the previous ten years. The discovery of valuable heavy minerals in Bangladesh's coastal sands, such as zircon, rutile and ilmenite, offers a rare chance to boost industrial growth in sectors like glass, ceramics and welding electrodes. If these resources are used wisely, the nation's industrial capacity could be increased and local communities could benefit from the creation of jobs. As a result, including mineral extraction in Bangladesh's blue economy plan may spur significant economic expansion and open up fresh avenues for sustainable growth (UNB, 2023)

3.2 Present scenario of Bangladesh in terms of blue economy

3.2.1 Fisheries. Bangladesh's GDP benefited from the fisheries industry to the extent of about 3.57% in 2022. This industry continues to be a pillar of the national economy, providing jobs for about 18 million people, or 11% of the nation's total population. Figure 1 shows the contribution of different ocean economy sectors to Bangladesh's GDP in 2022. In 2022, fisheries accounted for a substantial portion of the total fish production, which was estimated to be 4.6 million metric tons. Due to the increased demand for shrimp and other seafood

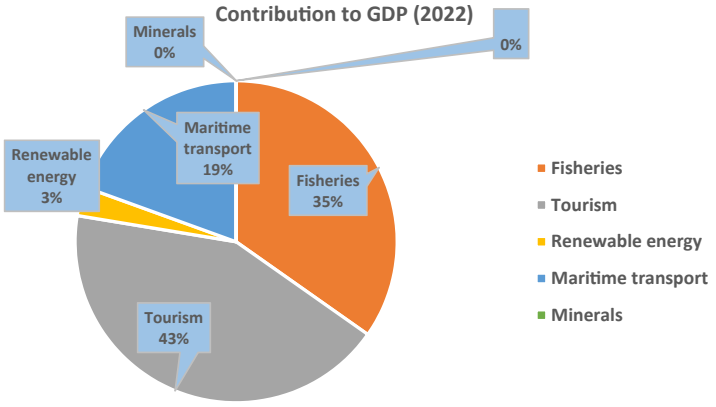

Figure 1. Pie chart of contribution of ocean economy in Bangladesh (2022). Source: Compiled by the author using data from FAO (2022), Noman (2024) and Das *et al*. (2024)

products worldwide, the industry continues to perform well in exports, bringing in about $500m a year (FAO, 2022)

3.2.2 Maritime transport. Bangladesh's economy depends heavily on the maritime transportation industry, which will account for 2% of GDP in 2022. Over 90% of the nation's seaborne trade passes through the Port of Chittagong, which has seen a steady increase in traffic, with an annual trade volume of about 80 million tons. The growth of maritime trade has been aided by the development and expansion of ports such as Chittagong and Mongla. In the upcoming years, it is anticipated that the government's continuous investments in enhancing port infrastructure and growing shipping services will further boost this sector's economic contribution (Noman, 2024).

3.2.3 Minerals. Bangladesh's future economic growth can be significantly aided by the mineral sector, especially with regard to marine-based minerals, which is still in its infancy. Exploration of gas and mineral resources in the Bay of Bengal has shown promising potential, despite the fact that marine minerals currently contribute very little directly to GDP. The sector's economic significance is anticipated to rise in the upcoming years due to the discovery of gas fields and other mineral resources within Bangladesh's EEZ. Specific GDP contribution estimates for marine minerals are not yet available, but as long as exploration and technological advancements continue, the industry is expected to grow (Noman, 2024)

3.2.4 Tourism. In 2022, Bangladesh's GDP benefited from the coastal and marine tourism industry to the tune of about 4.4%. Travel hotspots like Cox's Bazar, the Sundarbans and St. Martin's Island continue to be well-liked by both local and foreign visitors. Over $2bn was made in 2022 by the tourism industry, indicating rising interest in Bangladesh's distinctive marine and coastal attractions (Islam, 2024). Sustainable tourism practices have been actively promoted by the government to ensure that this industry thrives while protecting the nation's natural resources.

3.2.5 Renewable energy. A growing industry within Bangladesh's blue economy is renewable energy, specifically offshore wind and solar power. Relatively speaking, renewable energy's 0.3% GDP contribution in 2022 was low. But in order to boost the proportion of renewable energy in the country's energy mix, the government has set lofty goals. Bangladesh offers a lot of coastlines, which makes it a prime location for offshore wind farms, which have the potential to grow into one of the world's largest sources of clean energy. In the upcoming years, it is anticipated that the continued investments in renewable energy infrastructure, bolstered by global collaborations, will propel expansion in this domain and make a greater economic impact (Das *et al*., 2024)

3.3 Kellogg Foundation model

The overall analytical framework of the study is illustrated in Figure 2. The Kellogg Foundation logic model is used in the development, implementation and evaluation of projects and programs. The model, which has its roots in the 1930s W.K. Kellogg Foundation, is a prominent American philanthropic organization that assists organizations in articulating and visualizing the goals of their programs. According to W.K. Kellogg Foundation (2004), it offers a methodical approach to program planning and evaluation by delineating the logical progression from inputs and activities to outputs, outcomes and impacts.

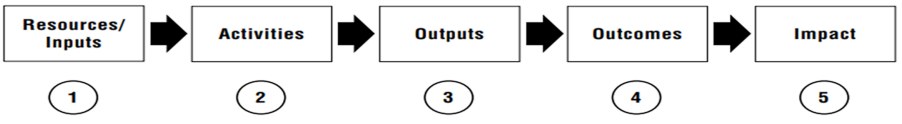

Figure 2. Kellogg Foundation logic model applied to Bangladesh's blue economy Source: Adapted from Kellogg (2004) and prepared by the authors

Origin and goals: The Kellogg Foundation developed the logic model as a result of its attempts to increase the efficiency of its programmatic and grant-making activities. It was created to help organizations define the objectives, methods and resources of their programs in order to make sure that interventions are well-organized and have a clear route to reaching intended results. The model is based on results-based management and systems thinking concepts, which highlight the significance of comprehending the connections between various program elements and how they contribute to overall success (W.K. Kellogg Foundation, 2004).

The following are the parts of the logic model:

Inputs: The assets, investments and resources needed to carry out the program. This covers resources including money, people, supplies and collaborations.

Activities: The particular methods, plans and fixes applied while utilizing the inputs. These are the activities and procedures that advance the program.

Outputs: The finished goods or deliverables that result directly from program activities. A tangible and quantifiable output would be the quantity of workshops conducted or materials given out.

Outcomes: The program's outputs' immediate and long-term impacts. Results show how the target population's knowledge, attitudes, abilities or behaviors have changed.

Impacts: The program's overall, long-term effects and advantages. According to W.K. Kellogg Foundation (2004), impacts are the more significant changes that come about as a result of reaching the intended goals, such as advancements in economic development or community health.

Governmental bodies, non-profits and other organizations frequently use this model to organize, oversee and assess their programs. Stakeholders can use it to evaluate the efficacy of interventions, align activities with desired outcomes and define program goals. The model promotes continuous improvement and accountability by offering a clear framework for comprehending how resources and actions lead to outcomes. A useful tool for program planning and assessment is the Kellogg Foundation logic model, which provides an organized method for converting resources and activities into significant effects. It helps companies make sure that their activities are strategically coordinated and efficiently run, which eventually increases their ability to fulfill their objectives (Kellogg, 2004).

The study employed the use of the Kellogg Foundation logic model, which is an organized and graphic approach to communicate and show the linkages between the resources required to run a program (Kellogg, 2004), the schedule of activities and the changes or outcomes the study aims to achieve.

This study employed the Kellogg Foundation logic model to comprehensively assess the Bangladesh blue economy, considering five key components: fisheries, renewable energy, tourism, minerals and maritime transport. This framework provided a systematic approach for mapping out the intricate relationships between resource inputs, planned activities and anticipated outcomes.

By identifying the specific resources required for each blue economy sector, the study delved into the necessary human capital, financial investments, technological advancements and information systems. Subsequently, the analysis outlined key activities to be undertaken within each sector, linking them to measurable outputs such as policy development, infrastructure improvements and capacity-building initiatives. The study further explored the causal pathways between these outputs and desired outcomes, focusing on changes in the behavior, knowledge, skills and overall well-being of stakeholders. Ultimately, the research traced the long-term impacts of blue economy initiatives, projecting economic, environmental and social impacts over a long period.

4. Data analysis and discussion

Fisheries: Table 2 summarizes the inputs, activities, outputs, outcomes and impacts of the fisheries sector under Bangladesh's blue economy initiative. The blue economy initiative in Bangladesh's fisheries sector leverages a variety of key inputs, including human resources

Table 2. Logic model analysis of the fisheries sector in Bangladesh

Key factor	Bangladesh Input	Activities	Outputs	Outcomes	Impact
Fisheries	*Human resources*: Marine biologists, fisheries experts, policy analysts and local fishing communities *Financial resources*: Funding from the government, international organizations and private sector investments *Information resources*: Data on fish stocks, fishing practices, economic contributions of fisheries and international best practices *Technological resources*: Tools for stock assessment and refrigerated storage facilities	Approximately 250 industrial steel body trawlers and 70,000 artisanal mechanized and non-mechanized wooden boats are used for fishing (Mahmud *et al*., 2020) Temporary fishing prohibitions enforced for specific times of the year on fish species, particularly Hilsa Installation of vessel tracking and monitoring system (VTMS) with satellite communication links in fishing vessels in phases to monitor and control Creation of ecologically critical areas (ECA) in order to preserve biodiversity and important habitats (Sajal, 2018)	Increased volume of fish caught and employment generated for local fishermen. Rates of adherence to the prohibitions and reports on fish population monitoring Reports on fishing regulations compliance are also provided, along with real-time data on vessel locations and activities. Plans for management and conservation are put into action	More fish available in neighborhood markets and more money coming in for fishermen and their families. Hilsa and other fish species' recruitment and breeding success have increased. Reduction of unreported, unregulated, and illicit fishing (IUU). Preservation of marine biodiversity and sustainable fisheries	Possibilities for both direct and indirect employment created in the processing, fishing and associated industries. Enhanced understanding of the value of conservation and sustainable fishing methods among the local populace. Reducing the use of harmful fishing techniques, maintaining important marine habitats and safeguarding biodiversity are all made possible by effective monitoring and control of fishing activities. Reduced lead times and more effective shipping practices all help to cut emissions and the carbon footprint

Source(s): Authors' compilation based on Mahmud *et al*. (2020) and Sajal (2018)

such as marine biologists, fisheries experts, policy analysts and local fishing communities, as well as financial support from the government, international organizations and private sector investments. With access to comprehensive data on fish stocks, fishing practices and international best practices and equipped with advanced tools for stock assessment and refrigerated storage facilities, the initiative has implemented several activities to promote sustainable fisheries. These activities include the use of about 70,000 artisanal mechanized and non-mechanized wooden boats and 250 industrial steel body trawlers for fishing (Mahmud *et al*., 2020), the imposition of temporary fishing bans to allow for the breeding of key species

like Hilsa, the phased installation of vessel tracking and monitoring systems (VTMS) in fishing vessels and the establishment of ECA to maintain critical habitats and biodiversity. As a result, there has been an increase in the volume of fish caught and employment for local fishermen, along with higher compliance rates with fishing bans and enhanced monitoring reports on fish populations. This has led to improved availability of fish in local markets, higher incomes for fishermen, increased breeding success and recruitment of fish species and a reduction in IUU fishing. The long-term impacts include the creation of direct and indirect employment opportunities, heightened awareness among local communities about sustainable fishing practices, an effective monitoring and control of fishing activities, which help preserve critical marine habitats and protect biodiversity, thereby contributing to the overall economic and social upliftment of coastal communities and ensuring the long-term viability of the fishing industry in Bangladesh.

Maritime transport: The maritime transport industry in Bangladesh is essential to the country's blue economy initiative, which is defined by a number of important activities as well as the results and effects that follow. The nation has made investments in the growth and support of maritime services, including the education of maritime professionals and the improvement of the capacities of enterprises involved in the maritime industry. This has greatly boosted the country's economy by producing a trained labor force and a thriving maritime services industry. With the help of government investments and incentives, the local shipping fleet has grown, resulting in a greater number of merchant ships registered in Bangladesh. This has decreased the country's dependency on foreign shipping and kept significant freight costs within its borders. Agreements with surrounding nations have strengthened coastal shipping and feeder services, increasing regional connectivity and increasing the effectiveness of maritime transportation. Furthermore, shorter lead times for imports and exports have resulted from the modernization of seaports, which includes the growth of deep-sea ports at Matarbari and Payra as well as the extension of the ports in Chittagong and Mongla. Significant social, economic and environmental benefits have resulted from these activities, including the creation of jobs, increased trade volumes and environmentally friendly maritime practices. By strategically focusing on these initiatives, Bangladesh is able to secure a sustainable and prosperous maritime future in addition to meeting its increasing trade demands. Table 3

Renewable energy: Through its offshore oil and gas exploration efforts, Bangladesh has improved the identification and possible development of new oil and gas fields through surveys and exploratory drilling. Better data sharing and monitoring procedures are being fostered by public-private sector collaboration. Traditional methods of producing sea salt along the coast of Cox's Bazar have been modernized with mechanical equipment and cooperative formations, improving economic returns for local communities and increasing production (Hossain, 2006). Government incentives are being used to promote the development of marine-based renewable energy, with a particular emphasis on offshore wind farms and tidal energy, in an effort to draw private investment. Significant results from these efforts include improved data collection, more energy production and improved financial stability for regional farmers. Enhanced national energy security, increased productivity for salt producers and a varied energy portfolio supporting the national grid are the results. The long-term effects are complex and include raising GDP contributions, improving living standards and creating jobs, contributing to economic growth and promoting environmental sustainability by lowering carbon emissions and managing resources more wisely (see Table 4).

Tourism: To get the most of Bangladesh's natural coastal resources and improve the traveler experience, the country is strategically developing marine and coastal tourism. The development and upkeep of well-known beaches like Kuakata and Cox's Bazar, along with the building of lodging facilities like restaurants and hotels, are important undertakings. The construction and maintenance of pleasure boats and yachts, as well as the introduction of recreational water sports like jet skiing, parasailing and snorkeling, are expanding the range of tourism options. In order to facilitate boating and yachting activities, marina ports are being developed, which will improve the overall tourism experience (Nur Nobi and Majumder,

Table 3. Logic model analysis of the maritime transport sector in Bangladesh

Key factor	Bangladesh Input	Activities	Outputs	Outcomes	Impact
Maritime transport	*Human Resources*: Maritime professionals, port workers, shipping company employees, educators in marine academies *Financial resources*: Government funding, private sector investments, international loans/grants *Information resources*: Data on trade volumes, shipping routes and port capacities *Technological resources*: Vessel tracking systems and modern freight management technology	Construction of new deep-water ports at Matarbari and Payra equipped with cutting-edge handling machinery to handle growing trade and commerce (Sinha, 2023). Incentives and assistance for regional shipping firms to raise the quantity of merchant ships registered in Bangladesh. Establishing agreements with surrounding nations and medium-sized ships to facilitate feeder services and coastal shipping	A rise in the number of maritime professionals and improved services offered by companies involved in the maritime industry. An increase in investment in the regional shipping sector is reflected in the rise in the number of merchant ships registered in Bangladesh. Signed agreements pertaining to coastal shipping foster greater regional cooperation	Improved maritime education and training, resulting in a workforce with specialized knowledge. Reduction in dependency on foreign shipping companies, retaining freight costs within the country. Improved trade ties with surrounding nations	Increased employment opportunities and economic activity will raise living standards in coastal communities. Substantial increase in trade volumes and effective maritime transportation contribute significantly to GDP. Reduced lead times and more effective shipping practices all help to cut emissions and the carbon footprint

Source(s): Authors' compilation based on Sinha (2023)

2019). Cruise tourism is also being stimulated by the promotion of small cruise ships for island-hopping tours and by large-scale port infrastructure investments at strategic locations. Significant results are being produced by these efforts, including an increase in visitor arrivals, improved visitor experiences and improved port infrastructure. Increased tourism income, stronger local economies and the creation of jobs are the results. The long-term effects are complex and include raising GDP contributions, improving living standards and creating jobs, social benefits and environmental sustainability through the use of eco-friendly tourism practices. The economy and local communities Bangladesh stand to gain from this strategic approach, which puts the country's marine and coastal tourism industry in a position for sustainable growth (see Table 5).

Minerals: Exploration and mining of coastal and submerged minerals are essential parts of Bangladesh's blue economy plan. Within Bangladesh's EEZ, the main targets of underwater mining operations are polymetallic nodules, cobalt crusts and massive sulphide deposits. Investments in cutting-edge extraction methods and involvement in international projects overseen by the International Seabed Authority supplement these efforts. Concurrently, valuable heavy mineral sands are the focus of aggregate mining along the coastal belt from

Table 4. Logic model analysis of the renewable energy sector in Bangladesh

Key factor	Bangladesh Input	Activities	Outputs	Outcomes	Impact
Renewable Energy	*Human resources:* Marine engineers, energy experts, geologists, policy analysts and local communities *Financial resources:* Government funding, international grants and private sector investments *Information resources*: Geological data and renewable energy potential assessments *Technological resources*: Drilling rigs, mechanical equipment for salt production, wind turbines and wave energy converters	Exploration of offshore oil and gas in Kutubdia. Traditional salt farming along the coast of Cox's Bazar produces sea salt (Hossain, 2006). Investigating ocean thermal energy conversion (OTEC) and tidal energy. To stimulate private investment, the government may also offer grants, subsidies, and tax credits	More data and joint initiatives involving the public and private sectors. Creation of collaborations for salt farmers. Increased production of electricity from renewable marine sources and the provision of incentives	Increased self-sufficiency and national security in terms of energy. Higher living standards for communities that farm salt. The development of different job opportunities for maritime communities	Substantial contributions from oil and gas revenues to the national GDP. Improved access to clean energy and increased energy security. Sustainable methods for growing salt that lessen their impact on the environment

Source(s): Authors' compilation based on Das *et al*. (2024)

Patenga to Teknaf. Minerals like garnet, rutile, zircon and ilmenite are mined and sold to support a variety of industrial sectors, such as paper, glass, chemicals, ceramics and welding electrodes. In addition to increasing mineral production, the development of mineral extraction industries in coastal areas creates a large number of job opportunities for the surrounding community (Gazi *et al.*, 2019). Significant results are produced by these activities, such as the amount of minerals extracted and the number of industries that are founded. Increased mineral production, industrial expansion and job creation are the results. In the end, there are a variety of effects, including social gains from higher living standards and job creation, environmental sustainability from the use of eco-friendly mining techniques and economic growth from higher GDP contributions. With this calculated move, Bangladesh is better positioned to capitalize on the potential of its coastal and marine mineral resources, enhancing the lives of its citizens and promoting sustainable economic growth (see Table 6).

5. Policy recommendations for strengthening the marine economy in Bangladesh

Sustainable fisheries management.

(1) Implement strict monitoring and enforcement of fishing quotas to prevent overfishing;

(2) Promote community-based fisheries management to empower local fishermen and

Table 5. Logic model analysis of the tourism sector in Bangladesh

Key factor	Bangladesh Input	Activities	Outputs	Outcomes	Impact
Tourism	*Human resources:* Tourism experts, local communities and hospitality staff *Financial resources*: Government funding and private sector investments *Information resources*: Tourism data, best practices in sustainable tourism and market trends *Technological resources:* Infrastructure development tools, water sports equipment and marina construction materials	Creation and preservation of well-known beaches (like Kuakata and Cox's Bazar) and the surrounding tourism infrastructure. Creation marina ports and supporting infrastructure for boating and yachting (Nur Nobi and Majumder, 2019). Examples of these ports are Chittagong and Mongla. Promotion of small cruise ships for visits to Bangladesh's coastal islands	An increase in the number of visitors to beach resorts. Several marina ports have been developed, and pleasure boats and yachts are built and maintained. Sustainable business models are put into place and port infrastructure is upgraded	Increased numbers of visitors and income from beach-related travel. Increased employment in the marina and water sports industries in the area. Improved infrastructure and amenities at ports	Increased revenue for local companies that cater to tourists. Improved community involvement and superior services for both residents and visitors. Encouragement of environmentally responsible boating and water sports

Source(s): Authors' compilation based on Nur Nobi and Majumder (2019)

(3) Expand the use of marine spatial planning to protect breeding zones.

Marine-based renewable energy.

(1) Invest in offshore wind and tidal energy projects to diversify energy sources and

(2) Provide incentives for private sector investment in marine renewable energy.

Blue tourism development.

(1) Establish eco-friendly coastal tourism infrastructure while preserving biodiversity.

6. Conclusion

Bangladesh benefits from easy access to a wealth of resources and new business prospects brought about by the Bay of Bengal and the coastal regions. The application of the Kellogg Foundation Logic Model to assess Bangladesh's blue economy yielded noteworthy results concerning the opportunities and interdependencies among key sectors, including fisheries, tourism, minerals, renewable energy and maritime transportation. Through strategic

Table 6. Logic model analysis of the minerals sector in Bangladesh

Key factor	Bangladesh Input	Activities	Outputs	Outcomes	Impact
Minerals	*Human resources:* Geologists, mining engineers, environmental scientists and local communities *Financial resources:* Government funding, private sector investments and international grants *Information resources*: Geological surveys, mineral exploration data and international best practices *Technological resources:* Advanced extraction and processing technologies and research and development tools	Investigation of massive sulphide deposits, cobalt crusts and polymetallic nodules in Bangladesh's Exclusive Economic Zone (EEZ). participation in international programs overseen by the International Seabed Authority (ISA) for seabed mining (UNB, 2023). Gazi *et al.* (2019) investigated and found heavy mineral sands along the coastal belt from Patenga to Teknaf. commercialization of minerals extracted for use in a variety of industries (e.g. paper, glass, ceramics, chemicals and welding electrodes)	The quantity of exploration missions, geological surveys, and licenses granted for seabed mining operations. Amount of minerals processed and sold, as well as the volume of heavy mineral sands extracted	Increased ability to extract minerals from the deep sea. Adherence to international laws governing seabed mining. Employment creation in the mining and processing sectors	Significant contribution of marine mineral resources to the GDP of the country. Increased living standards and the creation of jobs for the nearby communities affected by mining operations. Ecological extraction techniques guaranteeing negligible harm to the environment

Source(s): Authors' compilation based on Gazi *et al.* (2019) and UNB (2023)

investments in human capital, technological innovation and infrastructure development, it is possible to promote sustainable economic growth and maintain ecological balance, as demonstrated by the study's careful examination of resources, activities and outcomes. The study emphasizes the value of developing capacity and adopting sustainable practices. It also outlines the long-term benefits of these efforts, which include better livelihoods, increased economic resilience and improved environmental sustainability. Bangladesh is developing its blue economy more and more. Because of its rich biodiversity, the fisheries industry has the potential to grow significantly economically with modernization and sustainable management. As Bangladesh's maritime zone in the Bay of Bengal develops, more opportunities for marine trade and commerce will arise, which will lead to a boom in maritime transportation. Opportunities for economic diversification arise from the exploration of marine minerals, and if the tourism industry is developed sustainably, its distinctive natural and cultural resources can increase revenue and job opportunities. In order for Bangladesh to fully benefit from the blue economy concept, research activities must be encouraged in order to produce the knowledge and skilled labor needed to create national plans and policies.

7. Limitations and scopes for further research

In spite of providing a structured evaluation of different sectors of the blue economy strategies of Bangladesh, this article lacks the in-depth analysis due to the unavailability of primary data sources. This paper is heavily dependent on secondary datasets, which somehow hinders the accuracy and timeliness of the study. A comprehensive analysis can be further encouraged by conducting several surveys on each sector, followed by structured or semi-structured interviews with the stakeholders. Proper interdependencies can be further analyzed from this to incorporate the significance of policymakers, industrialists and local community. Also, the specification of successful case studies of blue economy practices can be rigorously added as a scope of future research. Future research can focus on a multidisciplinary approach including the narratives of marine biotechnology, coastal zone management, offshore aquaculture, economic evaluation and carbon sequestration markets. This would depict a larger picture of this emerging economy of Bangladesh. Impact assessment can be another scope of future research, which would possibly identify the governance and implementation gaps along with the pragmatic need of feasibility studies. Also, the scope of environmental and social sustainability research can be further investigated in terms of addressing the effectiveness of coastal protected areas and climate resilient practices for a long-term period. Trials of a community-led approach can be a practical study to focus on the impact of blue economy through the eyes of the masses. Based on the narrative of industrial revolution, the inclusion of artificial intelligence and big data in terms of resource management can be further assessed. Sustainable financing models can also be incorporated to achieve the sustainable development goal targets for Bangladesh. By addressing these focused areas, future research can come up with better and specific recommendations which would be handy for the policymakers.

References

Alharthi, M. and Hanif, I. (2020), "Impact of blue economy factors on economic growth in the SAARC countries", *Maritime Business Review*, Vol. 5 No. 3, pp. 253-269, doi: 10.1108/mabr-01-2020-0006.

Bose, S. (2009), *The Indian Ocean: A Hundred Horizons in the Age of Global Empire*, Harvard University Press.

Das, N.K., Chakrabartty, J., Dey, M., Gupta, A.K.S. and Matin, M.A. (2024), "Present energy scenario and future energy mix of Bangladesh", *Energy Strategy Reviews*, Vol. 32, 100576, doi: 10.1016/J.ESR.2020.100576.

Ducruet, C., Cuyala, S. and El Hosni, A. (2018), "Maritime networks as systems of cities: the long-term interdependencies between global shipping flows and urban development (1890-2010)", *Journal of Transport Geography*, Vol. 66, pp. 340-355, doi: 10.1016/j.jtrangeo.2017.10.019.

FAO (2022), *The State of World Fisheries and Aquaculture 2022*. doi: 10.4060/CC0461EN.

Gazi, M.Y., Tafhim, K.T., Ahmed, M.K. and Islam, M.A. (2019), "Investigation of heavy-mineral deposits using multispectral satellite imagery in the eastern coastal margin of Bangladesh", *Earth Sciences Malaysia (ESMY)*, Vol. 3 No. 2, pp. 16-22, doi: 10.26480/esmy.02.2019.16.22.

Government of India (2020), "India's blue economy: a policy framework", available at: https://incois.gov.in/documents/Blue_Economy_policy.pdf

Hossain, M.S. (2006), "Salt cultivation area and production rate in cox's bazar and samut... | download table", available at: https://www.researchgate.net/figure/Salt-cultivation-area-and-production-rate-in-Coxs-Bazar-and-Samut-Sakhon-coast_tbl1_234902979

Islam, M.S. (2024), "Blue economy, complex challenges: the future of marine tourism in Bangladesh", *Saffron Journal of Culture and Tourism Research*, Vol. 2024 No. 1, pp. 42-68.

Islam, M.K., Rahaman, M. and Ahmed, Z. (2018), "Blue economy of Bangladesh: opportunities and challenges for sustainable development", *Advances in Social Sciences Research Journal*, Vol. 5 No. 8, doi: 10.14738/assrj.58.4937.

Kellogg, W.K. (2004), *Using Logic Models to Bring Together Planning, Evaluation, and Action Logic Model Development Guide*, available at: www.wkkf.org

W.K. Kellogg Foundation (2004), Logic Model Development Guide, available at: https://www.wkkf.org

Mahmud, Y., Mazid, M.A., Rahman, M.A., Haldar, G.C., Ashraful, M., Phd, A. and Abul Bashar, M. (2020), *Hilsa Fisheries Research and Development in Bangladesh Contributors Bangladesh Fisheries Research Institute Ministry of Fisheries and Livestock*, available at: www.fri.gov.bd

Mukherjee, P. (2018), "SAARC in the Sea: harnessing regional cooperation through blue economy", *ICSS 2018 FACULTY OF SOCIAL SCIENCES*, available at: http://repository.kln.ac.lk/handle/123456789/19471

Noman, A.Al (2024), "(PDF) Blue economy in Bangladesh: prospects and challenges", available at: https://www.researchgate.net/publication/378204421_Blue_Economy_in_Bangladesh_Prospects_Challenges

Nur Nobi, M. and Majumder, M.A. (2019), "Coastal and marine tourism/eco-tourism in the future", *Journal of Ocean and Coastal Economics*, Vol. 6 No. 2, doi: 10.15351/2373-8456.1120.

Parletta, N. (2019), "Making the blue economy sustainable", available at: https://www.forbes.com/sites/natalieparletta/2019/06/21/making-the-blue-economy-a-sustainable-reality/#337b0b9826f8 (accessed 8 December 2019).

Roberts, J. (2016), "The blue economy progress on the development of the blue economy in Seychelles", *International Conference Centre*.

Sajal, I.A. (2018), "Managing ecologically critical areas in Bangladesh", *IUCN E-Journal*, Vol. 8, pp. 65-72.

Sakhuja, V. (2015), "Harnessing the blue economy", *Indian Foreign Affairs Journal*, Vol. 10 No. 1, pp. 39-49.

Sinha, M.S. (2023), "The development of the Matarbari port and its significance for the region – national maritime foundation", available at: https://maritimeindia.org/the-development-of-the-matarbari-port-and-its-significance-for-the-region/

Smith-Godfrey, S. (2016), "Defining the blue economy", *Maritime Affairs: Journal of the National Maritime Foundation of India*, Vol. 12 No. 1, pp. 58-64, doi: 10.1080/09733159.2016.1175131.

The World Bank (2019), "Maldives ventures into the blue economy Matarbari", available at: https://www.worldbank.org/en/news/feature/2019/07/11/maldives-ventures-into-the-tlueeconomy

UNB (2023), "Bangladesh participating in 28th council of international seabed authority in Jamaica | the business standard", available at: https://www.tbsnews.net/bangladesh/bangladesh-participating-28th-council-international-seabed-authority-jamaica-665566

Wink, A. (2002), "From the mediterranean to the Indian Ocean: medieval history in geographic perspective", *Comparative Studies in Society and History*, Vol. 44 No. 03, doi: 10.1017/s001041750200021x.

World Bank and United Nations Department of Economic and Social Affairs (2017), *The potential of the blue economy: increasing long-term benefits of the sustainable use of marine resources for small island developing states and coastal least developed countries*, World Bank, available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/523151496389684076

Corresponding author
Sakif Al Ehsan Khan can be contacted at: sakif.khan17@gmail.com