International Journal of Oceans and Oceanography
ISSN 0973-2667 Volume 20, Number 1 (2026), pp. 9-34

https://www.ripublication.com

A Systematic Review of the Blue Economy and Sustainable Development Goals in the Context of Bangladesh

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Abstract

The Blue Economy (BE) has emerged as a vital framework for linking sustainable use of ocean resources with inclusive economic growth, environmental stewardship, and social well-being. For Bangladesh, a maritime nation with vast ocean resources and a growing coastal population, the BE offers significant potential to accelerate progress toward the Sustainable Development Goals (SDGs). This paper presents a systematic review of existing academic and policy literature to examine how the BE contributes to SDG achievement in Bangladesh. Using a PRISMA-based approach, 76 relevant publications (2012-2025) were reviewed across databases including Scopus, Web of Science, and national repositories. The review identifies major thematic areas economic development, social inclusion, environmental sustainability, ocean governance-and maps their linkages to specific SDGs. Findings show that while fisheries and aquaculture dominate BE research, sectors such as renewable marine energy, biotechnology, and eco-tourism remain underexplored. Opportunities for Bangladesh lie in leveraging maritime boundary settlements, investing in ocean-based industries, and fostering regional cooperation in the Bay of Bengal. However, challenges persist in policy fragmentation, weak institutional coordination, overexploitation of marine resources, and climate vulnerability. The study concludes that a balanced, inclusive, and ecosystem-based BE strategy is essential for aligning national development priorities with the SDGs.

Keywords Blue economy **.** Sustainable Development Goals **.** Marine resources **.** Ocean governance

1 Introduction

The Blue Economy (BE), often described as the ocean or marine economy, has emerged globally as a key strategy for safeguarding oceans and aquatic resources [1]. The notion of BE emerged from the United Nations Conference on Sustainable Development (Rio+20) in 2012 [2]. Although widely used, the term lacks a clear definition and is often used interchangeably with ocean or marine economy [1]. The United Nations has broadly defined the Blue Economy as "an ocean economy that seeks to enhance human well-being and social equity while substantially reducing environmental risks and ecological scarcities" [3]. Building on this, the World Bank offers a more operational perspective, describing it as "the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems." [4]. The World Bank's framing underscores the multidimensional scope of the BE, encompassing sustainable fisheries, ecosystem health, and pollution prevention [1].

A stable Earth system is essential for human prosperity and for achieving sustainable development [1]. In Europe, significant research initiatives such as the **Marine Investment for the Blue Economy** and **H2Ocean** projects have driven advancements in **multi-use platforms** and **innovative production technologies** across diverse sectors, including aquaculture, marine renewable energy, tourism, recreation, and maritime transport [5]. Through the EU's Blue Economy scheme, Ireland has become a leader in adopting these initiatives [6]. Similarly, China has recognized the necessity of transitioning production systems offshore, assigning the East China Sea Fisheries Research Institute to spearhead offshore aquaculture innovations [1]. In parallel, countries like **New Zealand and Chile** are also advancing offshore aquaculture initiatives under their Blue Economy frameworks [7, 8].

Bangladesh, with a 710-km coastline, an exclusive economic zone of 118,813 km^2, and an extended continental shelf of about 37,000 km^2 reaching depths of up to 50 m in the Bay of Bengal, is well positioned to benefit from the Blue Economy [9]. The settlement of maritime boundary disputes with Myanmar (2012) and India (2014) further enhanced Bangladesh's access to ocean resources, creating new opportunities for fisheries, shipping, energy exploration, and marine tourism (See Fig. 1) [10].

Bangladesh's coastal and marine ecosystem is part of the Bay of Bengal Large Marine Ecosystem, one of the world's 64 such systems [12]. Like other coastal regions, these ecosystems provide vital services supporting the livelihoods of millions. About 270,000 fishing households depend directly or indirectly on marine fisheries, while roughly 0.1 million people directly and 3.5 million indirectly rely on the Sundarbans [12, 13]. Artisanal fishing remains a key economic activity where alternative livelihoods are limited. Coastal population,

estimated at 45 million, was projected to reach 120 million by 2015, likely increasing dependency on these resources (Table 1) [13, 14].

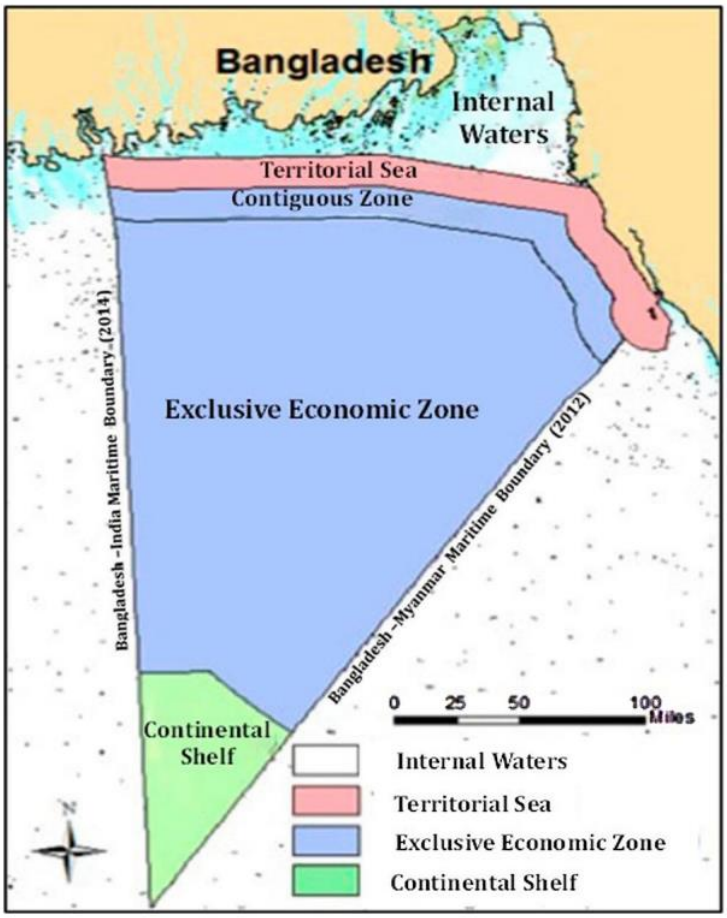


Fig. 1 Bangladesh's permanent maritime boundaries following settlements with India and Myanmar [11]

Recognizing the potential of ocean-based resources, the Bangladesh government has emphasized blue growth and the Sustainable Development Goals (SDGs), particularly SDG 14 on sustainable use of oceans and marine resources [12]. In 2014, Bangladesh hosted a Bay of Bengal partnership conference to advance regional blue economy initiatives under SAARC, linking blue growth with food security, poverty alleviation, job creation, trade, and ecosystem protection [11, 15].

However, the coastal and marine ecosystem faces mounting pressures from natural and human-induced changes, including unplanned coastal development, pollution, overfishing, biodiversity loss, and climate change [16]. Population growth, unsustainable resource use, and gaps in legal enforcement further threaten ecosystem services and human wellbeing [17]. While initiatives such as the establishment of a marine protected area and seasonal fishing closures exist, they

remain insufficient to address the rapid socio-ecological changes in the Bay of Bengal [18].

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

Threats	Explanation	References
Over-exploitation	Coastal fisheries are largely overexploited, leading to a significant decline in catch per unit effort due to overfishing and the use of destructive or illegal fishing gears.	[19].
Constraints related to laws and policy	The coastal fishery sector suffers from the absence of clear regulations, overlapping mandates among agencies, poorly defined responsibilities, inadequate institutional resources, weak monitoring, control, and surveillance (MCS) systems, and widespread non-compliance with existing rules.	[20].
Pollution	Municipal waste from major coastal cities, oil spills, and pollutants from ship-breaking activities in Chittagong have severely degraded the marine environment. Meanwhile, the coastal population of Bangladesh has more than doubled since the 1980s, now exceeding 16 million people.	[21].
Population growth	Since the 1980s, Bangladesh's coastal population has more than doubled, now surpassing 16 million people.	[22]
IUU fishing	Illegal fishing by foreign vessels and piracy by local criminal groups remain serious threats to coastal security and marine resources.	[23]
Rapid environmental change	Climate change is projected to reduce potential fish production within Bangladesh's Exclusive Economic Zone (EEZ) by around 10%. Additionally, ocean acidification poses a growing global threat, further endangering the country's coastal and marine living resources.	[22]

The Blue Economy is viewed in two ways: as a driver of growth and development, and as a space of vulnerable ecosystems needing protection [24]. Reconciling these competing perspectives requires strategies that leverage the ocean economy's growth potential while managing its risks and threats [25]. In this context, the UN Sustainable Development Goals (SDGs) emphasize that economic development should be both inclusive and environmentally sustainable, highlighting the need to balance the economic, social, and environmental aspects

of ocean development [26]. By synthesizing evidence across multiple domains, this study aims to examine how Blue Economy (BE) initiatives in Bangladesh relate to the Sustainable Development Goals (SDGs). It seeks to identify the key opportunities, challenges, and gaps in the current approaches to BE implementation. Furthermore, the study intends to provide policy-relevant insights that can help align national BE strategies more effectively with the broader SDG agenda.

2 Overview of coastal and marine ecosystem services in the Bay of Bengal: Linkages to blue economic growth and the Sustainable Development Goals (SDGs).

The concept of Blue Growth emphasizes unlocking "the potential of our seas and oceans for jobs and growth" [27]. For Bangladesh, realizing this potential largely depends on the sustainable utilization of its commercially valuable coastal and marine resources [28]. The country's coastal and marine ecosystems comprising fisheries, mangroves, beaches, coral reefs, plankton, seagrasses, and seaweeds deliver a wide range of provisioning (biotic and abiotic) and cultural ecosystem services (Table 2) [29]. These resources not only underpin livelihoods but also contribute significantly to food security, employment, and foreign exchange earnings [30].

Among them, marine and coastal fisheries play a vital role as a source of animal protein and income [31]. The Hilsa fishery, for instance, supports the livelihoods of around 2.50 million people and generates an annual value of approximately USD 1.30 billion [32, 33]. Other non-traditional fisheries, including seaweeds, squids, cuttlefish, jellyfish, and oysters (*Crassostrea* spp.), also show considerable economic promise [28]. The Sundarbans mangrove ecosystem provides a diverse range of provisioning services, offering fish, shrimp, honey, wax, timber, medicinal plants, and fodder [20]. In addition, marine provisioning services support emerging blue growth sectors such as aquaculture (for food production) and blue biotechnology, which explores marine biota for compounds with pharmaceutical, nutraceutical, and cosmetic applications [34].

The high productivity of Bangladesh's coastal waters, driven by rich phytoplankton diversity, further enhances the country's potential for marine aquaculture development [28]. Notably, Bangladesh has been identified as possessing the highest proportion of suitable areas in Asia for bivalve culture, with optimal environmental conditions and minimal conflicting uses [35]. Currently, about 1,83,221 hectares of coastal land primarily in the South-eastern coastal belt are used for shrimp farming, the country's second largest foreign exchange earning sector [36].

In terms of blue energy, Bangladesh's marine ecosystems present significant opportunities for harnessing renewable energy sources such as wind, wave, and solar, alongside non-renewable resources like offshore oil and gas [15, 28]. The country's marine abiotic resources, including mineral-rich beach sands, also hold potential for the extraction of rare earth elements and industrial metals such as Cr, Ni, Zn, Mo, and Pb [34]. The coastal and marine ecosystems offer

cultural services, including tourism, religious, and spiritual values many of which remain largely untapped yet hold substantial potential for sustainable blue economic growth [37].

Table 2 Key Ecosystem Services Derived from the Coastal and Marine Environment of Bangladesh

Items	Description	References
Food	Overview of ecosystem service categories based on the common international classification of ecosystem services (CICES) Fish, shellfish, and algae as essential food resources The coastal and marine waters of Bangladesh are home to an exceptionally rich diversity of aquatic life. This includes approximately 475 species of bony fish, 50 species of cartilaginous fish, 50 species of crabs, 36 species of shrimp, 5 species of lobsters, 7 species of turtles, 3 species of starfish, and 11 species of dolphins. In addition, non-conventional fishery resources comprise around 301 species of marine mollusks such as bivalves, snails, slugs, cuttlefish, squids, and octopuses along with 7 distinct squid species and 2 cuttlefish species. The region also supports 156 species of algae. During the 2014-2015 fishing season, the total harvest from coastal and marine fisheries reached approximately 0.6 million metric tons, with hilsa shad (*Tenualosa ilisha*) alone accounting for 251,815 metric tons, or about 42% of the total catch. The Sundarbans, the world's largest mangrove ecosystem, further enriches this biodiversity, harboring 678 aquatic species including 210 fish, 59 reptiles, 8 amphibians, 11 cetaceans, and 16 mollusks. Moreover, the mangrove forest contributes valuable food resources such as fruits, young shoots, floral nectar, and honey, supporting both local livelihoods and ecological sustainability.	[20, 38, 39]

Items	Description	References
Biotic materials	Local communities in coastal Bangladesh traditionally use various mangrove plants for medicinal purposes, including their leaves, young shoots, tender leaves, and bark. Similarly, among the traditional Hindu Jaladas communities along the South-eastern coast, different parts of marine fish such as the whole fish, skull, flesh with grey matter, cephalo-thoracic portion, pointed beak, fatty tissue, spines, shells, and air bladders are utilized in indigenous medicine for treating a range of ailments. These practices reflect the deep-rooted ethnomedicinal knowledge and cultural reliance on coastal and marine biodiversity.	[20, 40, 41]
Abiotic Resources, Materials, and Energy Sources	With an estimated annual sediment deposition of approximately 665×10^6 metric tons, the Bay of Bengal (BoB) holds significant reserves of organic hydrocarbons, particularly oil and natural gas. The Bay's non-living resources include crude oil, natural gas, and sea salt. Of the 26 gas fields discovered in Bangladesh to date, two are located offshore. Additionally, around 17 types of heavy mineral deposits such as zircon, rutile, ilmenite, leucoxene, kyanite, garnet, magnetite, and monazite have been identified in the beach sands along the South-eastern coast. Sea salt production is also a major coastal activity, covering an estimated 6,000 hectares of cultivated area.	[14, 28, 42].
Aesthetic, Religious, and Spiritual Values	Bangladesh is endowed with remarkable natural and cultural assets, including one of the world's longest sea beaches at Cox's Bazar, the planet's largest contiguous mangrove forest the Sundarbans and numerous national parks and islands. The Sundarbans also serves as a spiritual and cultural centre for local Hindu communities, deeply intertwined with their beliefs and rituals, exemplified by the annual Rass Mela held at Dublar Char. National symbols further reflect this coastal heritage: the face of the Bengal tiger (*Panthera tigris* Linnaeus, 1758) adorns the emblem of the Bangladesh National Cricket Team, while the hilsa shad, the country's national fish, holds profound social and cultural	[20]

Items	Description	References
	significance. Moreover, caste-based Hindu fishing communities have long maintained a deep religious and traditional connection with coastal and marine fishing in the Bay of Bengal.	

3 Conceptual framework

3.1 Evolution of the blue economy

The term **Blue Economy (BE)** has been interpreted in multiple ways since it gained prominence at the **United Nations Conference on Sustainable Development (Rio+20) in 2012** [43]. The **United Nations (2014)** broadly defined the BE as an ocean economy aimed at improving human well-being and social equity while reducing environmental risks and ecological scarcities [44]. The **World Bank (2017)** expanded this understanding, describing the BE as the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems" [45].

Beyond these institutional definitions, scholars emphasize that the BE is not only about the exploitation of ocean resources but also about **restructuring economic activities** to achieve a balance between **economic, social, and environmental objectives** [46]. In practice, however, interpretations vary: some stakeholders emphasize economic growth (e.g., shipping, ports, fisheries), while others highlight marine conservation, social inclusion, or climate resilience [24]. For Bangladesh, the government's official policy documents such as the **Seventh Five-Year Plan (2016-2020)** and the **Perspective Plan (2021-2041)** incorporate the BE as a strategic development pillar [47]. Yet, there is no single agreed definition, which creates both flexibility and challenges in operationalization.

3.2 Linking the blue economy to the SDGs

The Sustainable Development Goals (SDGs), adopted in 2015, outline a comprehensive global framework comprising 17 goals and 169 targets [48]. The Blue Economy (BE) contributes both directly and indirectly to several of these goals, particularly in key areas. It supports **SDG 1 (No Poverty)** by providing livelihoods and income opportunities for coastal and fishing communities, and **SDG 2 (Zero Hunger)** through fisheries and aquaculture that play a vital role in ensuring national food security and nutrition [49]. The BE also advances **SDG 7 (Affordable and Clean Energy)** by promoting offshore renewable energy sources such as wind, tidal, wave, and ocean thermal energy [50]. In line with **SDG 8 (Decent Work and Economic Growth)**, the BE generates employment in fisheries, shipping, shipbuilding, and marine tourism sectors [51]. Similarly, it contributes to **SDG 9 (Industry, Innovation, and Infrastructure)** through port development, logistics, and marine biotechnology, which foster industrial advancement [52]. Environmental sustainability is reinforced through **SDG 13 (Climate Action)**, as activities like coastal protection, mangrove restoration, and sustainable marine management enhance climate resilience [53]. The BE is central to **SDG 14 (Life Below Water)**, focusing on the sustainable use and conservation

of oceans, seas, and marine resources [54]. Finally, achieving **SDG 17 (Partnerships for the Goals)** depends on international cooperation, technology transfer, and strategic partnerships to implement BE initiatives effectively [55]. Overall, the Blue Economy functions as a cross-cutting enabler that advances multiple SDGs simultaneously, though it also entails trade-offs such as industrial expansion in coastal areas that may create jobs (SDG 8) while posing risks to marine ecosystems (SDG 14).

3.3 Analytical lens

To systematically assess the role of the Blue Economy (BE) in achieving the Sustainable Development Goals (SDGs) in Bangladesh, this review adopts a "triple bottom line" framework. This approach evaluates three interconnected dimensions of sustainability. The **economic sustainability** dimension examines the BE's contributions to national growth, trade expansion, and livelihood generation. The **social sustainability** aspect focuses on inclusiveness, equity, gender participation, and employment opportunities created through BE initiatives. Finally, the **environmental sustainability** component assesses the health of marine and coastal ecosystems, biodiversity conservation, and the BE's role in enhancing climate resilience. Together, these dimensions provide a holistic understanding of how the Blue Economy supports sustainable development in Bangladesh.

4 Methodology

4.1 Research approach

This study adopts a **systematic literature review (SLR)** approach to analyze the relationship between the Blue Economy (BE) and the Sustainable Development Goals (SDGs) in the context of Bangladesh. The review follows the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)** guidelines, which ensure transparency, replicability, and rigor in synthesizing evidence. The PRISMA framework is particularly relevant as it provides a structured process for identifying, screening, and analyzing literature across multiple sources.

4.2 Data sources and search strategy

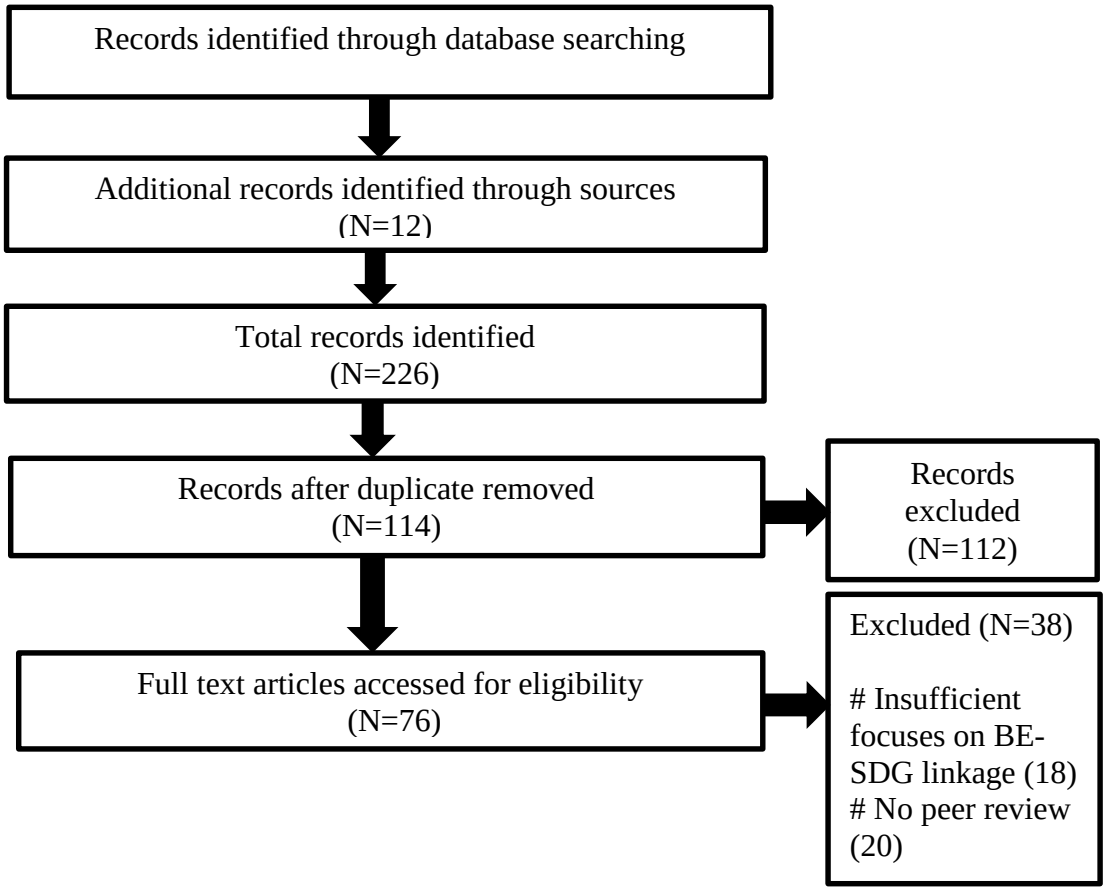
The review utilized both international academic databases and national policy documents to ensure a comprehensive understanding of the subject. Key sources included academic databases such as Scopus, Web of Science, Google Scholar, and ResearchGate, along with institutional repositories from organizations like the United Nations (UN), World Bank, FAO, IUCN, ADB, and relevant government agencies including the Bangladesh Planning Commission, Department of Fisheries, and the Bangladesh Oceanography Research Institute (BORI). Policy documents such as Bangladesh's Perspective Plan (2021-2041), Delta Plan 2100, Five-Year Plans, and Blue Economy strategies were also consulted. To maximize coverage, a combination of keywords was used, including "Blue Economy" AND "Bangladesh," "Marine resources" AND "Bangladesh," "Sustainable Development Goals" OR "SDGs" AND "Blue Economy," and "Ocean economy" OR "Marine economy" AND "Bangladesh." The search was limited to English-

language literature published between 2012, the year of the Rio+20 Conference, and 2025.

4.3 Inclusion and exclusion criteria

The inclusion criteria for the review encompassed studies that explicitly addressed the Blue Economy in Bangladesh, research linking Blue Economy sectors with Sustainable Development Goal (SDG)-related outcomes, and publications such as peer-reviewed journal articles, book chapters, reports, policy briefs, and dissertations. Only documents published between 2012 and 2025 were considered. Conversely, the exclusion criteria ruled out studies focusing solely on technical aspects of marine science such as oceanography or fish physiology-without clear development linkages. Non–peer-reviewed materials, including blogs and newspaper opinions, were also excluded unless they were cited in recognized policy reports. Additionally, duplicated studies appearing across multiple sources were omitted from the analysis.

Fig. 2 Flowchart depicting the systematic process for literature search



4.4 Screening process

The screening process for this review was conducted in three distinct stages. In the **identification** stage, a total of 214 records were retrieved through initial database

and document searches. During the **screening** stage, titles and abstracts were carefully reviewed to determine their relevance, leading to the exclusion of 112 records that did not address Blue Economy SDG linkages or were outside the Bangladesh context. In the **eligibility and inclusion** stage, the full texts of 114 studies were examined in detail, resulting in the final inclusion of 76 studies based on their relevance, quality, and overall contribution to the research objectives. A PRISMA flow diagram visually represents this review process, showing the number of studies identified, screened, excluded, and ultimately included in the analysis (See Figure 2).

4.5 Data extraction and analysis

Each selected study was systematically coded according to several criteria to ensure consistency and depth of analysis. The coding framework included **publication details** such as the year of publication, author, and source type; **thematic focus** encompassing key Blue Economy sectors such as fisheries, aquaculture, mariculture, shipping, energy, gas, minerals, tourism, governance, and environmental management; and **SDG linkages**, identifying whether the study made explicit or implicit contributions to one or more Sustainable Development Goals. Additionally, **key findings** from each study were extracted, highlighting opportunities, challenges, synergies, and trade-offs relevant to the Blue Economy in Bangladesh. The synthesized data were then analyzed thematically and organized under three major dimensions of sustainability: **economic** (growth, trade, and livelihoods), **social** (equity, employment, and gender inclusion), and **environmental** (ecosystem health, pollution control, and biodiversity conservation).

5 Results

5.1 The analytical context within the framework of SDGs

The Sustainable Development Goals (SDGs), officially titled "Transforming Our World: The 2030 Agenda for Sustainable Development", represent a comprehensive global framework designed to address a wide range of sustainable development challenges [56]. The SDG framework consists of 17 goals and 169 targets, forming an integrated blueprint for global progress [57].

Among these, Goal 14 "Conserve and sustainably use the oceans, seas, and marine resources for sustainable development" directly emphasizes the protection and sustainable management of marine and coastal ecosystems [58]. However, several other goals also have direct or indirect linkages to marine and coastal conservation, as well as to the livelihoods and well-being of coastal communities [12]. These include Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 6 (Clean Water and Sanitation), Goal 7 (Affordable and Clean Energy), Goal 8 (Decent Work and Economic Growth), Goal 10 (Reduced Inequalities), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), and Goal 15 (Life on Land) [12].

Before the adoption of the SDGs in 2015, Bangladesh had already achieved significant progress under the Millennium Development Goals (MDGs), particularly in areas such as poverty reduction, food security, universal primary

education, gender parity in schools, reduced infant and maternal mortality, expanded immunization coverage, and control of communicable diseases [59]. Building on this progress, Bangladesh has integrated the 2030 Agenda into its Seventh Five-Year Plan (2016-2020), aligning national priorities with global development objectives [60]. In line with this plan, the government has adopted an inclusive "Whole-of-Society" approach, ensuring active participation from NGOs, development partners, the private sector, civil society organizations (CSOs), and the media in both planning and implementation [61].

To facilitate coordinated action, the 'SDGs Implementation and Monitoring Committee' was established under the Prime Minister's Office, while the Bangladesh Planning Commission has conducted data gap analyses and developed relevant indicators for all SDG targets [12]. The government is also finalizing a comprehensive Monitoring and Evaluation Framework to assess progress [12].

Furthermore, Bangladesh has clearly defined institutional responsibilities by mapping lead, co-lead, and associate ministries against each SDG target [60]. The introduction of the Annual Performance Agreement (APA) across all public sector agencies has strengthened accountability, ensuring that both ministries and individual officials are evaluated based on their contributions to achieving the SDGs [62].

5.2 Overview of reviewed literature

From the final pool of 76 selected studies, the majority (62%) were peer-reviewed journal articles, 24% were institutional reports from organizations such as the UN, World Bank, FAO, IUCN, and ADB, and the remaining 14% were national government publications, including policy briefs, Five-Year Plans, and the Delta Plan 2100. **Publication trends** indicate that research on the Blue Economy (BE) in Bangladesh expanded notably after the 2012 Rio+20 Conference and gained further momentum following the resolution of maritime boundary disputes in 2012 and 2014. A significant surge in publications occurred after 2017, reflecting the growing global recognition of the BE as a catalyst for achieving the SDGs. In terms of **sectoral focus**, fisheries and aquaculture accounted for the largest share of studies (45%), followed by research on shipping and ports (20%), environmental and ecological issues (18%), and emerging areas such as marine tourism, biotechnology, and renewable energy (17%). Regarding **geographic emphasis**, most studies concentrated on the Bay of Bengal and the coastal districts of Bangladesh, including Cox's Bazar, Chattogram, Khulna, Satkhira, and Barguna. This distribution highlights a notable research imbalance while food security and livelihood-related aspects of the BE are well explored, innovation-driven sectors such as blue biotechnology, offshore renewable energy, and eco-tourism remain comparatively underrepresented in the existing literature.

5.2 Thematic findings

5.2.1 Economic contributions of the blue economy

Fisheries and aquaculture (SDGs 1, 2, 8, 14) represent one of the most significant components of Bangladesh's Blue Economy. The country ranks as the fifth-largest aquaculture producer globally, with fisheries contributing approximately 3.57% to

the national GDP and employing over 12% of the total labour force. Marine capture fisheries particularly hilsa, shrimp, and tuna play a crucial role in ensuring food security, supporting livelihoods, and generating export earnings. However, challenges such as overfishing, habitat degradation, and weak regulatory enforcement threaten the long-term sustainability of the sector.

In the area of shipping and maritime trade (SDGs 8, 9, 17), about 90% of Bangladesh's international trade is conducted via sea routes. Major developments, including the expansion of the Chattogram and Mongla ports and the construction of Payra Port, directly contribute to SDG 8 (economic growth) and SDG 9 (industry and infrastructure). Nevertheless, sustainability concerns persist due to oil spills, the hazardous nature of the shipbreaking industry, and weak maritime governance. Strengthening international partnerships and regional cooperation (SDG 17) has been widely recommended to enhance maritime trade efficiency and safety. Persistent challenges such as port congestion, outdated logistics systems, and the absence of deep-sea port infrastructure continue to constrain the sector's potential.

Coastal and marine tourism (SDGs 8, 12, 14) holds significant promise for employment generation, particularly in areas such as Cox's Bazar, Saint Martin's Island, and the Sundarbans. While tourism contributes to local economies and aligns with SDG 8 (decent work and economic growth), unregulated and mass tourism has led to waste accumulation, coral reef damage, and biodiversity loss. To achieve SDG 12 (responsible consumption and production) and SDG 14 (life below water), scholars and policymakers advocate for sustainable tourism frameworks, eco-certification programs, and enhanced community participation. Despite the global appeal of Bangladesh's coastal attractions, the marine tourism sector remains underdeveloped due to poor infrastructure, environmental degradation, and the lack of well-defined eco-tourism strategies.

Finally, marine energy and biotechnology (SDGs 7, 9, 13) represent emerging but largely untapped components of Bangladesh's Blue Economy. Offshore renewable energy sources such as wind, tidal, and wave energy, alongside marine biotechnology applications in pharmaceuticals and bio-products, offer significant potential for supporting SDG 7 (affordable and clean energy) and SDG 9 (industry, innovation, and infrastructure). However, these sectors face considerable challenges, including limited investment, insufficient technology transfer, and inadequate policy integration. The Bay of Bengal is believed to contain vast untapped energy resources, but exploration of offshore oil, gas, and renewable energy remains at a nascent stage. Moreover, the alignment of these initiatives with climate resilience objectives (SDG 13) is still underdeveloped within Bangladesh's current Blue Economy policy framework.

5.2.2 Social dimensions of the blue economy

The Blue Economy (BE) provides both direct and indirect employment to over 30 million Bangladeshis, particularly in coastal regions. However, artisanal fishing communities continue to face high levels of poverty due to seasonal variability, limited storage and processing facilities, and weak bargaining power in local and regional markets. Women play a significant yet often overlooked role in fish

processing, net mending, and small-scale aquaculture, but there is a clear gender gap in access to credit, training, and decision-making within BE sectors. To enable coastal communities to fully benefit from emerging opportunities in the Blue Economy such as shipping, marine biotechnology, and eco-tourism studies emphasize the importance of vocational training, marine education, and the adoption of new technologies.

5.2.3 Environmental and ecological sustainability

The health of Bangladesh's marine ecosystems is under significant threat due to overexploitation of fish stocks, destruction of breeding grounds, and illegal fishing practices, all of which jeopardize biodiversity. Coastal and marine environments are further impacted by pollution from industrial effluents, ship-breaking yards, and plastic waste, with Chattogram identified as a major hotspot for marine pollution. Plastics, untreated industrial discharges, and oil leakage pose severe risks to marine life, directly affecting SDG 14 on life below water. Climate change exacerbates these challenges, as rising sea levels, salinity intrusion, and extreme weather events threaten both ecosystems and livelihoods, putting pressure on critical areas like the Sundarbans mangrove forest, a UNESCO World Heritage site (SDG 13). In response, Bangladesh has established several marine protected areas (MPAs), including the Swatch of No Ground (SNG), to conserve biodiversity; however, enforcement and monitoring of these initiatives remain weak.

5.2.4 Governance and institutional arrangements

Bangladesh has integrated the Blue Economy (BE) into key national development frameworks, including the Seventh and Eighth Five-Year Plans, the Perspective Plan (2021-2041), and the Delta Plan 2100. Despite this, policies often prioritize economic growth over ecological sustainability, highlighting the need for stronger legal frameworks, effective enforcement mechanisms, and participatory governance structures to achieve SDG 16. Institutional fragmentation further complicates BE management, as multiple ministries such as the Ministry of Fisheries and Livestock, Ministry of Shipping, Ministry of Environment and Forests, and Ministry of Power and Energy tend to operate in silos, leading to duplication of efforts and weak coordination. While Bangladesh engages in regional initiatives like the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) and the Indian Ocean Rim Association (IORA), collaboration on BE issues remains limited relative to its potential.

5.3 Mapping blue economy contributions to the SDGs in Bangladesh

This study explores how Bangladesh's blue economy initiatives support the achievement of the SDGs. It identifies key opportunities, challenges, linkage with SDGs and policy pathways for aligning ocean-based economic growth with sustainable development objectives (Table 3).

Table 3 Mapping the Contributions of the Blue Economy to the SDGs in Bangladesh

BE sector	Key SDGs linked	Positive contributions	Challenges/Gaps
Fisheries & Aquaculture	SDGs 1, 2, 8, 14	Food security, livelihoods, exports	Overfishing, climate risks
Shipping & Trade	SDGs 8, 9, 17	Maritime trade, port development, regional cooperation	Pollution, shipbreaking hazards
Coastal Tourism	SDGs 8, 12, 14	Jobs, cultural promotion, eco-tourism potential	Habitat destruction, waste management
Marine Energy & Biotech	SDGs 7, 9, 13	Clean energy, innovation, resilience	Investment gaps, low Research & development
Governance & Environment	SDGs 13, 14, 16	Ecosystem protection, climate action, participatory governance	Weak enforcement, fragmented institutions

6 Discussion

6.1 Critical Insights from the Review

The systematic review demonstrates that the **Blue Economy (BE)** in Bangladesh has considerable potential to accelerate Sustainable Development Goal (SDG) achievement. Fisheries, aquaculture, and shipping emerge as the dominant sectors, contributing directly to **economic growth (SDG 8)**, **food security (SDG 2)**, and **poverty alleviation (SDG 1) supported by** Bir et al. (2020) [63]. However, the environmental dimension (SDG 14) and social inclusion aspects particularly gender equity and community participation receive comparatively less attention in both research and policy [64].

Key insights reveal several critical dimensions of Bangladesh's Blue Economy (BE) landscape. There exists a marked sectoral imbalance, as most studies and initiatives continue to focus on traditional BE sectors such as fisheries and ports, while emerging areas like marine renewable energy, blue biotechnology, and eco-tourism remain largely underexplored similar to Elston et al. (2024) [65]. Governance gaps further constrain progress, with institutional fragmentation and weak inter-ministerial coordination limiting the BE's ability to contribute holistically to the Sustainable Development Goals (SDGs) same report presented by Hossain et al. (2023) [66]. Additionally, trade-offs and conflicts are evident, as economic growth initiatives such as port expansion, industrial aquaculture, and tourism often clash with environmental sustainability objectives, underscoring the urgent need for integrated planning and management similar to Bhuyan et al. (2020) [67]. Finally, climate vulnerability poses a major challenge, as coastal communities and marine ecosystems are highly exposed to climate change impacts, which threaten the long-term sustainability of Blue Economy activities [68].

6.2 Synergies Between BE and SDGs

The review highlighted several significant synergies between Blue Economy (BE) activities and the Sustainable Development Goals (SDGs). **Fisheries and aquaculture** play a dual role in supporting livelihoods, improving nutrition, and enhancing export earnings, thereby contributing to SDGs 1, 2, and 8 similar report also presented by Haque and Mahmud, (2025) [69]. **Marine protected areas (MPAs)** promote biodiversity conservation, strengthen climate resilience, and ensure fisheries sustainability, aligning with SDGs 13 and 14 like Islam and Shamsuddoha, (2018) [12]. Similarly, **shipping and port modernization** foster trade and industrial development while enhancing regional cooperation, advancing SDGs 8, 9, and 17 similar report by Islam et al. (2024) [70]. Moreover, **emerging sectors** such as marine biotechnology and renewable energy present new opportunities for innovation, climate action, and sustainable industrialization, directly supporting SDGs 7, 9, and 13 [71]. Collectively, these synergies demonstrate that the Blue Economy can serve as a cross-cutting catalyst for sustainable development when effectively integrated into national policy and planning frameworks [72].

6.3 Trade-offs and Challenges

Despite its vast potential, the Blue Economy (BE) in Bangladesh faces several trade-offs and challenges that complicate its sustainable development. A key tension exists between economic and environmental goals, as the rapid expansion of industrial aquaculture and port infrastructure, while generating income, often results in significant ecosystem degradation, undermining SDG 14 (Life Below Water) similar to Islam et al. (2024) [70]. Similarly, coastal tourism, though a major source of employment, can cause habitat loss and environmental pressure if not properly regulated [73]. Policy and institutional gaps further weaken the coherence of national strategies, as fragmented governance and overlapping mandates among ministries hinder effective coordination and alignment with the SDGs similar to Rahman, (2021) [60]. Social equity concerns also persist, with coastal women and marginalized groups frequently excluded from the benefits of Blue Economy initiatives, thereby limiting progress toward SDG 5 (Gender Equality) reported by Das (2023) [44].

Moreover, climate-related risks including sea-level rise, cyclones, and salinity intrusion pose severe threats to coastal livelihoods, directly impacting poverty reduction (SDG 1) and food security (SDG 2) similar to Guleria (2020) [74]. The Ministry of Foreign Affairs, through two national workshops held in 2014 and 2017, identified 26 Blue Economy sectors encompassing shipping and coastal shipping, seaports, passenger ferry services, inland waterway transport, shipbuilding and recycling, fisheries and aquaculture (including coastal and marine culture), marine bioproducts and biotechnology, oil and gas, sea salt production, ocean renewable and tidal energy, blue energy (osmosis) and biomass, aggregate mining (sand and gravel), marine mineral extraction, coastal and cruise tourism, recreational water sports, yachting and marinas, artificial island construction and coastal greening, human resource development, marine surveillance, and marine spatial planning reported by Hossain et al. (2024) [76].

However, despite identifying these diverse opportunities, most sectors remain largely untapped due to the lack of effective institutional mechanisms, strategic investment, and long-term policy initiatives.

6.4 Lessons from Global Practices

Comparative studies from other maritime nations offer valuable lessons for Bangladesh. In Seychelles, integrated Blue Economy strategies combine fisheries, tourism, and marine conservation, effectively linking revenue generation with ecological sustainability [77]. Indonesia demonstrates how community-based fisheries management can strengthen local livelihoods while protecting biodiversity [78]. Similarly, Sri Lanka employs marine spatial planning to align tourism, fisheries, and industrial activities, thereby reducing conflicts [79]. For Bangladesh, adopting approaches such as ecosystem-based management, spatial planning, and participatory governance could help achieve a balance between economic growth, social equity, and ecological sustainability [80].

6.5 Implications for Bangladesh

A holistic, multi-sectoral strategy is essential to fully leverage the Blue Economy for achieving the Sustainable Development Goals. Strengthening institutional coordination across ministries, local governments, and regional bodies is critical to ensure coherent and effective implementation supported by Bawden et al. (2025) [81]. Additionally, investments in capacity building, technology adoption, and innovation are necessary to develop emerging sectors such as marine energy and biotechnology similar to Uddin and Islam (2019) [82]. Monitoring and enforcement of environmental regulations should be enhanced to prevent ecosystem degradation, while policies must also prioritize social inclusion, particularly for women and vulnerable coastal populations supported by Islam and Shamsuddoha (2018) [12].

7 Policy Implications and Recommendations

Integrating the Blue Economy into National SDG Strategies requires formally embedding the Blue Economy (BE) within Bangladesh's SDG implementation frameworks, ensuring that sectoral initiatives in fisheries, shipping, tourism, and marine energy explicitly contribute to SDG targets similar to Islam et al. (2024) [70]. Key development plans, including the Perspective Plan 2041, Delta Plan 2100, and the Five-Year Plans, should incorporate clear BE-SDG linkages along with measurable indicators to monitor progress reported by Khatun and Saadat (2021) [83]. Strengthening Governance and Institutional Coordination involves establishing a national Blue Economy coordination body to align activities across ministries, agencies, and local governments, while promoting inter-ministerial and multi-stakeholder collaboration to reduce policy fragmentation and duplication like Sarker et al. (2019) [68]. Regional cooperation in the Bay of Bengal through platforms such as BIMSTEC and IORA should be enhanced to ensure sustainable maritime resource management supported by Ganeshan (2021); Iqbal (2023) [84, 85].

Encouraging Emerging Sectors includes investing in marine renewable energy such as offshore wind, tidal, and wave energy to diversify the energy mix,

promoting research and development in marine biotechnology for pharmaceuticals, bio-products, and aquaculture innovations, and developing sustainable eco-tourism infrastructure in coastal and island regions while minimizing ecological impact supported by Garba and Abubakar (2025) [86]. Climate Resilience and Environmental Protection require strengthening coastal ecosystem restoration, including mangroves, coral reefs, and wetlands, to enhance resilience to climate change, monitoring and regulating marine pollution from plastics, industrial effluents, and ship-breaking activities, and implementing marine spatial planning to balance industrial, economic, and conservation needs like Shampa et al. (2023) [87].

Social Inclusion and Capacity Building focuses on ensuring gender-inclusive policies by providing women access to training, credit, and decision-making in fisheries, aquaculture, and coastal enterprises, developing skills and vocational programs for youth and local communities to participate in emerging BE sectors, and fostering community participation in planning and monitoring to improve ownership and compliance similar to Tabe-Ojong et al. (2025) [88]. Monitoring and Evaluation involves establishing robust systems to track BE contributions to SDG targets using measurable economic, social, and environmental indicators, along with conducting periodic reviews and impact assessments to ensure that BE policies remain aligned with sustainable development priorities.

8 Conclusion

This systematic review demonstrates that the **Blue Economy (BE)** has significant potential to contribute to the **Sustainable Development Goals (SDGs)** in Bangladesh. Fisheries, aquaculture, shipping, and emerging sectors such as marine renewable energy and biotechnology offer opportunities for **economic growth, livelihood improvement, and innovation**, while marine conservation and climate resilience initiatives support **environmental sustainability**. However, realizing the full potential of the BE in Bangladesh requires addressing key challenges: **policy fragmentation, weak institutional coordination, environmental degradation, climate vulnerability, and social exclusion**. Trade-offs between economic development and ecological protection must be carefully managed through **integrated planning, participatory governance, and evidence-based policymaking**. Bangladesh can draw lessons from global experiences, adopting **ecosystem-based management, marine spatial planning, and sustainable resource use** to ensure that the Blue Economy contributes holistically to national development and SDG achievement. Investments in **capacity building, technology, research, and regional cooperation** are essential to unlock emerging opportunities in marine energy, biotechnology, and eco-tourism. In conclusion, a **balanced, inclusive, and sustainable Blue Economy strategy** can serve as a transformative pathway for Bangladesh to achieve its development goals, enhance livelihoods, and secure the long-term health of its marine ecosystems. Future research should focus on **underexplored sectors**,

quantitative SDG impact assessments, and **innovative governance models** to support evidence-based decision-making.

Author contributions: M.A.H.-Writing review & editing, Visualization, Software, Methodology, Formal analysis, and Data curation. A.S.M.H.A.A.-Validation, Resources, and Investigation. M.M.N.-Validation, Supervision, and Investigation. S.I.-Validation, and Investigation. H.M.H.R.-Validation, Software, Resources, Investigation.

Funding: No

Declarations

Ethical approval and consent to participate: Not Applicable.
Competing interests: The authors declare no competing interests.
Data availability: Not Applicable.
Consent to Publish declaration: Not applicable
Clinical trial number: Not applicable

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