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RESEACH ARTICLE

Unlocking Potentials of Blue Economy: The Status, Opportunities, Challenges and Future Perspectives

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Abstract

The Blue Economy refers to the sustainable use of ocean and aquatic resources for sustainable economic growth, improved livelihoods, and job creation, while preserving the health of aquatic ecosystems and resilient of aquatic environment. This review assessed the current status of the Blue Economy and highlighted its significance to the national economies and sustainable development. It has explored key sectors such as fisheries, aquaculture, maritime transport, eco-tourism, and renewable energy. In addition, the review also identified the major challenges hindering the full realization of Blue Economy potentials, including overfishing, marine pollution, and climate change. Furthermore, it has provided actionable insights and forward-looking recommendations for policymakers, stakeholders, and practitioners. The findings demonstrate how countries can sustainably and inclusively harness their aquatic resources to advance economic development, environmental stewardship, and resilience.

Keywords Blue Economy · Sustainability · Ocean Resources · Socio-Economic Development · Aquatic Ecosystems.

1. Introduction

The Blue Economy (BE) emerged as a transformative development paradigm that promotes the sustainable use of marine, coastal, and inland water resources to drive economic growth, improve livelihoods, and create employment, while safeguarding ecosystem health and resilience (Melgarejo, 2014; Mistri & Mistry, 2023). Despite its growing importance, there is no universally agreed definition of the BE, as interpretations vary across institutions and regions depending on priorities and guiding principles (Gouvello & Simard, 2024). Nonetheless, a broad consensus exists around its core objective: balancing economic development with environmental sustainability. For instance, the World Bank (2017) defined the BE as the sustainable use of ocean resources for economic growth and improved livelihoods, while maintaining ecosystem health. Similarly, the European Commission conceptualized it as encompassing all economic activities related to oceans, seas, and coastal areas, including both traditional and emerging sectors (Yuan & Failler, 2025). The United Nations Environment Programme (UNEP, 2017) and the Commonwealth of Nations were further emphasized environmental stewardship and responsible resource management, while the United Nations Economic Commission for Africa (UNECA, 2016) expanded the scope to include freshwater systems such as rivers, lakes, and groundwater.

Drawing from these perspectives, the BE can be understood as the sustainable and inclusive utilization of aquatic ecosystems such as oceans, seas, coasts, rivers, and lakes, to support economic growth, job creation, and livelihoods, while ensuring environmental protection, social equity, and long-term resilience. The concept gained global prominence following the 2012 United Nations Conference on Sustainable Development

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(Rio+20), which highlighted the need for development pathways that enhanced human well-being, while reducing environmental degradation (Smith-Godfrey, 2016; Lee et al., 2020). Since then, coastal and island developing states have been at the forefront of advancing the BE agenda, recognizing their reliance on ocean resources and the need for sustainable management approaches tailored to their vulnerabilities. Globally, aquatic resources are increasingly viewed as a new economic frontier, driven by population growth, rising incomes, declining terrestrial resources, and technological advancements that enable access to previously underutilized marine assets (Lafortune & Ubaldi, 2018).

The scope of the BE is broad and context-specific, encompassing a wide range of sectors linked to aquatic environments. These include fisheries and aquaculture, maritime transport, port operations, shipbuilding and repair, coastal tourism, renewable marine energy, and the extraction of marine living and non-living resources (European Commission, 2025). At the national level, policies reflect this diversity. For example, Zanzibar's BE Policy (2022) prioritized fisheries, aquaculture, tourism, maritime trade, and energy, while Tanzania's National BE Policy (2024) adopted a more comprehensive framework that integrated natural resources, tourism, water, irrigation, energy, transport, minerals, industry, trade, and environmental conservation (RGoZ, 2022; URT, 2024). Traditionally, BE performance has been assessed using economic and social indicators such as sectoral output, profitability, and employment generation, often aligned with international frameworks like those of the OECD (2016), which emphasize the integration of economic growth, social equity, and environmental sustainability.

Beyond economic contributions, the BE offers significant environmental and social benefits. It supported habitat conservation, promotes sustainable aquaculture, facilitated renewable energy production, and enhanced livelihoods, particularly in coastal communities (Sarker et al., 2018; Wenhai et al., 2019). In addition, BE approaches were contributed to climate change mitigation and adaptation through initiatives such as marine protected areas, pollution control, and ocean-based renewable energy systems (Wilson & Forsyth, 2018). Among BE sectors, aquaculture, especially mariculture has been emerged as a critical component for achieving food and nutrition security, income generation, and environmental sustainability. Activities such as seaweed and bivalve farming provide multiple ecosystem services, including carbon sequestration, water quality improvement, and habitat restoration (Chung et al., 2017; Hoegh-Guldberg et al., 2019; Troell et al., 2023; Mendes et al., 2024). As a nature-based solution, sustainable mariculture contributes to economic diversification while enhancing climate resilience and supporting ecosystem health.

Global initiatives have further strengthened the BE agenda by promoting science-based and integrated approaches to ocean management. Notable examples include the United Nations Decade of Ocean Science for Sustainable Development and the High-Level Panel for a Sustainable Ocean Economy, both of which aimed to reverse ocean degradation and advance a sustainable and inclusive ocean economy. These initiatives emphasize the importance of innovation, data-driven decision-making, and cross-sectoral collaboration in achieving BE objectives.

Despite these advancements, significant challenges remain. Environmental degradation, marine pollution, weak governance frameworks, and inequitable distribution of benefits continue to hinder the effective implementation of BE initiatives. In many regions, institutional fragmentation and limited capacity constrain the ability to manage marine resources sustainably and inclusively. These challenges highlight the need for a systematic and integrative approach to understanding the BE. Conducting comprehensive reviews of existing knowledge can help identify gaps, address inconsistencies, and synthesize best practices, thereby strengthening the evidence base for policy-making. Such approaches enhance methodological rigor and transparency, support the development of robust governance frameworks, and guide the sustainable and equitable implementation of BE strategies.

2. Methodological approach for systematic literature review

Accordingly, this systematic review synthesized global evidence published between 2009 and 2025, to assess the status, opportunities, and challenges of the BE across key sectors. The review aimed to generate actionable insights and policy-relevant recommendations that support the achievement of the Sustainable Development Goals (SDGs), particularly Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 7 (Affordable and Clean Energy), and Goal 14 (Life Below Water), as well as national BE policy objectives. Specifically, the review sought to unlock the potential of the BE by examining its current global status and highlighting its contribution to

national, regional, and global economies in promoting sustainable socio-economic development and economic stability. The analysis focused on major BE sectors, including fisheries and aquaculture, maritime transport, eco-tourism, and renewable ocean energy, while identifying emerging opportunities for innovation, investment, and inclusive growth. In addition, the review critically synthesized environmental, legal and institutional frameworks, financial, and governance-related challenges that constrained the full realization of BE potential. Furthermore, the review explored the interlinkages between the BE and the Circular Economy (CE), highlighting pathways through which resource efficiency, waste reduction, and sustainable production systems can enhance ocean-based economic activities. The review also examined current research trends and future development trajectories shaping the global BE agenda.

To achieve these objectives, the study was guided by six key research questions: (i) What are the conceptual foundations, research trends, and global status of BE? (ii) What are the emerging opportunities and economic potential of the BE? (iii) What legal and institutional frameworks govern the BE worldwide? (iv) What challenges and constraints hindering the sustainable development of BE? (v) What is the relationship between the BE and the CE? and (vi) What are the strategic priorities and future directions in the BE? Addressing these questions enabled the review to develop a comprehensive and structured evidence base to inform policy design, strategic planning, and the sustainable implementation of BE initiatives across multiple governance levels. Each research question was addressed through a systematic analysis of sectoral and cross-sectoral evidence, integrating findings from fisheries and aquaculture, coastal and inland eco-tourism, maritime trade and inland waterway transport, and renewable energy sectors.

The first research question assessed the current global status of BE activities by examining global investment trends, regional BE highlights, and sectoral developments of BE. The second question, identified the emerging opportunities exists within the global BE, including investment in sustainable fishing and aquaculture practices, development and promotion of eco-tourism in both inland and marine water bodies, investment in marine and inland waterway transportation infrastructures, development and deploy renewable energy technologies that utilize inland water bodies, support research and development in the BE sector, and collaborate with African governments and other stakeholders to develop and implement sustainable BE policies. The third question, examined legal and institutional frameworks supporting BE governance across the four continents, these include European, American, Asian and African continent. Other question follow same trend as presented. The fourth question, analysed major challenges constrained sustainable development of BE potentials such as overfishing and fisheries resources depletion, marine pollution, climate change, poor governance and regulation, limited investment and funding, and technology and innovation limitations. The fifth highlighted the strong interlinkages between the CE and the BE, emphasizing resource efficiency and sustainable production practices. Finally, the sixth synthesized current research trends and future development pathways shaping the evolution of the BE.

The review adopted a holistic and multidisciplinary perspective, synthesizing evidence across multiple interconnected sectors. Particular attention was given to sector-specific growth pathways, regional and global investment dynamics, and the legal and institutional frameworks underpinning effective BE implementation. Cross-cutting challenges, including environmental pressures and governance constraints, were also examined to provide a comprehensive understanding of the opportunities and systemic barriers influencing sustainable BE development.

A multi-source approach was employed to ensure broad coverage of both scholarly and policy-oriented literature. Major academic databases accessed included Web of Science, Scopus, Google Scholar, and ScienceDirect. Additional sources included StartUs Insights, the Tanzania National Fisheries Database, and institutional repositories from organizations such as the Food and Agriculture Organization, World Bank, and United Nations Economic Commission for Africa, as well as thesis and dissertation repositories from higher education institutions worldwide. This multi-source strategy ensured the inclusion of evidence from diverse geographical regions and governance contexts.

The literature search employed a structured combination of keywords and Boolean operators, including "BE," "Ocean Economy," "Sustainable Fisheries," "Aquaculture," "Maritime Transport," "Eco-tourism," "Renewable Ocean Energy," and "Circular Economy." Publications were selected based on the following criteria: (i) publication between 2009 and 2025; (ii) inclusion of peer-reviewed journal articles, policy reports, or authoritative institutional publications; and (iii) explicit focus on BE sectors, sustainability dimensions, governance mechanisms, or policy frameworks. A systematic screening and thematic synthesis process were applied to organize and analyze the literature. This approach ensured methodological rigor, transparency, and

reproducibility, enabling each research question to be comprehensively addressed, while integrating both sectoral and cross-sectoral perspectives.

The findings of this review are organized around the six key research questions (RQs) that guided the study, with results presented in Sections 3 through 8, each corresponding to RQ1 through RQ6 in the order they were formulated. RQ1 addressed the conceptual foundations, research trends and global status of the Blue Economy (BE), while RQ2 identified opportunities and economic potential across key sectors, including fisheries, aquaculture, eco-tourism, and marine renewable energy. RQ3 examined the legal and institutional frameworks governing BE development, and RQ4 highlighted major challenges and constraints, particularly environmental, governance, and financial factors that limit sustainable development. RQ5 explored the interlinkages between the BE and the Circular Economy, emphasizing pathways for resource efficiency and sustainability. Lastly, RQ6 synthesized strategic priorities and future directions shaping the evolution of the global BE.

3. Conceptual Foundations, Research trends, and Global Status of the Blue Economy

The Blue Economy (BE) has gained significant global attention in recent years as countries strive to promote sustainable ocean use while addressing environmental challenges (Islam et al., 2018; Mussa et al., 2019; Lee et al., 2020; Martínez-Vázquez et al., 2021; Pouponneau, 2023; Asmiya et al., 2025). International frameworks, such as SDG 14: Life Below Water, highlighted the importance of conserving marine ecosystems and ensuring sustainable livelihoods from ocean resources (Virto, 2018; Lee et al., 2020; Huck, 2022; Arora et al., 2023). Small Island Developing States (SIDS), including Zanzibar (Unguja and Pemba), are increasingly integrating BE principles into national policies, balancing economic growth with ecological sustainability (Mussa et al., 2019; Pouponneau, 2023; Asmiya et al., 2025).

Rapid technological advancement and economic development have accelerated the exploitation of BE potentials, supported by innovative approaches that minimize environmental impacts (Jammeh, 2022; Zhang et al., 2024; Tirumala & Tiwari, 2022). Advances in marine biotechnology and sustainable aquaculture, along with renewable marine energy deployment (offshore wind, tidal energy), promote conservation, job creation, and energy transitions (Chatterjee et al., 2025; Constant et al., 2021; Oloruntobi et al., 2023). International collaboration is critical for managing transboundary marine ecosystems and ensuring a sustainable BE for future generations (Upadhyay & Mishra, 2020). Global BE growth is further driven by increasing investments, innovative financing mechanisms, and recognition of the ocean's role in sustainable development (Johansen & Vestvik, 2020; Sarangi, 2023).

Globally, priority BE sectors include fisheries and aquaculture (sustainable management, responsible aquaculture, combating IUU fishing); maritime transport and ports (green shipping, port modernization, safety); coastal and marine tourism (eco-tourism, cultural heritage, community initiatives); marine renewable energy (offshore wind, tidal, wave, OTEC); marine biotechnology (pharmaceuticals, cosmetics, industrial products); coastal resilience and climate adaptation (protecting mangroves, reefs, and seagrasses, climate-smart planning); marine pollution control (plastics, chemicals, oil spills); marine spatial planning and ocean governance (integrated management, policy, sector conflict resolution); and capacity building, research, and education (ocean science, professional training, public awareness). According to StartUs Insights (2024), the top ten BE priority areas in 2023 included marine probiotics, blue renewable energy, ocean pollution management, deep-sea mining, marine biotechnology, sustainable aquaculture, ocean-conscious consumption, coastal resilience, green maritime shipping, and marine biodiversity enhancement. Numerous studies have documented the global status of BE and its links with the Circular Economy (CE) (see Table 1).

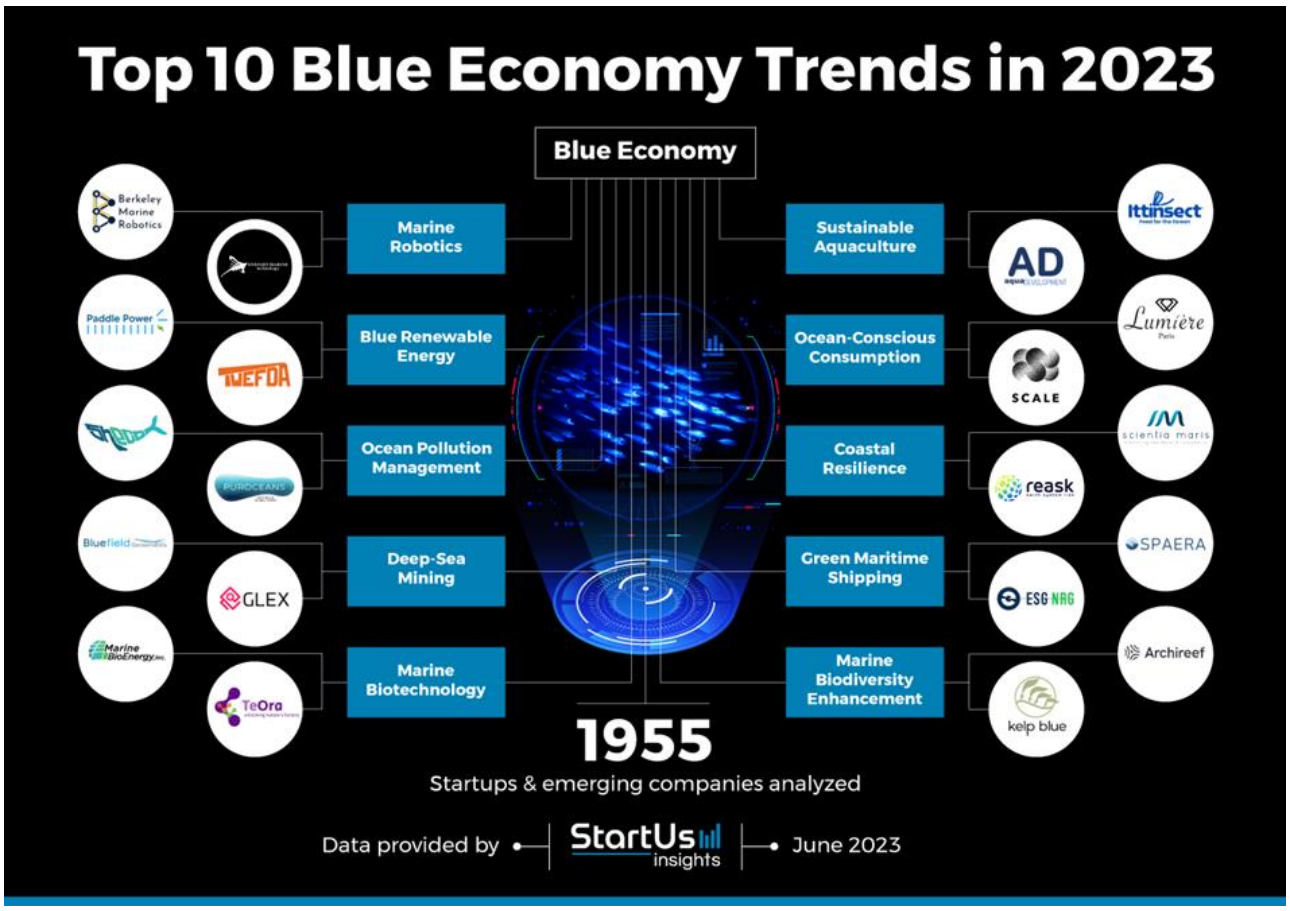

Figure 1. Top 10 BE trend in 2023, *source:* StartUs Insights (2024).

Table 1. Comparative review of selected BE Studies: Research Objectives, Methods, and Key Findings.

S/N	Study objective/Research questions?	Research method	Key findings	References
1	To analyse the potential of the BE in promoting sustainable fisheries and marine resources	Literature review & data analysis	Highlighted that sustainable management of marine fisheries is critical for the BE; overfishing remains a significant challenge.	Pauly and Zeller (2016)
2	To examine the existing literature on the potential of BE models in Less Developed Countries (LDCs), Small Island Developing States (SIDS), and developing nations such as Sri Lanka, and identify opportunities for further expanding the benefits of the BE in coastal states through the development of innovative approaches	Literature review and analysis of existing research on BE models	The study showed that BE models can boost fisheries, tourism, and energy sectors. Success depends on strong regulations, regional cooperation, and support from governments and the public. Countries like Sri Lanka face challenges in creating sustainable revenue and marine conservation. Overcoming these issues with innovative strategies can unlock BE's full potential for coastal nations.	Asmiya et al. (2025)
3	To analyze the representation of Small Island Developing States (SIDS) in BE literature and highlight their diversity and perspectives.	A systematic literature review	SIDS are underrepresented in research and often treated as a homogeneous group. There is a significant knowledge gap and inequity in research capacity. SIDS have diverse perspectives on BE implementation, which are rarely captured.	Pouponneau (2023)

Table 1 (cont.). Comparative review of selected BE Studies: Research Objectives, Methods, and Key Findings.

S/N	Study objective/Research questions?	Research method	Key findings	References
4	To synthesize current scientific knowledge and address prevailing research gaps on the BE, blue growth, social equity, and small-scale fisheries (SSF), and explore the need for further research on how different aspects of the BE risks lead to inequity in the pursuit of ocean sustainability	A scoping review of global literature	The collection found that there is a missing link between international policy deliberations and national-level implementation plans in the BE context Several studies claimed that critical re-thinking of policies is required to ensure the sustainability of BE trajectories Mitigation, and conflicts resolution are needed to address the impacts of the BE and blue growth on coastal livelihoods	Das (2023)
5	To evaluate the policy process governing marine ecosystem functions and institutional frameworks aimed at promoting a sustainable BE, with a focus on international maritime law and regional policies.	Analysis of existing marine regimes, laws, policies, and management tools.	Effective marine environmental protection requires integrated laws, policies, and management tools to address weak ocean governance, marine pollution, climate change, IUU fishing, haphazard tourism, and unplanned coastal development Education and awareness are crucial for sustainable development. A BE roadmap is necessary to provide a comprehensive strategy for ocean-based sustainable development that brings together the economy, environment, and society, closely linked to the UN 2030 Sustainable Development Goals (SDGs). BE required profound and structural changes in the regulatory-management-governance policy process using the ecosystem-based Marine Spatial Planning method	Islam (2022)
6	To develop a careful definition of the BE and analyze case studies that illustrate its various aspects, aiming to enhance understanding and promote global dialogue on sustainable ocean management.	Literature review and case studies	The BE is a relatively new but promising concept with diverse applications worldwide. There's a need for improved data access, monitoring, and management. Strengthening international cooperation, sharing achievements, and establishing global partnerships are crucial for its development. Nonetheless, significant opportunities remain to deepen collective understanding and analysis of the BE.	Wenhai et al. (2019)
7	The paper aims at generating thoughts and actions towards investigating various opportunities of the BE, ways of cashing the benefits as well as identifying challenges and ways of overcoming them	A compilation and review of existing regional research and data related to the BE.	Bangladesh and South Asia have significant potential to adopt the BE approach. However, required strong political willingness and commitment, rigorous researches, and promoting social awareness.	Bari (2017)
8	To examines the scientific evidence of the association between the BE and the UN's SDGs, and relevance and alignment of stakeholders on the link between the BE and SDGs	A literature survey covering studies from 1998 to 2018.	The study found that BE is highly associated with SDGs 14–17, especially SDG 3 (Good Health & Well-Being) and SDG 8 (Decent Work & Economic Growth). Stakeholder involvement showed some differences and variations in the relationship between the BE and SDGs. Clarifying stakeholder roles is essential for setting achievable goals that promote sustainable economic and societal development while protecting ocean health.	Lee et al. (2020)

Table 1 (cont.). Comparative review of selected BE Studies: Research Objectives, Methods, and Key Findings.

S/N	Study objective/Research questions?	Research method	Key findings	References
9	To analyze the scientific development of the BE (BE) and related concepts using bibliometric methods, exploring links between BE, Circular Economy (CE), and Blue Growth (BG).	A bibliometric analysis of published literature using bibliometric mapping tools (VOSviewer)	The study highlighted the need for alliances between the sectors that compose BG with the incorporation of the CE in order to achieve a sustainable BE in both developed and developing countries. The BG strategy is the bridge between the BE and the CE. The CE presents itself as a promising alternative that could mitigate tensions between stakeholders who support both growth and degrowth positions	Martínez-Vázquez et al. (2021)
10	Examine how circular economy initiatives can support the achievement of a sustainable BE, assess the role of resource efficiency, waste reduction, and value retention in fisheries, aquaculture, and marine-based industries, and identify policy, governance, and innovation pathways that enable the integration of circular economy principles into BE frameworks.	Systematic literature review of peer-reviewed articles. Conceptual analysis, and Case-based illustrations and Policy and governance analysis,	Circular initiatives have significantly enhanced sustainability of marine living resources by minimizing waste, improving by-product utilization, and extending resource life cycles Fisheries and aquaculture value chains offer strong entry points for circular practices through fish waste valorization; and energy recovery and eco-design of processing systems	Ha (2024).
11	To establish the conceptual relationship between the new BE and the maritime sector, discuss the barriers to achieving the circular economy through new BE initiatives, highlight the barriers and drivers of the circular economy in the port sector, and identify the strategies to mitigate the challenges militating against the utilisation of new BE initiatives as a drive in achieving the circular economy.	Comprehensive literature review, policy and strategy analysis, case study analysis and conceptual framework.	. The research found a strong interconnection between the BE and the CE, and the need to emplace a circular regime in the maritime domain, especially in ports, in order to further enhance sustainability BE initiatives such as renewable energy integration, waste-to-resource systems, and industrial symbiosis significantly enhance circularity in port environments.	Pacheco (2022).

3.1. Global Investment Trends in Blue Economy

Global investment in BE activities is rapidly accelerated, driven by the urgent need for sustainable ocean-based solutions, climate resilience, biodiversity conservation, and carbon sequestration (Bennett et al., 2024). In Europe, the BE represented a dynamic and competitive sector, contributing around EUR 250 billion to the EU economy and employed nearly 5 million people, while offering opportunities for innovation, research and development (R&D), economic diversification, job creation, competitiveness, and sustainability. Investments in BE projects, particularly in green energy, have tripled over the past decade, reaching over €13 billion between 2018 and 2023 (EU BE Observatory). Globally, ocean-related trade reached a record $2.2 trillion in 2023, with investments in blue technology and marine and coastal tourism, making a total of $346 billion and $725 billion, respectively (UNCTAD). Innovative financial tools, such as blue bonds and debt-for-nature swaps, are gaining traction, with the EU planning to allocate €3.5 billion in 2024 toward ocean protection and sustainability initiatives (Tirumala & Tiwari, 2022).

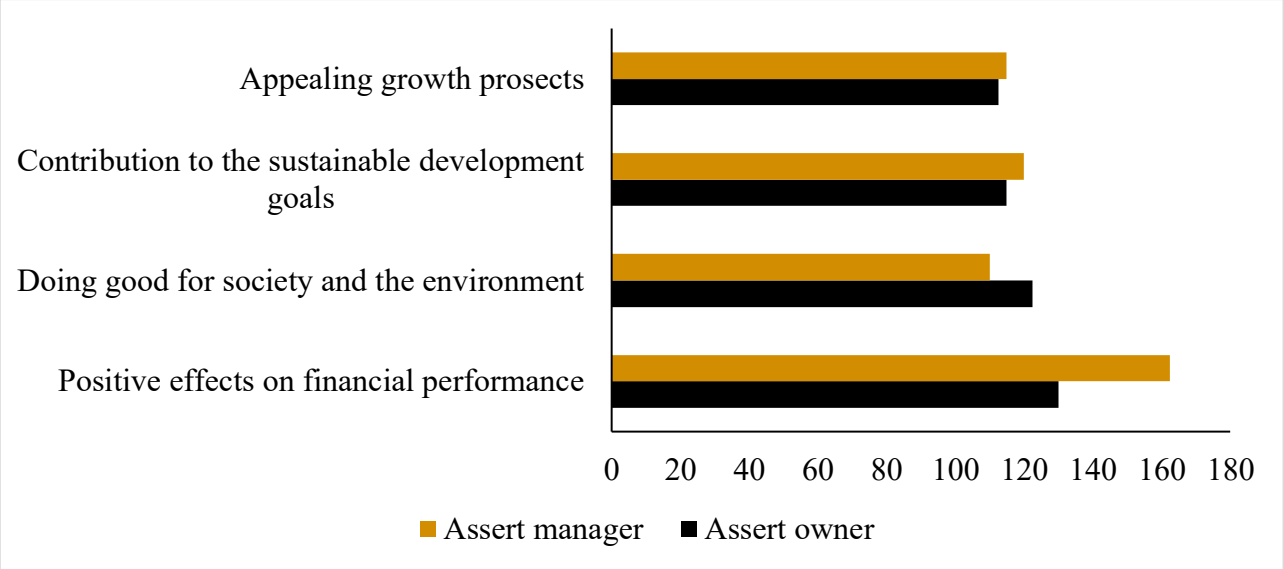

Figure 2. Drivers for the sustainable economy investment, source: Tirumala and Tiwari 2022.

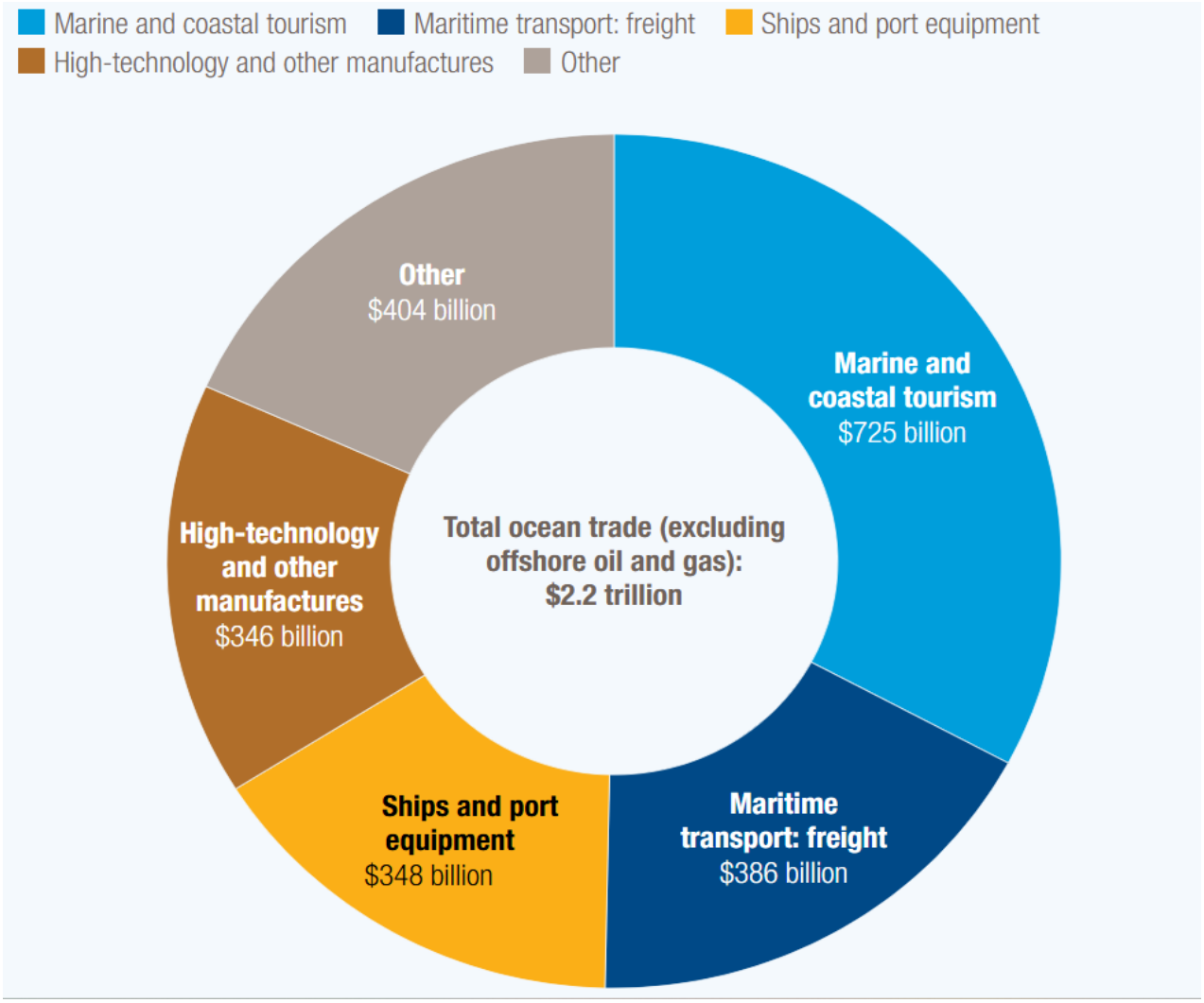

Figure 3. World Ocean goods and services exports, dollars, 2023, source: UN Trade and Development (UNCTAD), UNCTAD stat.

Moreover, over the past 20 years, disclosed investments in the aquaculture sub-Sector in Europe have reached €1.5 billion, representing 10% of total BE capital, with 31% of deals reported deal sizes, compared to 36% across the entire BE. In terms of deal volume, aquaculture ranks fourth after blue renewable energy (50%), water management, and shipbuilding / refit (EU BE Observatory). Globally, aquaculture is the fastest-growing food production sub-Sector (FAO, 2024) and is increasingly recognized as a solution to pressing challenges, provided nutritious and diverse food for a growing population, while typically having lower climate and environmental impacts than other farming systems (Subasinghe et al., 2009; Subasinghe & Norman, 2024). The sub-Sector also attracted more investment from specialized fund managers than fisheries, likely due to faster growth, higher profitability, and more structured practices, compared to fisheries' reliance on wild catches and variable yields (FAO, 2022; World Bank, 2024).

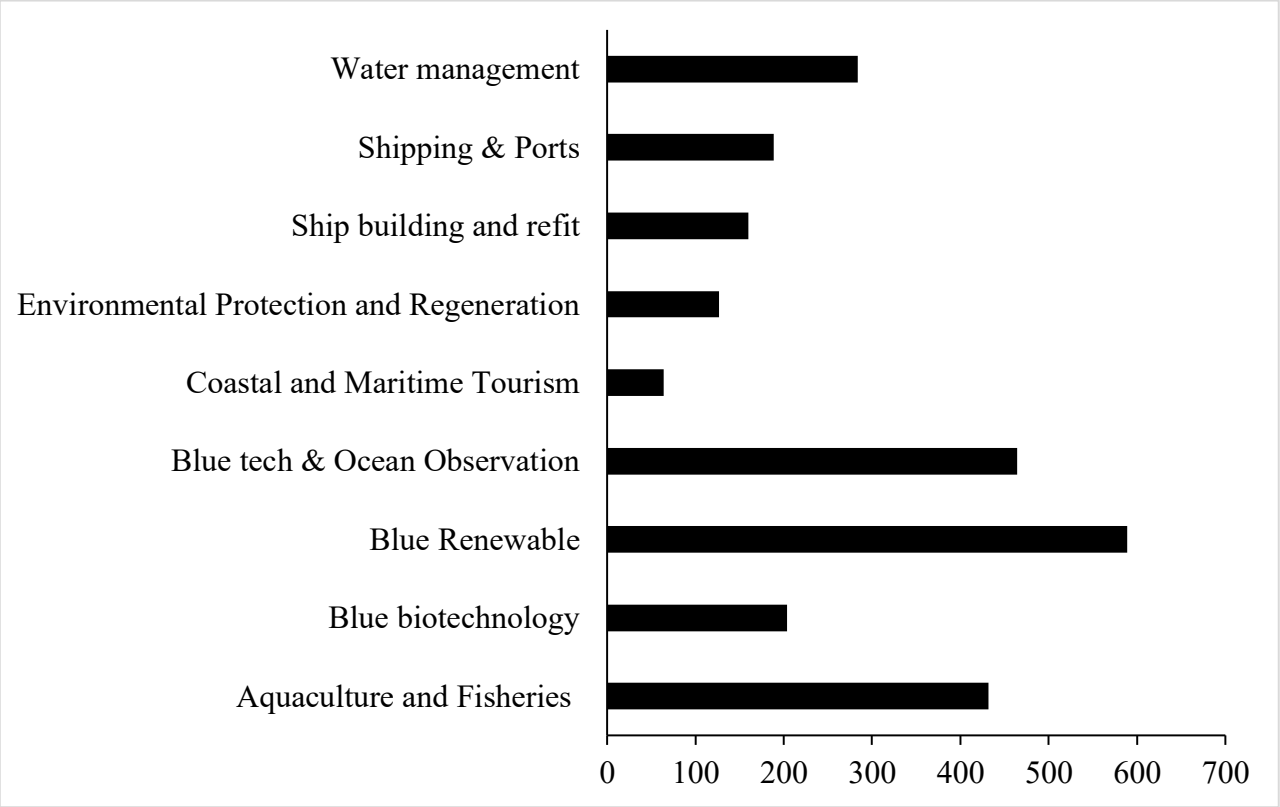

Figure 4. Total number of investment deals in BE between 2000 to 2023, source: Tirumala & Tiwari, 2022.

3.2. Regional Blue Economy highlights

Many African countries continue to prioritize the BE, particularly by reviewing legal and institutional frameworks. For example, Cabo Verde and São Tomé and Príncipe leverage debt-for-climate swaps to fund BE projects in sectors such as water, sanitation, and renewable energy (OECD, 2022). In Tanzania, the government has operationalized its National BE Policy (2024) to enhance fisheries, aquaculture, energy, and tourism (URT, 2024), while Zanzibar's BE Policy (2022) focused on fisheries and aquaculture, maritime trade and infrastructure, energy, tourism, and marine governance (RGoZ, 2022). Zanzibar recognized the BE's role in promoting socio-economic development, aimed to become the leading hub for BE activities in the Western Indian Ocean by utilizing maritime resources for inclusive growth and employment. However, increasing pressures from shipping, fishing, tourism, energy development, and oil and gas exploration pose challenges to its marine ecosystems (RGoZ, 2022). Tanzania has leveraged its blue resources for inland aquaculture using cage farming technology, increasing production from 18,716 MT in 2020 to 43,416 MT in 2024 (Mmanda et al., 2020; Mmanda, 2025; URT, 2024). Seaweed production on the mainland reached 8,551 MT, while artisanal small-scale fisheries contributed 472,579 MT in 2024, supporting rural livelihoods and water access. Globally, fisheries and aquaculture production reached 223.2 million tonnes in 2024, including 185.4 million tonnes of

aquatic animals and 37.8 million tonnes of seaweed, with aquaculture contributing 130.9 million tonnes, accounted for 62.6% from inland aquaculture and 37.4% from marine and coastal systems (FAO, 2024; Mmanda, 2025). These trends highlight the growing contribution of sustainable BE sectors to economic development and food security.

Aquaculture and fisheries investment is largely concentrated in North America, particularly the United States, with Asian investors engaging more in growth-stage opportunities or through mergers and acquisitions (M&A) (Bennett et al., 2024). However, global aquaculture is dominated by Asian investors, enabling several countries in the region to lead the industry for decades (FAO, 2024). In Tanzania, the government has made substantial investments in BE priority activities through programs that support fish farming in Lake Victoria and Lake Tanganyika, provided modern fishing boats to small-scale fishers, and empowered seaweed farmers in Zanzibar and mainland Tanzania with farm inputs, equipment, and aquaculture extension training for youth under the BBT-LIFE program (personal communication). In 2024, the Ministry of Livestock and Fisheries, in collaboration with the Office of the Prime Minister on Labour, Youth, and Employment, launched the second phase of BBT-LIFE at the Fisheries Training Agency (FETA) in Bagamoyo, selecting 300 youth for training in quality and commercial fish farming, with a total planned government investment of TZS 9 billion, starting with TZS 5.5 billion in 2024. Additionally, the government plans to acquire 450 modern fishing boats and tools worth TZS 460.33 billion through the IMF Extended Credit Facility (ECF) to enhance artisanal fisheries.

Similarly, the Revolutionary Government of Zanzibar, through the Ministry of BE and Fisheries, has invested in seaweed farming and small-scale fisheries, supplying approximately 508 modern fishing boats under initiatives such as the "MastaBoti" loan program via NMB Bank and direct government support. These boats, equipped with GPS and fish-finding technology, increase fishing efficiency and promote sustainability. The government has also invested in infrastructure, including fishing ports and seaweed processing factories in Pemba Island, to further develop the Blue Economy and strengthen value chains. Moreover, The European Union pledged over TZS 3 trillion to support Tanzania’s energy sector, strengthening its role in clean energy, regional integration, and infrastructure development under the Global Gateway Initiative in 2025.

3.3. Sectoral Developments of Blue Economy

The BE promoted sustainable use of oceans, seas, lakes, and aquatic resources to drive economic growth, create jobs, improve livelihoods, and protect ecosystems (Karani et al., 2022; Maskaeva et al., 2024). The key sub-Sectors include fisheries and aquaculture, maritime trade and infrastructure, energy, tourism, marine governance, as well as marine living and non-living resources, biotechnology, shipbuilding, port operations, coastal tourism, and marine renewable energy (RGoZ, 2022; Elston et al., 2024; Liu et al., 2021; Borriello et al., 2025). Modernizing fishing fleets with advanced technologies, safety equipment, and efficient systems enhances productivity, sustainability, and profitability, especially for small-scale fishers (Kaur & Datta, 2021; Twumasi et al., 2022). In Tanzania and Zanzibar, 450 modern fishing boats are planned under ECF and TASFAM programs to support artisanal fishers, increase yields, and strengthen BE sectors (personal communication).

In Kenya, the government has implemented fleet upgraded for fishers on Lake Victoria and the Indian Ocean under the BE Implementation Framework, including smart fish tracking systems and mobile-based catch documentation tools. Similar approaches in developed countries include financial support via subsidies, access to credit, and insurance for fisheries activities. East African governments continue to encourage private sector investment in the fishing industry, recognizing that modernized fleets enhance efficiency, safety, product quality, reduce post-harvest losses, promote sustainable fishing, and support climate resilience (Twumasi et al., 2022). The key modernization measures include acquiring new boats and engines, retrofitting vessels with ice storage, GPS, fish finders, and solar-powered systems, providing safety equipment, capacity-building and training for fishers, facilitating financial access through programs such as ECF and TASFAM, and promoting cooperative models for shared boat ownership (Basurto et al., 2013; Marais et al., 2013; Walsh, 2020; Arnupapboon et al., 2023; Rizwan et al., 2024; Setiawan et al., 2024; European Commission, 2016; Wanchana & Sayan, 2018).

Sustainable aquaculture practices, including cage farming, improved hatchery production, and eco-friendly feed, have also been promoted globally (NDCs, 2024; Haque et al., 2025). Post-harvest losses are mitigated through cold storage, processing plants, and packaging for export markets, combined with capacity-building for small-scale fishers and aqua-farmers on sustainable practices, safety, and business skills (Odoli et al., 2019;

Kruijssen et al., 2020; Acharjee et al., 2021; Abdul et al., 2024). These government and private sector efforts have contributed to record global fisheries and aquaculture production of 223.2 million tonnes in 2022, comprising 185.4 million tonnes of aquatic animals and 37.8 million tonnes of algae, with aquaculture alone accounting for 130.9 million tonnes (FAO, 2024).

The African BE sector generated an estimated USD 296 billion and 49 million jobs in 2018, including USD 80 billion from offshore oil and gas, USD 80 billion from tourism supporting 24 million jobs, and about 3% of global shipping value, handling 500 million tonnes of goods (Failler et al., 2020; Sacko, 2020; Manyilizu, 2023). The fisheries sector contributed approximately USD 15 billion with 13 million employees, producing 10 million tonnes of marine capture fish that provide food and nutritional security to 200 million Africans, accounting for 20% or more of the continent's animal protein intake (Failler et al., 2020; Sacko, 2020; Manyilizu, 2023).

4. Opportunities and Economic Potential of the Blue Economy

4.1. Invest in sustainable fishing and aquaculture practices

The BE encompasses various sectors, including fisheries, aquaculture, marine biotechnology, and coastal tourism, all of which can benefit from sustainable practices (Choudhary et al., 2021; Youssef, 2023; Elston et al., 2024; Herath et al., 2024; Sumaila & Villasante, 2025). In focusing on sustainable fishing and aquaculture, we can address critical issues such as overfishing, habitat destruction, and climate change, while simultaneously enhancing food security and economic resilience (Kumar, 2014; Rice & Garcia, 2011). One of the primary areas where investment can yield substantial returns is in the development of sustainable aquaculture systems (Valenti et al., 2018; Martins et al., 2010; Aich et al., 2020). According to Islam & Yasmin (2017), traditional aquaculture practices often lead to environmental degradation, including water pollution, depletion of wild fish stocks, and habitat destruction. However, innovations in aquaculture, such as recirculating aquaculture systems (RAS) (Zhang et al., 2011; Ahmed & Turchini, 2021), and integrated multi-trophic aquaculture (IMTA) (Ridler et al., 2007; Buck et al., 2018; Troell et al., 2009), can mitigate these impacts. RAS, for instance, allows for fish farming in a controlled environment, with minimal water exchange, thereby reducing pollution and conserving water resources (Zhang et al., 2011). The investment in these technologies not only promotes sustainability but also enhances productivity and profitability for aquaculture businesses.

In addition, sustainable fishing practices can significantly benefit coastal communities that depend on fisheries for their livelihoods. Implementing sustainable fishing methods, such as selective gear technology and community-based management practices, can help maintain fish stocks populations and ensure that fish stocks remain viable for future generations (Campos-Silva & Peres, 2016; Hossen, 2024). Furthermore, investment on the monitoring and enforcement mechanisms can enhance compliance with sustainable practices, leading to healthier marine ecosystems and more reliable fish supplies (Williams & Corral, 1999; Kemp et al., 2023; Tolentino-Zondervan a& Zondervan, 2022). This approach not only supports the local economy but also fosters social equity by involving local communities in decision-making processes regarding resource management. Moreover, the integration of technology in fisheries and aquaculture can drive sustainability efforts across the globe (Yue et al., 2022; Føre et al., 2023; Zhang et al., 2023; Sumartono et al., 2025). Innovations such as satellite monitoring, drone surveillance, and blockchain technology for traceability can improve transparency and efficiency in seafood supply chains (Latief et al., 2023; Ellahi et al., 2023; Rowan, 2023). According to Ellahi et al. (2023), blockchain can provide consumers with information about the origin and sustainability of their seafood, encouraging responsible consumption. Therefore, investing in these technological advancements can create new markets and opportunities, aligning economic growth with environmental stewardship. Investment in sustainable fishing and aquaculture practices presents a multifaceted opportunity within the BE.

4.2. Develop and promote eco-tourism in both inland and marine water bodies

Developing and promoting ecotourism requires a holistic approach that balances environmental conservation, economic benefits for local communities, and responsible tourism practices. This involves establishing clear policies, building capacity within local communities, and implementing sustainable infrastructure development, while promoting responsible tourism awareness. The eco-tourism has played a critical role in an income and employment generation, become an attractive tool for stimulating economy, enhancing rural lifestyles and inducing positive changes in the distribution of income in the developing world (Liu, 2006). With increasing concern for environment, ecotourism is believed to be the fastest growing tourism segment (Campbell, 1999; Liu & Xu, 2004). In 1999, The government of Peoples Republic of China through National Tourism Administration (CNTA) has established an ecotourism Year". Over the consecutive past years have witnessed its vital role in Gross Domestic Product (GDP) growth and anti-poverty programs (Tang, 1999). Moreover, the governments should establish clear policies for promoting ecotourism, including specific strategies for capacity building, carrying capacity management, zoning, and participatory approaches within the industry. According to Alfiandri & Mayarni (2023), reported that to improve the implementation of governance regulations in developing coastal-border ecotourism, a synergy between governmental institutions and local community groups should be established, human resources capacity should be enhanced, infrastructure should be built, and environmental surveillance and control should be improved (Alfiandri & Mayarni (2023). Community-based ecotourism (CBET) is a kind of ecotourism that pays more attention on community's benefits, community participation and empowerment of communities (Tang, 2019). However, the lack of community capacity is the major barrier to effective and sustainable tourism development (Fariborz Aref et al., 2010; Aref, 2011; Dias et al., 2024). In many developing countries, local community has restricted access to decision-making due to the government-dominated development model (Tang, 2019). Some regions have set the regional plans to enhance ecotourism sector, such as A guide to plan and promote ecotourism activities and measure their impacts in Mediterranean Protected Areas, aimed to provide protected area managing bodies and the local ecotourism sector with a clear pathway to plan and enhance engaged conservation-focused ecotourism in their areas (Noll et al., 2019). Similarly, In March 1996, the United Nations Program for Development (UNDP) requested Conservation International Foundation (CIF) to develop a strategy for the management of ecotourism in the Inka Region, Perú, due to increased complaints over community participation in decision making on tourism industry (Bonilla, 1997). The Participatory Ecotourism Planning involves the participatory process by engaged in all sectors involving in eco-tourism industry include private sectors, communities, NGOs, local governments and ecotourism specialists for sustainable BE and socio-economic development and national economy stability (Bonilla, 1997).

Similarly, developing and promoting inland and marine water tourism products and services represents a significant opportunity for the BE, which emphasizes sustainable use and conservation of ocean and freshwater resources. Inland water bodies such as lakes, rivers, and wetlands offer unique ecosystems that can attract a diverse array of tourists seeking recreational activities, serene natural environments, and cultural experiences (Rodrigues, 2015; Prideaux et al., 2009; Chakraborty et al., 2020). The manipulation of these natural assets, regions can create tourism offerings that not only provide economic benefits but also enhance environmental stewardship and community engagement.

Inland water tourism can lead to the creation of various products and services, such as eco-friendly boat tours (dolphin and whale watching tours), fishing and angling experiences, nature-based accommodations, and educational programs focused on local biodiversity and conservation efforts (Zeppel, 2008; Dash & Balamurugan, 2024). These initiatives can boost local economies by generating jobs, supporting small businesses, and increasing demand for local crafts and culinary specialties (Davenport & Davenport, 2006; Vumbunu et al., 2021; Mancini et al., 2022). Furthermore, by fostering partnerships between local governments, tourism operators, and community organizations, stakeholders can ensure that the benefits of tourism are equitably distributed and that local cultures and traditions are preserved and promoted (Rahman and Baddam 2021; Semwal et al. 2024; Chauhan 2025).

Sustainability is a core principle of the BE, and inland and marine water tourism can exemplify this by prioritizing environmentally responsible practices. Implementing measures to minimize ecological impact, such as using electric or non-motorized boats, promoting low-impact activities, and establishing guidelines for wildlife interactions, can help protect fragile ecosystems while still providing enjoyable experiences for visitors (Veríssimo et al., 2021). Additionally, educational initiatives aimed at tourists can raise awareness

about the importance of conserving water resources and protecting local habitats, fostering a sense of responsibility and connection to the environment (Sharma & Sodani, 2024; Cook, 2024).

Moreover, the development of inland water tourism can play a crucial role in climate adaptation and resilience (Mereu et al., 2016; Jarratt & Davies, 2020). Through promoting activities that encourage appreciation for natural water systems, communities can strengthen their ties to these resources and enhance their capacity to respond to environmental changes. Investments in tourism infrastructure, such as trails, observation points, and information centers, can also support conservation efforts and improve public access to these vital ecosystems (Wolf et al., 2019). Therefore, creating a harmonious relationship between tourism and environmental conservation, inland water tourism can serve as a vital pillar of the BE, driving sustainable growth while safeguarding precious aquatic resources for future generations.

4.3. Investment in marine and inland waterway transportation infrastructures

Over 90% of world trade uses sea routes and many economic sectors are either directly or indirectly dependent on ocean resources (Lane & Pretes, 2020; OECD, 2022). These include traditionally exploited marine resources (living resources such as fish and/or non-living resources such as oil and gas) as well as the use of the ocean/ seas for tourism, research and shipping (Brodie Rudolph et al., 2020; Carolyn, 2022). Investment in inland waterway transportation infrastructure is another opportunity within the BE framework (Bu & Nachtmann, 2021). Through enhancing inland and marine waterways, countries can develop a more efficient, cost-effective, and environmentally friendly mode of transport that reduces reliance on road and rail networks, thus decreasing carbon emissions and mitigating traffic congestion (Bu & Nachtmann, 2021; Hassan & Xuefeng, 2022). Improved inland and marine waterway systems can facilitate the movement of goods and people, bolster local economies, and promote trade, particularly in regions where traditional transport modes are limited or inefficient (Garrido & Pimentel, 2023). Moreover, such investments can stimulate tourism and recreation, further contributing to economic diversification (Mamirkulova et al., 2020; Nguyen, 2021; Apriyanti, 2024; Corboș et al., 2024). With the global push towards sustainability, enhancing inland waterway transportation aligns with the principles of the BE by promoting integrated approaches to resource management that also consider the ecological impacts of transport infrastructure (Outa et al., 2021; Ding & Tabeta, 2024; Marwa et al., 2024; Buhiyan et al., 2025).

4.4. Develop and deploy renewable energy technologies that utilize inland water bodies

The development and deployment of renewable energy technologies that utilize inland water bodies represent a significant opportunity within the BE framework (Attri, 2016; Karani et al., 2022; Pires Manso et al., 2023). Inland and marine water bodies, such as lakes, rivers, reservoirs and oceans/ seas, are underutilized resources that can be harnessed for sustainable energy generation. By applying technologies such as hydropower, solar photovoltaics, and floating wind turbines, these water bodies can provide clean and renewable energy while minimizing environmental impacts (Pouran et al. 2022; Benjamins et al. 2024; Chen et al., 2024a; Katare et al., 2024; Marino et al., 2025). For instance, the implementation of hydropower systems can generate electricity without the large-scale disruptions typically associated with traditional fossil fuel extraction (Opperman et al., 2023; Moran et al., 2018). Moreover, solar panels installed on the surfaces of reservoirs not only produce energy but also reduce evaporation and help maintain water levels, thereby benefiting local ecosystems (McKuin et al., 2021; Pringle et al., 2017). This dual functionality enhances the resilience of both energy and water resources, promoting sustainability and economic growth. Furthermore, the development of these technologies can create jobs in engineering, installation, and maintenance, contributing to local economies and fostering community engagement in renewable energy initiatives (Bishoge et al., 2020; Dirma et al., 2024; Ma & Wang, 2025; Unegbu et al., 2025).

4.5. Support research and development in the BE sector

Support for research and development (R&D) in the BE sector represents an opportunity for sustainable economic growth and environmental conservation worldwide (Fontes et al., 2019; Lee et al., 2020; Samad and Abbasi 2022; Kontovas et al., 2022; Almeida et al., 2025; Rafiq et al., 2025). The BE encompasses a range of activities related to the ocean and coastal resources, including fisheries, marine biotechnology, and renewable energy (Choudhary et al., 2021; Youssef, 2023; Elston et al., 2024). The investment in R&D, stakeholders can develop innovative technologies and sustainable practices that enhance productivity while minimizing ecological impact (Lee & Min, 2015; Sarpong et al., 2022; Kwilinski et al., 2025). For instance, advancements in aquaculture can lead to more efficient fish farming techniques that reduce overfishing and habitat destruction, thereby contributing to biodiversity preservation (Boyd et al., 2020; Blanchard et al., 2017). Therefore, prioritizing R&D in the BE not only fosters economic resilience but also promotes the sustainable management of marine resources for future generations.

4.6. Collaborate with African governments and other stakeholders to develop and implement sustainable BE policies

Collaborating with African governments and other stakeholders to develop and implement sustainable BE policies presents a significant opportunity for the growth and resilience of the region's marine and coastal resources (Karani et al., 2022; World Bank, 2025). In working together with governments, local communities, NGOs, and private sector actors, stakeholders can ensure that policies are inclusive, transparent, and reflective of the needs and priorities of the people who depend on these resources (White et al., 2022; Nurfallah & Saputra, 2025; Ibrahim et al., 2025). This collaboration among stakeholders can facilitate the sharing of best practices and innovative solutions tailored to local contexts, enabling the development of strategies that balance economic development with environmental protection (Niner et al., 2022; Karani et al., 2022; Elston et al., 2024). For instance, joint efforts can lead to the establishment of marine protected areas, the promotion of sustainable fishing practices, and the creation of resilient coastal management frameworks that not only safeguard biodiversity but also support the livelihoods of coastal communities (Diz et al., 2018; Weigel et al., 2014). Furthermore, these partnerships can attract investment and technical assistance from international organizations and private entities, fostering an ecosystem conducive to sustainable economic growth (Luna, 2024; Hafidh et al., 2024). This collaborative approach will empower African nations to take ownership of their marine resources, ensuring that the BE becomes not only a pathway to economic prosperity but also a means to enhance social equity and environmental sustainability (Niner et al., 2022; Karani et al., 2022; Matovu et al., 2025).

5. Legal and Institutional Frameworks of Eeconomy

As the concept of BE focused on the sustainable use of ocean resources, is supported by a complex web of legal and institutional frameworks, both international and national (Ward, 2008; Tirmizi, 2010; Kuboja, 2013; Grip, 2017; Kaltenborn et al., 2017; Molla et al., 2019; Rahman, 2021; Jahromi & Jahromi, 2023; Bennett et al., 2024). The global legal framework for BE encompasses international conventions like the UN Convention on the Law of the Sea (UNCLOS) and regional frameworks, as well as national policies and regulations. It aims to promote sustainable marine resource use and protect biodiversity, and resilient environment, while fostering economic growth, research and innovation in ocean-related sectors. The United Nations Convention on the Law of the Sea of 1982 (UNCLOS, 1982) is a cornerstone, providing the overarching legal framework for ocean activities. Many national governments have developed specific policies and laws to manage their coastal and marine resources, often aligning with UNCLOS.

5.1. European continent

In Europe, BE activities are managed under several maritime policies and other legal legislation that were formulated, approved and implemented across the European countries (Innocenti and Attombri, 2024; Lise et al., 2025). European Maritime States have commitments to protect species and habitats and maintain quality

standards in coastal and offshore waters, which enhanced direct response to environmental legislation in Europe (Rogers et al., 2007; Carpenter, 2012; Puharinen, 2023). These commitments to biodiversity conservation made during the opening of The Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') for signature in Paris on 22 September 1992 and at the World Summit on Sustainable Development (Rogers et al., 2007). On the other hand, in November 2009, the Marine and Coastal Access Act (MCAA) was passed and implemented, aimed to the management and protection of the marine and coastal environment in the UK (Rodwell et al., 2014). This act enabled the establishment of eight (8) main components which include: the establishment of the Marine Management Organisation (MMO); a marine planning system; a reformed marine licensing system; a new mechanism for marine nature conservation; modernising of inshore fisheries management and marine enforcement; a new authorisation scheme for migratory and freshwater fisheries; improvement in coastal access; and a more 'joined up' approach to coastal and estuarine management (Rodwell et al., 2014).

In addition, in 2011, UK formulated and implemented Marine Policy Statement of 2011, which enabled the facilitation and support the formulation of Marine Plans particularly Marine Spatial planning (MSP) across the UK maritime, ensuring that marine resources are used in a sustainable way in line with the high-level marine resources objectives. This objectives include to promote sustainable economic development; enabled the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change, and ocean acidification, and adapt to their effects; ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and heritage assets; and contribute to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues. Moreover, Marine Strategy Framework Directive (MSFD) and Marine Spatial Planning (MSP) were also implemented soon after launched the implementation of marine policy of 2011 (Brennan et al., 2014). The MSFD imposed a duty on Member States to achieve Good Environmental Status (GES) in four regional seas, while MSP required Member States to replace their fragmented (Brennan et al., 2014). Thereafter, the review was done Ten (10) years post passed the Marine and coastal access act. 2009, which led to the introduction of marine spatial planning to UK to access progress and effectiveness of the plans and their policies across the UK member states (Slater et al., 2020). The review outcomes indicated that Scotland has led the way with a National Marine Plan that has already been reviewed; England's approach has been to produce a sequence of regional plans with two adopted; Wales adopted its National Marine Plan in November 2019, while Northern Ireland's national marine plans are not yet adopted but it is under preparation in 2020, with the target to be adopted on 2023 (Slater et al., 2020). In Sweden, adopted EU Integrated Maritime Policy in 2009, two years after being launched in 2007, aimed to create a competitive, innovative, and sustainable maritime sector that promotes safe, efficient, and environmentally sound shipping while also ensuring sustainable management of marine resources. This was achieved through various policies and initiatives, including the Swedish Maritime Strategy of 2015, under the work of the Swedish Maritime Administration established in 1956, and Swedish Agency for Marine and Water Management in 2011. All these institutions were aimed at ensuring that shipping can operate safely and efficiently throughout the year in the Swedish waters and in all ports.

In addition, National Transport Policy of 1998 and its amendments of 2009, aimed at ensuring accessibility to all, high quality, safe, and environmentally friendly transport and fair pricing and efficiency as well as aligned with the EU's sustainable transport system objectives, which focused on climate change, green transport technology, and modal shift (Burden et al., 2023). Others legal frameworks implemented in Europe include Government Resolution on Finland's maritime policy guidelines of 2019, aimed to ensure that Finland exercises global influence and produces solutions ensuring that the use of marine natural resources is sustainable, the state of the marine environment is good and the effects of climate change do not exceed the carrying capacity of the oceans.

5.2. American Continent

In America, the legal framework for the BE in the United States is built upon a combination of federal laws, executive orders, and regulatory agencies that govern the sustainable use of ocean and coastal resources. Key legislation includes the Coastal Zone Management Act (1972), which promotes balanced coastal development and conservation, and the Magnuson-Stevens Fishery Conservation and Management Act (1976), which regulates marine fisheries within U.S. waters. The Ocean Policy Committee, re-established under Executive

Order 13840 (2018), coordinates national efforts to advance ocean science, technology, and economic growth, aligning with BE goals. Additionally, agencies such as NOAA, the U.S. Coast Guard, and BOEM oversee ocean-related activities including marine spatial planning, offshore energy, fisheries, and marine transportation. Collectively, this framework supports innovation, job creation, environmental protection, and resilience in USA ocean sectors.

5.3. Asian Continent

In Asian countries, BE economy activities were managed regionally through established Association of Southeast Asian Nations (ASEAN), an intergovernmental organization aims to promote economic and security cooperation among its ten members: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The ASEAN's leaders were committed to promoting BE through the ASEAN Leaders' Declaration on the BE, which was adopted at the 38th and 39th ASEAN Summit held in October 2021. The tasks were assigned to the ASEAN Coordinating Council (ACC) to oversee the overall implementation of this Declaration and explore and develop modalities for cooperation on the BE.

In China, the BE initiatives are managed by The China Council for International Cooperation on Environment and Development (CCICED), has long served as a vital platform for advancing sustainable development in China through high-level policy dialogue and international cooperation. Since its establishment in 1992, the CCICED has brought together Chinese and global experts to address pressing environmental challenges, fostering innovative solutions for green growth, climate resilience, and ecological conservation. As China accelerates its transition toward a sustainable future, the ocean has emerged as a critical frontier for balancing economic development with environmental stewardship. As part of its current Phase VII (2022–2027) studies, CCICED is leading the "Sustainable Oceans Management under the Vision of Carbon Neutrality" initiative. This initiative aimed at developing governance frameworks, blue finance systems, and green technologies to support an ocean-based economy aligned with carbon neutrality goals. In addition, the initiative enabled China to consider sustainable BE as a strategic national development priority within its overall carbon peak and neutrality objectives. It calls for reforms in fisheries governance, marine plastic pollution reduction, ocean industry accounting, and integration of blue-carbon ecosystems (CCICED, 2023).

5.4. African Continent

In Africa, Blue Economy (BE) activities are coordinated regionally, particularly across the Western Indian Ocean region (Colgan et al., 2021).

In Tanzania, BE governance is split between the Ministry of Livestock and Fisheries on the mainland and the Ministry of Blue Economy and Fisheries in Zanzibar. The key legal instruments in Zanzibar include the Fisheries Act (2010), Maritime Transport Act (2006), Environmental Management Act (2015), BE Policy (2020), and Fisheries Policy (2022). In mainland Tanzania, BE activities are managed by the National Fisheries Act (2003), Fisheries Regulations (2009), Environmental Management Act (2004), National Fisheries Policy (2015), Deep-Sea Fisheries Management and Development Act (2020) and Regulations (2021), and the National BE Policy (2024). These frameworks collectively regulate sustainable resource use, aquaculture, and marine ecosystem conservation.

In Kenya, BE is governed under the Fisheries Management and Development Act (2016), Fisheries (General) Regulations, and sector-specific instruments such as the Prawn Fishery Management Plan (2010) and Fisheries Lake Naivasha Regulations (2012). Marine environmental protection is managed by the Environmental Management and Co-ordination Act and the National Environment Policy (2013), promoting integrated resource management and community involvement. Mozambique governs its BE through Fisheries Law (2013), Law of the Sea (2019), multiple decrees regulating maritime surveillance, fisheries, sport fishing, and environmental impact assessment, as well as the Policy and Strategy of the Sea (2017) and the Environmental Act (2014), ensuring sustainable development and biodiversity protection.

In South Africa, the BE is regulated through the Marine Living Resources Act (1998), Fisheries Management and Development Act (2016), Marine Protected Areas Act (2003), and Aquaculture Development Bill (2023), complemented by the Small-Scale Fisheries Policy (2012), National Freshwater Wild Capture Fisheries Policy (2022), and National Environmental Management Acts (1998, 2008). These instruments

emphasize sustainable utilization of marine resources, community upliftment, food security, and ecosystem protection.

Madagascar's BE is governed by the Fisheries and Aquaculture Ordinance (1993), industrial and artisanal shrimp fishing regulations (2000), trawling regulations (2003), and environmental management under the Environment Charter (1990, amended 2015) and MECIE Decree (2004), ensuring sustainable fisheries and ecosystem protection. Mauritius regulates fisheries and aquaculture through the Fisheries and Marine Resources Acts (1998, 2007, 2023), the Maritime Zone Act (2005), and a suite of regulations addressing marine protected areas, species management, and EU partnership agreements (2013–2026). Environmental management is guided by the Environmental Protection Act (2002), preventing marine pollution and ensuring sustainable development.

Comoros manages BE via the Fisheries and Aquaculture Act (2007) and is committed to the Fisheries Transparency Initiative (FiTI). Marine environmental protection is guided by the Environment Act (1994) and related decrees, including those establishing marine parks, biodiversity conservation, and environmental impact assessments. Seychelles implements BE governance through the Fisheries Act (2014), Fisheries (Aquaculture) Regulations (2020), Conservation and Climate Adaptation Trust Act (2015), Maritime Zone Act (1999, amended 2009), and the Fisheries Sector Policy and Strategy (2019), with marine environmental oversight through the Environment Protection Acts (2016, 2019) and associated regulations for waste, plastics, and disaster risk management. These frameworks collectively ensure sustainable fisheries, aquaculture, marine conservation, and alignment with socio-economic development goals.

6. Challenges and Constraints to Blue Economy Development

The development of the BE, emphasizes the sustainable use of ocean resources for economic growth, improved livelihoods, job creation and ocean ecosystem health. However, despite the promises of the BE, there are ongoing challenges that need to be addressed. Overfishing and fisheries resources depletion, marine pollution, and habitat destruction continue to jeopardize marine ecosystems, making it imperative for stakeholders to adopt more sustainable fishing practices (Carneiro et al., 2021). Moreover, the impact of climate change, particularly on ocean temperatures and acidity levels, poses additional threats to marine biodiversity and the industries reliant on these resources (Doney et al., 2012; Talukder et al., 2022; Jan et al., 2023). In addition, the equitable distribution of benefits from BE initiatives remains a key concern, as marginalized communities often lack access to the resources and decision-making processes related to ocean management (Das, 2023; Chen et al., 2024b; Croft et al., 2024; Cisneros-Montemayor et al., 2025). Building resilience through inclusive policies that engage local communities and incorporate traditional knowledge is essential for fostering a truly sustainable BE (Elston et al., 2024; Caldeira et al., 2025).

6.1. Overfishing and fisheries resources depletion:

Overfishing and fisheries resource depletion pose significant challenges to marine ecosystems and the communities that depend on them (Sumaila et al., 2016; Murawski, 2000). According to Möllmann & Diekmann (2012), unsustainable fishing practices have a direct consequence, not only for fish stock populations but also for the broader ecological balance and the economic livelihoods of people around the world. The impacts include the depletion of fish stocks when fish are caught at a faster rate than they can reproduce. For instance, the Atlantic cod fishery was once one of the most abundant fish stocks but suffered a dramatic decline due to excessive fishing, leading to its collapse in the 1990s (Hilborn & Litzinger, 2009). Overfishing also disrupts the food chain, leading to the decline of other marine species (Roux et al., 2013). For example, the fishing of large predatory fish such as sharks can result in the overpopulation of smaller fish, altering the ecological balance and causing damage to coral reefs due to unchecked herbivore populations (Ferretti et al., 2010; Fenner, 2012; Douglas, 2025). The loss of these crucial species accelerates habitat destruction and diminishes biodiversity. Moreover, many fishing methods, such as trawling, lead to bycatch and habitat destruction through the capture of non-target species and juvenile fish, which are usually discarded dead or dying (Davies et al., 2009; Boussarie et al., 2020; Raju & Rajan, 2024). The shrimp trawling industry is well known for its significantly high bycatch rate of up to 80%, which threatens and endangers the survival

of vulnerable species such as sea turtles and seabirds (Criales-Hernandez et al., 2006: Al-Baz & Chen, 2015; Abdulqade et al., 2015; Abdulqader et al., 2020).

6.2. Marine Pollution

Various forms of marine pollution, such as plastic waste, oil spills, heavy metals, and agricultural runoff, pose significant challenges to the development of the BE worldwide (Islam & Tanaka, 2004; Landrigan et al., 2020; Abirami, 2024; Motlagh et al., 2025). These pollutants degrade marine ecosystems and negatively impact biodiversity. Critical habitats such as coral reefs, mangrove forests, and seagrass meadows which are essential for maintaining ecosystem health, particularly vulnerable to pollution (Aniebone et al., 2024). According to Aniebone et al. (2024), a healthy ecosystem forms the foundation of the BE; therefore, pollution directly hinders its development. Furthermore, pollutants disrupt marine food chains through bioaccumulation, leading to declines in fish stocks and other marine organisms (Spalding, 2016; Okafor-Yarwood et al., 2020). This, in turn, threatens ecological balance and undermines fisheries, which are considered an essential component of the BE. Pollution also reduces the attractiveness of coastal and marine areas, severely affecting development of tourism industry (Arabadzhyan et al., 2021; Metilelu et al., 2022; Das, 2023; Hernández et al., 2023; Sikotariya et al., 2024). For example, algal blooms caused by agricultural runoff or oil spills can make coastal areas less appealing, as beaches, dive sites, and marine parks lose their charm, which are resulting in fewer tourist arrivals and economic losses for coastal communities (Sarkar & Sarkar, 2018; Shah & Soni, 2024). Therefore, marine pollution significantly undermines the potential of the BE by degrading ecosystems, harming fisheries, reducing tourism, and posing both health risks and economic burdens (Thushari & Senevirathna, 2020).

6.3. Climate Change

Rising surface sea temperatures, ocean acidification, and changing weather patterns impact marine ecosystems and coastal communities, creating uncertainty for sectors reliant on ocean resources (Speers et al., 2016; Hoegh-Guldberg and Bruno 2010; Doney et al., 2012). These climate changes challenge the development of the BE in several ways such as; Shifts in marine biodiversity. Rising sea temperature and ocean acidification alter the distribution and abundance of marine species. For instances, fish populations tend to migrate to cooler waters, affecting fisheries and livelihood of fishing communities (Deepananda & Macusi, 2012). According to Wetz & Yoskowitz (2013) rising sea levels and extreme weather events also lead to coastal erosion, loss of habitat and increased salinity in estuaries and wetlands. This threatens marine biodiversity and affect tourism and recreational activities that form an integral part of the BE. While climate change presents numerous challenges for the BE, it also offers opportunities for innovation and transformation towards sustainability.

6.4. Poor Governance and Regulation

Effective governance and regulatory frameworks are essential for the sustainable management of marine resources and the protection of marine ecosystems (Bennett & Dearden, 2014; Soma et al., 2015). However, many countries, particularly those with limited financial and institutional capacity, struggle to enforce existing laws and regulations. This enforcement gap poses significant challenges, leading to widespread of illegal fishing practices that not only deplete fish stocks but also disrupt the ecological balance of marine habitats (Zulfiqar & Butt, 2021). Additionally, unregulated activities such as coastal development, pollution, and overfishing contribute to habitat destruction and further increase the vulnerability of marine environments (Airoldi 2004; Ben-Hasan & Christensen, 2019; Sumaila & Tai, 2020; Cordova et al. 2025; Pawar, 2016; Elisha & Felix, 2021). These issues are compounded by the insufficient protection of marine areas. Many designated marine protected areas (MPAs) lack the resources and management capacity needed to be effective. As a result, conservation efforts are often undermined, leading to declines in biodiversity and the loss of critical ecosystem services that support both coastal communities and the global economy (De Groot et al., 2012; Ingram et al., 2012; Ferraro et al., 2025).

6.5. Limited Investment and Funding

Investment and funding for sustainable projects within the BE face significant challenges, particularly in developing countries, whereby financial resources are often limited (Islam & Sarker, 2022). The BE encompasses various sectors such as fisheries, marine tourism, and renewable ocean energy, all of which require substantial upfront capital for infrastructure, technology, and capacity building (Bari, 2017; Islam et al., 2018; Lee et al., 2020; Martínez-Vázquez et al., 2021). Many developing countries struggle to attract private investment due to perceived risks, lack of regulatory frameworks, and limited access to financial markets (Martínez-Vázquez et al., 2021). Furthermore, international funding mechanisms, such as climate finance and development aid, may not be adequately aligned with the specific needs of BE initiatives, leading to insufficient support for innovative projects (Sumaila et al., 2021). Public-private partnerships can play a crucial role in bridging this funding gap, but they require a conducive policy environment and strong institutional frameworks to be effective. In addition, a conducive environment includes clear legal frameworks, streamlined procurement processes, and effective risk management strategies (Suwardi & Saad, 2024; Nwaoburu & Mark ,2025; Kumar et al., 2025).

6.6. Poor adoption of Technology and Innovation

Access to advanced technologies is crucial for sustainable fishing, aquaculture, and marine conservation, tourism sector development (Agboola, 2014; Sankhla et al., 2020; Modeel et al., 2024). Although many regions particularly in developing countries face a significant barrier in adopting these innovations. Limited financial resources, inadequate infrastructure, and a lack of technical expertise hinder the implementation of environmentally friendly practices (Sungkawati, 2024; Choudhary et al., 2021). Technologies such as satellite monitoring, drone surveillance, and artificial intelligence can enhance fishery management by providing real-time data on fish stocks and ecosystem health, ultimately leading to more sustainable practices (Toonen & Bush, 2020; Rahimi-Midani, 2023; Mandal & Ghosh 2024). Moreover, innovations in aquaculture, such as integrated multi-trophic aquaculture (IMTA) and biofloc technology, can reduce the environmental footprint of fish farming while increasing productivity (Khanjani et al., 2022).

In addition, Technology plays a crucial role in enhancing the experience and sustainability development of eco-tourism industry (Zhang & Deng, 2024; Kesavan & Polisetty, 2025). The adopted technologies have enabled personalized travel experiences, simplified bookings, and expands global reach through digital marketing and social media (Yavorska et al., 2019; Huo et al., 2021). Technology also helps manage visitor numbers, monitor environmental impact, and offer immersive educational experiences, ultimately contributing to a more responsible and sustainable eco-tourism model (Zhang & Deng, 2024). However, application of technological innovation has disrupted the tourism industry, even more than social media channels due to the rise of the sharing economy that made possible by the widespread use of digital technologies, such as smartphones, and the ubiquitous availability of the mobile Internet, peer-to-peer sharing platforms like Airbnb have revolutionized tourism in the aftermath of the global financial crisis (Hallak et al., 2020). Recently, GIS technology was considered as a valuable tool for investigating specific questions that pertain to tourism development including location, condition of the area, trends and changes, routing to and through the site, and patterns associated with resource use (Dye & Shaw, 2007). Nevertheless, it has a strong relationship between tourism development and land use change. Additionally, GIS has been used in tourism as a decision supporting tool for sustainable tourism planning, impact assessment, visitor flow management, and tourism site selection (Rahman, 2010). According to Rahman (2010), application of GIS is limited in tourism but recently used for park management, facility monitoring, visual resource assessment, and identifying suitable areas for developing tourism activities.

6.7. Inter-sectoral conflicts

Inter-sectoral conflicts in ocean management often arise when competing interests such as tourism, fishing, shipping, and renewable energy clash, complicating efforts to implement cohesive and sustainable strategies (Virto, 2018; Huck, 2022; Arora et al., 2023). Sectors frequently prioritize economic gains over ecological considerations, resulting in over-exploitation of marine resources, habitat degradation, and heightened environmental risks (Ebarvia, 2016; World Bank & UNDESA, 2017). For example, shipping lane expansions can disrupt fishing grounds, while offshore renewable energy projects may interfere with tourism in pristine

marine areas (Smyth et al., 2015; Lloret et al., 2022). These conflicts are often exacerbated by fragmented governance and limited stakeholder engagement, underscoring the need for integrated ocean management (IOM) that balances economic interests with environmental sustainability (Winther et al., 2023; Xue et al., 2023).

Small-scale fisheries in the developing countries are particularly vulnerable, facing challenges in resource governance and fish allocation rights (Chuenpagdee, 2011; Bower et al., 2014). The growth of recreational fisheries can provide alternative livelihoods but may also intensified social conflicts when access is contested, particularly in communities with low resilience to ecological and economic shocks (FAO, 2010; Bower et al., 2014). Effective conflict management in such contexts requires understanding of local dynamics, and adopting strategies that prevent or mitigate disputes, while promoting sustainable resource stewardship. Both 'top-down' and 'bottom-up' approaches have proven effective in different contexts: top-down strategies, involving government-led regulation and partnerships, successfully resolved conflicts in South Africa's Orange Vaal River and San Salvador, Philippines, whereas bottom-up approaches, characterized by community-led co-management, worked in northern Mongolia, relying on voluntary participation and shared responsibility (Jensen et al., 2009; Wilson et al., 2006; Bower et al., 2014).

Various tools support conflict management and IOM, including market-based instruments (MBIs), ecosystem-based management (EBM), marine spatial planning (MSP), integrated coastal zone management (ICZM), and sea-land/land-sea management (SLM). These approaches facilitate sustainable ocean governance and advance SDG14 (conserve and sustainably use oceans, seas, and marine resources), and are increasingly applied in both developed (Norway, USA) and developing (China) countries to balance industrial, economic, and environmental objectives (Xue et al., 2023). For instance, Norway's Barents Sea marine development plan (2006) strategically rezoned areas for energy production, fisheries, biodiversity reserves, and shipping, while introducing eco-environmental compensation measures to reconcile industrial activity with ecosystem protection (Øseth & Korneev, 2020). Similarly, Australia's early 21st-century management of the Great Barrier Reef delineated tourism zones from coral reef areas, successfully integrating ecosystem conservation with tourism development, demonstrating the potential of coordinated spatial planning to achieve both ecological and economic outcomes (Vince, 2018; Xue et al., 2023).

7. Interlinkages between the Blue Economy and Circular Economy

Rapid human population growth has intensified the over-exploitation and mismanagement of marine natural resources and ecosystems worldwide. As a result, the planet is approaching or has already exceeded several environmental tipping points, increasing the risk of irreversible ecological changes (Rockström et al., 2009; Jin & Feng, 2024). In response to these challenges, there is growing recognition of the need to rethink social and economic development models that are traditionally based on linear resource extraction and waste disposal (Ha et al., 2024). Within this context, the Circular Economy (CE) has emerged as a transformative framework aimed at decoupling economic growth from resource depletion and environmental degradation (Kirchherr et al. 2023; Upadhayay et al. 2024; Sangoremi et al. 2025). The Circular Economy is commonly defined as an economic system that replaces the "end-of-life" concept with strategies focused on reducing, reusing, recycling, and recovering materials across production, distribution, and consumption processes (Kirchherr et al., 2017; Kirchherr et al. 2023). On the other hand, CE is widely recognized as a central pillar for achieving environmental and economic sustainability on a global scale (Teixeira, 2024). Consequently, CE has gained increasing attention from both governments and the private sector as a pathway toward sustainable development. In Africa, although several countries have begun adopting circular economy–related policies at national and regional levels, the integration of CE principles remains limited and is not yet fully mainstreamed (Andriamahefazafy & Failler, 2022).

Recent studies highlight the strong interlinkages between the CE and the BE, particularly in the sustainable management of marine and aquatic resources. Evidence suggests that improved circularity performance enhances the sustainability and productivity of marine living resources, thereby supporting a more resilient BE (Ha et al., 2024). The BE and CE are therefore increasingly viewed as symbiotic frameworks that jointly promote sustainable development by integrating ocean resource management with waste reduction, material reuse, and ecosystem restoration (Pacheco, 2022; Ha, 2024). In this sense, the BE can be understood as a sectoral and spatial domain within which Circular Economy principles are operationalized. While the BE

focuses on sustainable maritime industries such as fisheries, renewable energy, and tourism, the Circular Economy provides the operational framework to minimize waste, recycle marine-based materials (e.g., fishing nets), and restore marine ecosystems (Andriamahefazafy & Failler, 2022; Ha, 2024). The relationship between New BE and CE is described briefly in fig. 5.

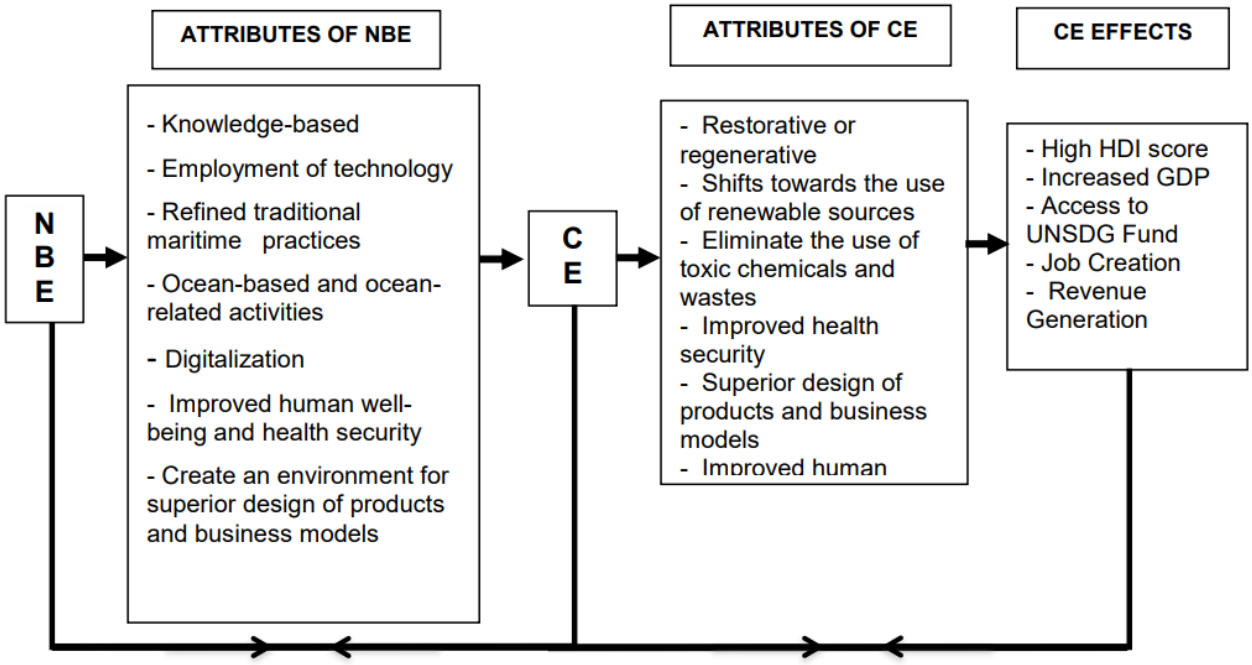

Figure 5: Relationship between New BE and Circular Economy, *Source:* Pacheco (2022) (*NBE: New BE; CE: Circular economy; HDI)*

8. Strategic Priorities and Future Directions in the Blue Economy

Fostering BE initiatives presents a promising opportunity to significantly enhance socio-economic development, promote sustainable utilization of ocean resources, ensure economic stability, and support environmental resilience in both developed and developing countries. The future of the BE lies in its strategic alignment with environmental sustainability, technological innovation, inclusive governance, and regional cooperation. As global attention to ocean health and climate resilience continues to intensify, countries including coastal and island states, must prioritize integrated marine spatial planning, adopt ecosystem-based management approaches, and invest in science and innovation. The BE holds the potential to become a transformative force for inclusive and sustainable growth, especially in developing countries like Tanzania, where marine and freshwater resources remain underutilized. To unlock its full potential, coastal and island states must adopt integrated approaches that combine sustainable practices with innovative technologies. Therefore, in the future, greater emphasis should be placed on:

i. Building institutional and human capacity to manage emerging sectors such as blue biotechnology, oil and natural gas exploration, marine renewable energy, and carbon sequestration through blue carbon ecosystems.
ii. Enhancing data collection and monitoring systems, and fostering public-private partnerships to ensure long-term sustainability, transparency, and accountability.
iii. Strengthening policies and regulatory frameworks to promote sustainable marine resource use, incentivize marine research and development, and support local communities in sustainable fisheries and aquaculture practices.
iv. Expanding hands-on training and capacity-building programs to empower local communities, fostering a sense of ownership and stewardship in marine conservation efforts.

v. Empowering women and youth, and integrating them into BE initiatives to promote social inclusion, equity, and community resilience.
vi. Promoting regional and international collaboration, particularly in addressing transboundary marine challenges, mobilizing blue financing instruments, and sharing knowledge and best practices.
vii. Advancing sustainable fisheries management, including the adoption of digital tools in small-scale fisheries to combat illegal, unreported, and unregulated (IUU) fishing.
viii. Strengthening collaboration among stakeholders including government institutions, private sectors, academia, and local communities to develop cohesive strategies that balance conservation and economic development.
ix. Establishing and effectively managing marine protected areas (MPAs), and promoting eco-tourism as dual strategies for biodiversity conservation and income generation.
x. Improving maritime infrastructure, such as ports, shipping facilities, and logistics systems, to facilitate trade, tourism, and regional economic integration.
xi. Balancing economic development with environmental conservation, ensuring that ocean and freshwater resources contribute meaningfully to achieving global targets such as the SDGs 2030, the African Union's Agenda 2063, and national development priorities.

9. Conclusion

This review systematically examined the BE through six guiding research questions and confirmed that each objective was substantially addressed. First, regarding the conceptual foundations and global status of the BE (RQ1), the evidence showed that BE initiatives are expanding across both developed and developing regions, particularly within fisheries, aquaculture, maritime transport, eco-tourism, and renewable energy sectors, although levels of investment and development remain uneven. On the other hand, most of the Archipelago states particularly Zanzibar Islands increasingly to integrate BE principles into their national policies, reflecting a strong commitment to balancing economic growth with ecological sustainability. Second, the review identified opportunities and economic potential of the BE (RQ2), including investment in sustainable fisheries and aquaculture practices, promotion of eco-tourism in both inland and marine water bodies, investment in marine and inland waterway transportation infrastructures, development and deployment in sustainable ocean energy technologies, support research and development in the BE sector, collaboration with African governments and other stakeholders to develop and implement sustainable BE policies and regulations, and all of which offer pathways for inclusive economic growth and diversification. Third, analysis of legal and institutional frameworks (RQ3), revealed that while many countries have established policies and governance structures to support BE development, implementation gaps, weak coordination, and limited enforcement capacity continue to constraining their effectiveness efforts. Fourth, the review confirmed that multiple challenges and constraints that hinder sustainable BE development (RQ4), notably overfishing and fisheries resources depletion, marine pollution, climate change pressures, poor ggovernance and regulation, limited Investment and funding in developing countries, poor adoption of technology and innovation, and inter-sectoral conflicts. Fifth, the assessment of the interlinkages between the BE and CE (RQ5), demonstrated strong complementarities, particularly through resource efficiency, waste reduction, ecosystem restoration, and sustainable production and consumption approaches that enhance environmental resilience. Finally, examination of research trends and future directions (RQ6), indicated growing interdisciplinary donor's funding support emphasizing innovation, ecosystem-based management, digital technologies, and inclusive governance as critical pathways for advancing BE sustainability.

Unlocking these potentials requires strong political will, coordinated policies, robust legal and institutional frameworks, and inclusive stakeholder engagement. Priority should be given to building capacity, investing in innovation and infrastructure, empowering coastal communities especially women and youth, and enhancing regional and international cooperation. In addition, with strategic planning, sustainable management practices, and the integration of science and traditional knowledge, the BE can become a driving force for a resilient and prosperous future. Countries like Tanzania, rich in aquatic resources yet underutilized, have a unique opportunity to lead in transforming the BE into a pillar of sustainable development.

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