

5. The Role of Ports as Blue Economy Hubs: Sustainability, Innovation, and Policy Alignment

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Abstract

Oceans contribute by approximately 3–5% to the global gross domestic product (GDP) and support a range of economic activities in coastal states. To balance environmental protection and economic rise, the Blue Economy concept was introduced. The blue economy concepts have been addressed via multiple literatures, however, there is a need for a systematic literature review to identify and assess the consolidated factors and existing research gaps. In this study, the research provides an observational assessment of port capacities to function as transformative pillars of the Blue Economy, focusing on their environmental performance and operational sustainability. The research results indicate that while many ports have adopted key environmental enablers, such as improved pollution control, ballast-water management, and emissions-reduction measures, their implementation varies significantly across regions, revealing persistent gaps related to governance, monitoring capability, and technological integration. From a broader perspective, the findings underscore the need for harmonized frameworks, strengthened regulatory alignment, and greater investment in green and smart port technologies to ensure that ports can fully support national and regional Blue Economy ambitions. This work contributes to the ongoing discourse by highlighting where progress has been made and where further research and policy innovation are critically required.

Keywords: Blue Economy- Environmental Performance -Operational Sustainability- Green and Smart Ports- Port Governance

1. Introduction

The stabilization of the earth's climate requires the support of the ocean as it plays a vital role for human life through the provision of essential natural resources, including food, raw materials, valuable substances and energy, moreover it is fundamental to global trade too. However, the expansion of the economic growth and the human development have placed the marine ecosystems into an increasing strain through the open and intensive use of ocean resources and services, this pressure is driven by activities such as overfishing, resource extraction and pollution related disruption of coastal and marine environment (Vega-Muñoz et al., 2021). Whereas ports sit at the heart of how societies access and benefit from ocean services, they function as primary gateways through which these resources are transferred, processed, and distributed, thereby supporting local and global economies by providing the infrastructure and connectivity that enable ocean-based activities at scale. However, as key nodes in maritime

logistics and coastal developments, ports can contribute to environmental impacts through ship emissions, ballast water discharge, waste streams, coastal industrial expansions, dredging activities and pollution risks, placing intensive pressure on marine and coastal environments if not managed properly.

Ports are increasingly overstressed by the rapid growth in cruise tourism calls, which, while economically attractive, generate environmental pressures that often exceed local waste management and monitoring capacities. This situation poses a significant environmental threat with long-term consequences when systems and controls are insufficient, leading to the failure of ports to maintain adequate facilities and remain tourism nodes rather than evolving into sustainable blue economy hubs (Sliškovic et al., 2018). For this reason, ports are not merely passive transport facilities; they play a critical role in shaping whether ocean use supports a sustainable blue economy or accelerates environmental degradation.

Ports can become blue economy hubs capable of balancing economic growth with marine ecosystem protection when they (a) enable green value creation, (b) reduce environmental externalities, (c) coordinate policies and investments across public and private stakeholders, and (d) integrate stronger environmental governance supported by effective monitoring systems and sustainable green technologies.

The integration of efficient port functions as blue economy hubs typically exhibits several multi-level characteristics, including:

1. Institutionalized environmental management and disclosure, such as the adoption of Environmental Management Systems (EMS), systematic monitoring, and priority setting, with tools tailored to the specific needs, risks, and operational realities of European ports—particularly the EcoPorts Port Environmental Review System (PERS) and the Self-Diagnosis Method (SDM) (ESPO, 2025).
2. Decarbonization pathways covering port operations, the ship–port interface, and hinterland connections, supported by realistic implementation and governance frameworks (World Bank, 2025).
3. Innovation governance, which views green and digital innovation as integrated systems to enable widespread adoption and implementation (Liu et al., 2025).
4. Policy alignment across multiple governance levels, supported by strong port–city integration and coordinated governance mechanisms (OECD, 2024).

2. Research background

Ports are not only transport nodes but also institutional and infrastructural platforms that connect shipping, logistics, coastal industry, tourism, fisheries, and emerging ocean energy and data services. This positioning makes ports natural candidates to operate as blue economy hubs within an increasingly place-based blue economy development agenda that depends on local governance capacity and cross-sector coordination.

The OECD highlights that blue economy outcomes at the local and regional levels depend strongly on territorial characteristics and coordinated governance across multiple levels,

underscoring the direct and influential role that port authorities must play in shaping these outcomes (OECD, 2024).

International decarbonization pressures further elevate the enabling role of ports. The IMO's 2023 GHG Strategy sets ambitious targets and calls for measures that encourage port developments and activities supporting efficient ship–shore interfaces, including onshore power supply and the uptake of zero- and near-zero-emission fuels (IMO, 2023).

Reinforcing sustainability as a core operational priority, the World Bank's Port Reform Toolkit (Module 8) emphasizes the need for ports to integrate environmental sustainability into planning, infrastructure, and operations, addressing issues such as air emissions, water impacts, biodiversity loss, and climate risks (World Bank, 2025).

2.1 Problem Statement

Many ports have introduced sustainability measures and modernization initiatives; however, implementation varies significantly across contexts due to uneven governance capacity, monitoring systems, financing mechanisms, and technology integration. While ports may demonstrate policy adoption, formal commitments, and pilot projects, these efforts do not always translate into consistent delivery capacity. This gap undermines ports' ability to support national and regional blue economy ambitions.

2.2 Research Gap

- Decarbonization and innovation efforts frequently face governance challenges and funding constraints in regions with limited resources. Consequently, comparative research is needed to identify policy instruments and mechanisms that can support and scale implementation across diverse port contexts (Alamouch et al., 2024).
- Although tools for measuring port environmental management already exist (e.g., EcoPorts), comprehensive indicators capturing full blue economy hub performance, integrating economic value creation, environmental boundaries, and social inclusion, remain inconsistent and unevenly applied across regions (ESPO, 2024).
- The growing body of research on port–city relations highlights the need for stronger empirical studies examining how port–city conflicts are managed, how benefits are distributed, and how governance arrangements can be made more inclusive within port–city systems (Pagés Sánchez, 2025).

2.3 Research Questions and Objectives

The overarching objective of this study is to examine how ports can function as effective enablers of the Blue Economy through structured frameworks, operational practices, and governance arrangements. Accordingly, the study addresses the following research questions:

- RQ1 (Frameworks): What Blue Economy frameworks exist within ports, and to what extent are they standardized?

- RQ2 (Enablers): What port-related activities and practices facilitate the implementation of Blue Economy concepts?
- RQ3 (Governance): Which port governance models most effectively support Blue Economy activities?

These questions align with the study's aims by focusing on institutional structures, operational enablers, and governance mechanisms that shape the role of ports as transformative pillars of the Blue Economy.

3. Research Methodology

This study adopts a systematic literature review (SLR) methodology to address the core research questions. The review is conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, as articulated by Haddaway et al. (2022), ensuring transparency, reproducibility, and the minimization of selection bias.

To operationalize the review, the port-related Blue Economy framework was structured around four analytical dimensions: governance, environmental performance, operational practices, and innovation. These dimensions were translated into Boolean search clusters comprising the following search string:

("blue economy") AND (port OR ports) AND (governance OR framework) AND ("green port" OR "smart port") AND ("pollution control" OR "ballast water").

The search strategy was applied across the principal academic databases, Scopus, ScienceDirect, and Web of Science, to ensure comprehensive coverage of peer-reviewed literature. The initial screening yielded a total of 40 articles ($n = 40$), indicating a relatively limited body of literature that concurrently addresses these thematic elements. These findings highlight fragmentation within the existing research and underscores the need for more integrated analytical frameworks in port-centric Blue Economy studies. The PRISMA-based screening and selection process is illustrated in Figure 1.

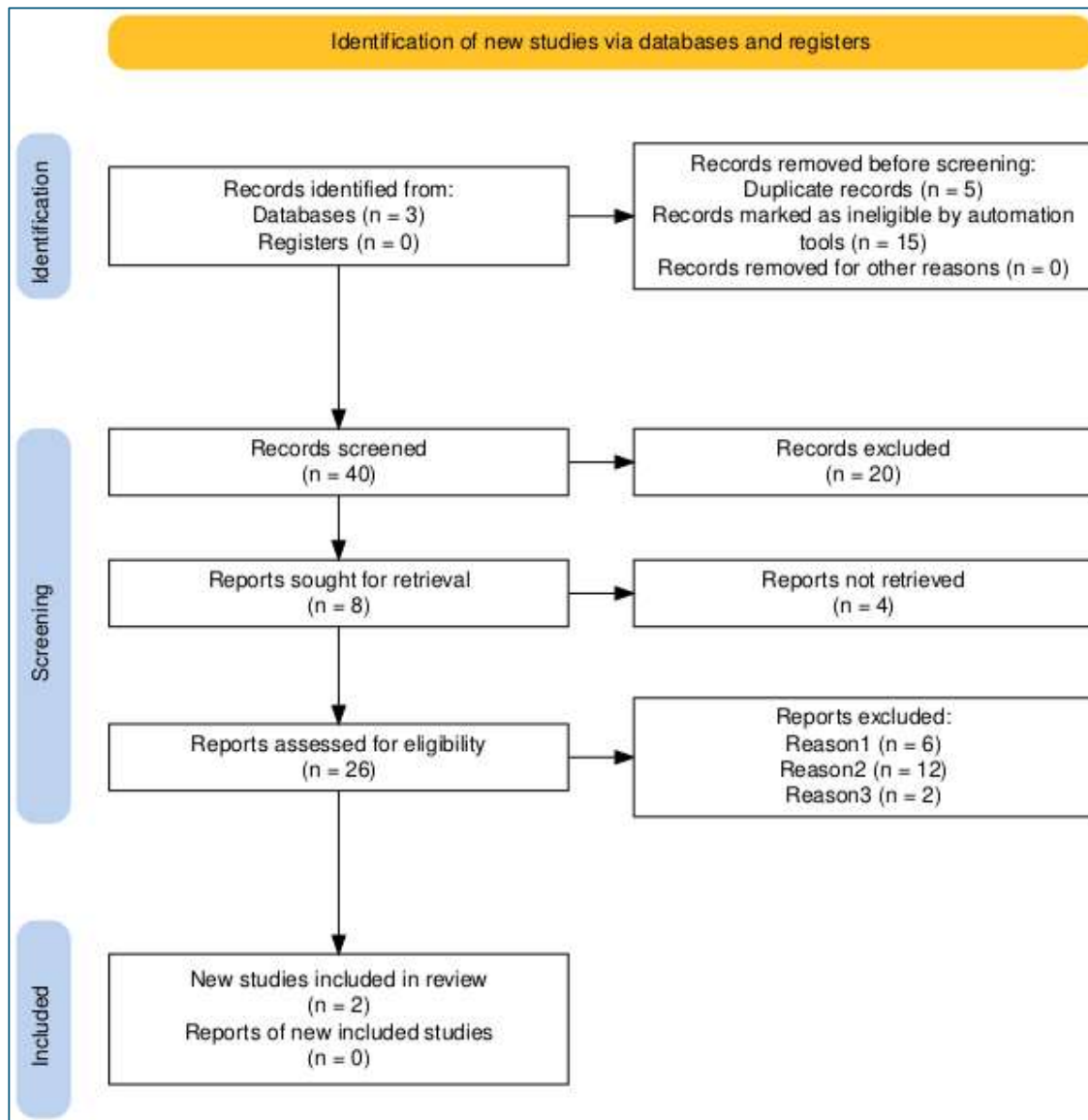


Figure 1. PRISMA for Blue economy within the ports SLR, n=40

The inclusion criteria for this systematic literature review were defined to ensure the relevance, quality, and academic rigor of the selected studies. Only peer-reviewed journal articles published in the English language were considered, as English represents the dominant language of international scholarly communication and ensures consistency in interpretation. Furthermore, eligible studies were required to have a primary and explicit focus on the Blue Economy, including its conceptualization, governance frameworks, environmental dimensions, operational practices, or innovation-related applications, with clear relevance to port or maritime contexts.

Following the initial screening, exclusion criteria were applied to further refine the dataset and enhance analytical robustness. Studies were excluded if they lacked a clearly articulated and robust research methodology, such as well-defined data collection procedures, analytical frameworks, or systematic reasoning. In addition, articles whose main findings were not directly aligned with the scope and objectives of the present study—including those with only peripheral or incidental references to the Blue Economy, were removed from further analysis. Grey



literature, conference papers, editorials, and opinion pieces were also excluded to maintain methodological consistency and ensure comparability across the reviewed studies. As a result, 26 articles were retained for inclusion in the systematic review.

This two-stage inclusion and exclusion process ensured that the final corpus of literature was both methodologically rigorous and substantively relevant, thereby strengthening the validity of the synthesis and the conclusions drawn from the review.

4. Results and Discussion

4.1 Structured Synthesis of the Core Literature Identified Through the Systematic Review

Table (1) provides a structured synthesis of the core literature identified through the systematic review, offering a transparent and comparative overview of how the Blue Economy has been conceptualized, operationalized, and evaluated across different contexts. The table systematically maps each study against five analytical dimensions, themes, scope, main findings, methodology, and geographical coverage, thereby enabling cross-study comparison and thematic pattern recognition.

This structure supports the identification of dominant research strands (e.g., governance, environmental performance, port sustainability, blue justice, and innovation), as well as methodological approaches ranging from conceptual and policy-oriented analyses to empirical case studies, systematic reviews, and quantitative assessments. By explicitly capturing regional coverage, the table also highlights spatial imbalances in the literature, revealing a concentration of studies in Europe and selected developing regions alongside a relative underrepresentation of integrated, port-focused Blue Economy frameworks at the global level.

Overall, the table functions as both an evidentiary baseline and an analytical tool, justifying the subsequent synthesis by demonstrating the fragmentation of existing research and underscoring the need for more coherent, cross-dimensional approaches to ports within the Blue Economy discourse.

Table 1. A structured synthesis of the core literature identified through the systematic review

NO	CITATION	THEMES	SCOPE	MAIN FINDINGS	REGION COVERED
1.	Spalding, M.J. (2016). The New Blue Economy: The Future of Sustainability. Journal Of Ocean and Coastal Economies, 2(2), Article 8.	Blue Economy definition; ecosystem services valuation; sustainable ocean use; integration with SDGs; ocean-positive industries; natural capital accounting.	Conceptual and policy-oriented analysis covering traditional and emerging ocean-based industries, with emphasis on sustainability metrics and national income accounting.	Argues that the traditional ocean economy is largely unsustainable. Proposes the New Blue Economy as a regenerative subset that aligns economic growth with ecosystem protection through standardized metrics, valuation of ecosystem services, and precautionary governance.	Global scope, with illustrative examples from the United States, Europe, Small Island Developing States, and Least Developed Countries.
2.	Smith-Godfrey, S. (2016). Defining the Blue Economy. Maritime Affairs: Journal of the National Maritime Foundation of India, 12(1), 58–64. https://doi.org/10.1080/09733159.2016.1175131	Blue Economy definitions; ocean economy; international trade; ocean services; minimum criteria; classification of ocean-based activities	Conceptual and literature-based review analyzing existing definitions of the Blue Economy and structuring ocean-based economic activities linked to trade, transport, and services	The paper establishes that the Blue Economy emerged from the growing importance of oceans as enablers of international trade and connectivity between markets. It critically reviews existing Blue Economy definitions and identifies minimum criteria required for an economy to be considered 'blue'; particularly the integration of economic value creation with environmental responsibility. The study further classifies ocean-based activities and services to identify priority focus areas for Blue Economy growth, providing a conceptual foundation for regulatory and economic policy development.	Global (conceptual and literature-based, no single regional focus)
3.	Bari, A. (2017) Our Oceans and The Blue Economy: Opportunities and Challenges. Procedia Engineering.	Blue Economy opportunities; GDP contribution; fisheries; shipping; tourism; energy; governance	Regional assessment of Blue Economy sectors and development challenges	Finds South Asia; especially Bangladesh, has strong Blue Economy potential, requiring political commitment, data development, and sustainable governance.	South Asia (Bangladesh, Bay of Bengal region)
4.	Patil, P., Virdin, J., Colgan, C., Hussain, M., Failer, P., & Vegh, T. (2018). Toward a Blue Economy. World Bank, Washington, DC.	Blue economy conceptualization; ocean economy vs blue economy; natural capital accounting; policy pathways; sustainability targets; ecosystem services; governance reform	National-level policy and conceptual framework aimed at guiding the Government of Bangladesh in assessing ocean-based economic activities, natural capital dependencies, and transition pathways toward a sustainable blue economy	The report establishes a clear distinction between the ocean economy and the blue economy, emphasizing the need to balance economic growth with ecological limits. It highlights critical policy gaps in measuring current ocean uses, setting sustainability targets, and defining transition pathways. A conceptual framework is proposed linking ocean-based industries with underlying natural, produced, and human capital, and identifying policy entry points to either enhance sustainable inputs from ecosystems or reduce harmful outputs such as pollution. The report stresses the importance of robust data, indicators, and monitoring systems to support evidence-based policymaking and track progress.	Bangladesh (Bay of Bengal, national maritime jurisdiction)

5.	Wenhai Et Al. (2019) Successful Blue Economy Examples with An Emphasis on International Perspectives. Frontiers In Marine Science.	Blue Economy case studies; governance; data systems; innovation; ecosystem-based management	Review and synthesis of global Blue Economy theoretical and applied case studies	Demonstrates that successful Blue Economy implementation depends on science-based policy, data sharing, international cooperation, and ecosystem stewardship.	Global (Europe, Asia, Americas, Africa)
6.	Lee, K.-H., Noh, J., & Khim, J.S. (2020) The Blue Economy and The United Nations' Sustainable Development Goals. Environment International.	Blue Economy–SDGs alignment; stakeholders; policy coherence; ecosystem services	Systematic literature review (1998–2018) examining BE linkage with UN SDGs and stakeholder roles	Finds Blue Economy strongly aligned with SDGs 14–17, but governance boundaries and stakeholder roles remain vague; calls for clearer stakeholder mapping and measurable targets.	Global
7.	Munim, Z.H., Sorn-Friese, H., & Dushenko, M. (2020) Identifying the Appropriate Governance Model for Green Port Management. Journal Of Cleaner Production.	Green ports; governance models; MCDM; sustainability; privatization	Empirical multi-criteria decision analysis comparing port governance models using ANP and BWM methods	Demonstrates that higher levels of privatization (landlord/private ports) enhance green port management effectiveness; BWM shown to be efficient decision-support tool.	Indian Ocean Rim (Bangladesh, Sri Lanka, Tanzania)
8.	Vakili, S.V., Olqer, A.I., & Ballini, F. (2020) The Development of a Policy Framework to Mitigate Underwater Noise Pollution from Commercial Vessels. Marine Policy.	Underwater noise pollution; port policy; SDGs; ocean governance; environmental management	Policy framework development proposing a port-level Underwater Noise Management Plan (UWNMP)	Identifies major regulatory and awareness gaps; positions ports as key actors in mitigating underwater noise via PDCA-based, multi-disciplinary management frameworks.	Global (policy-relevant, port-focused)
9.	Vega-Muñoz, A. Et Al. (2021) How to Measure Environmental Performance in Ports. Sustainability.	Environmental performance indicators; SDGs; green ports; measurement frameworks	Systematic and PRISMA-based review of environmental performance indicators in ports	Identifies two dominant measurement approaches influenced by ESPO and Green Marine; highlights lack of harmonized global EPP metrics and strong SDG alignment.	Global (literature-based)
10.	Nitt-Drießelmann, D. & Wedemeyer, J. Green (2021) Port Development – What role do ports play in achieving climate goals? Economic Service.	Decarbonization; climate policy; port emissions; EU MRV	Policy and emissions-accounting analysis of ports' role in achieving EU climate targets	Shows ports as multifunctional climate actors; highlights governance gaps and need for incentives, shore power, and hinterland emission reduction.	European Union
11.	Argyriou, I. Et Al. (2022) Challenging A Sustainable Port: A Case Study of	Port sustainability; KPIs; citizen participation; multi-objective optimization	Empirical case study using KPIs, surveys, SPSS, and factor analysis	Finds strong links between social acceptance, demographics, and sustainability outcomes; proposes integrated environmental–social–economic measures.	Mediterranean (Greece)

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	Souda Port. Case Studies on Transport Policy.	Blue economy policy gaps; small-scale fisheries (SSF); port development; blue justice; stakeholder participation; marine spatial planning	Empirical mixed-method study using participatory mapping, perception surveys and focus group discussions to examine impacts of port development on SSF and governance processes	Finds that port development in Lamu (Kenya) and Bagamoyo (Tanzania) has displaced small-scale fishers, degraded nearshore ecosystems, and reduced livelihood security. Reveals significant policy and governance gaps, particularly the exclusion of fishers from decision-making, weak compensation mechanisms, and limited implementation of SSF safeguards. Recommends stronger stakeholder engagement, adoption of SSF-focused Blue Economy policies, and use of Marine Spatial Planning to address blue justice concerns.	East Africa – Kenya (Lamu) and Tanzania (Bagamoyo)
12.	Thoya, P., Horigue, V., Möllmann, C., Maina, J., & Schiele, K.S. (2022). Policy gaps in the East African Blue Economy: Perspectives of small-scale fishers on port development in Kenya and Tanzania. <i>Frontiers in Marine Science</i> , 9, 933111. https://doi.org/10.3389/fmars.2022.933111	Port of the future; business models; sustainability; digitalization	Conceptual and participatory case study using Business Canvas Model for port strategy	Identifies future port roles as green energy hubs, intermodal logistics platforms, and innovation clusters; proposes transferable EU port strategy.	European Union (Barcelona case)
13.	Garrido Salsas, J. Et Al. (2022) Conceptualization of the Port of The Future Based on The Business Canvas Model. Case Studies on Transport Policy.	Ports; blue growth; marine democracy; blue justice; Environmental Impact Assessment (EIA); local ecological knowledge; participatory GIS	Comparative qualitative case studies of major port developments and their socio-ecological impacts, with emphasis on EIA processes and public participation	Across Chile (San Antonio), Panama (Colón), and Colombia (Cartagena), port expansion is linked to ecological harm (e.g., dredging/habitat impacts) and impacts on coastal livelihoods. EIA processes are largely controlled by port developers/consultants, constraining participation and sidelining local ecological knowledge; the article calls for stronger participatory rights and more democratic marine governance.	Latin America (Chile, Panama, Colombia)
14.	Anbleyth-Evans, J. (2023). Port developments and marine democracy in Latin America. <i>Marine Policy</i> .	Ocean & coastal management; governance; policymaking; Blue Economy; ports and shipping; climate change; marine spatial planning; bibliometrics	Large-scale bibliometric and knowledge-graph review of 3,782 peer-reviewed articles published in Ocean & Coastal Management between 1992 and 2021, using Cite Space to analyze trends, collaborations, and emerging topics	Demonstrates OCMA's substantial contribution to global ocean and coastal management by shaping governance, policy, and management practices. Identifies six dominant research areas: (1) marine and coastal ecology and environmental management, (2) marine spatial and resource planning, (3) port and shipping management and governance, (4) international maritime laws and regulations, (5) Blue Economy development and ocean governance, and (6) international maritime development policies. Highlights emerging themes including Blue Economy, shipping	Global (authors from over 130 countries; global coastal and ocean governance focus)
15.	Chen, J., Chen, H., Smith, T.F., & Rangel-Buitrago, N. (2023). Analyzing the impact and evolution of ocean & coastal management: 30 years in retrospect. <i>Ocean & Coastal Management</i> , 242, 106697. https://doi.org/10.1016/j.ocecoaman.2023.106697				

16.	Andersen, J.H., et al. (2023). Are European Blue Economy ambitions in conflict with European environmental visions? Ambio.	Blue Economy/Blue Growth; Maritime Spatial Planning (MSP/MSPD); cumulative pressures; ecosystem-based management; MSFD/WFD; Good Environmental Status	Scenario-based cumulative impact assessment of human stressors under EU MSPD-driven development, benchmarked against environmental objectives	decarbonization, marine litter, climate change adaptation, and marine spatial planning. Using Danish waters as a test case, the study models combined human pressures and compares a baseline with 2030/2050 scenarios. Results indicate cumulative pressures are likely to increase, suggesting deterioration of environmental status relative to MSFD/WFD objectives and potential conflict between MSPD development ambitions and environmental visions.	Denmark (Danish waters / Danish EEZ)
17.	Avilu, R.K. (2023). Limits to blue economy: challenges to accessing fishing livelihoods in Ghana's port communities. Maritime Studies, 22, 11.	Blue economy; port expansion; small-scale fisheries; political ecology; securitization; dispossession; displacement; coastal livelihoods; blue justice	Qualitative study of how port development and port-related security/urbanization affect access to fishing livelihoods in communities adjacent to major ports	Port expansion and security measures restrict access to traditional fishing spaces, create congestion in canoe bays, and together with urbanization, living costs beyond what fishing income can support. The study argues that marginalizing traditional livelihoods undermines equitable blue economy outcomes and can intensify coastal conflict, recommending justice-centered planning and inclusion of small-scale fisheries.	Ghana (port communities associated with Tema and Takoradi; Jamestown/Accra context)
18.	Techera, E.J.E. (2023). The intersection of marine and coastal conservation and nature-based solutions to climate change: Governance insights from Indian Ocean small island States. Ocean & Coastal Management, 239, 106579.	Nature-based solutions (NbS); climate change adaptation/mitigation; marine & coastal conservation; blue carbon; NDCs; governance integration; SIDS	Document analysis of Indian Ocean SIDS' NDCs to map how NbS commitments intersect with marine/coastal biodiversity conservation and governance arrangements	Across five Indian Ocean SIDS (Comoros, Maldives, Mauritius, Seychelles, Singapore), NDCs recognize marine/coastal ecosystems but vary in how explicitly they commit to NbS and governance integration. Mauritius and Seychelles provide comparatively detailed and quantified commitments (e.g., protected areas/blue carbon), while others show limited NbS references and identify data and capacity gaps; the paper stresses cross-sector coordination and regional cooperation for implementation.	Indian Ocean SIDS (Comoros, Maldives, Mauritius, Seychelles, Singapore)
19.	Taljaard, S., Weerts, S.P., & Audouin, (2024) M. Advancing sustainable port development in the Western Indian Ocean region. Current Opinion in Environmental Sustainability.	Sustainable ports; integrated port management; blue economy; ecosystem-based management	Regional policy-oriented review proposing an Integrated Port Management (IPM) framework and sustainability toolkit	Proposes a structured IPM-based toolkit across planning, design, construction and operations; stresses urgency of accelerating sustainable port development.	Western Indian Ocean (Africa)
20.	Jelić Mrčelić, G., Živanović, L., & Nerlović, V. (2024) The Role of	Fishing ports; sustainable blue economy; fisheries and aquaculture;	Conceptual and policy-oriented analysis examining the role of fishing ports within fisheries	Finds that fishing ports are critical enablers of a sustainable blue economy by supporting environmental protection, food quality and safety,	Global scope, with emphasis on FAO-led frameworks and

	Fishing Ports in the Sustainable Blue Economy. Technologia Acta, Vol. 16, No. 2, pp. 47–51. DOI: 10.51558/2232-7568.2023.16.2.47	FAO Blue Ports Initiative; SDGs; port state measures; IUU fishing control	and aquaculture value chains, aligned with FAO Blue Ports Initiative and Blue Transformation roadmap	fair pricing, workers' rights, community integration, marine spatial planning, and the prevention of illegal, unreported and unregulated (IUU) fishing.	coastal fishing ports worldwide
21.	Vaca Cabrero, J.; Gómez Garach, C.P.; Camarero Orive, A.; González-Cancelas, N. Evaluation of the Implementation of the Dimensions of the Blue Economy in Spanish Ports. Journal of Marine Science and Engineering, 12(2), 222. https://doi.org/10.3390/jmse12020222	Blue Economy dimensions; port governance; Delphi method; sustainability indicators; established and emerging maritime sectors	National-scale empirical assessment of Blue Economy implementation across 28 Spanish port authorities, covering both established and emerging maritime economic sectors	Develops a quantitative indicator to measure Blue Economy implementation in ports. Finds an average implementation level of approximately 78–80% across Spanish ports, with significant disparities between authorities. Established sectors dominate performance, while emerging sectors show high growth potential. Las Palmas ranks highest, while structural inequalities persist across the port system.	Spain (national port system: Atlantic and Mediterranean facades)
22.	Anbleyth-Evans, J. et al. (2024) From a Brown to a Blue Economy in Chile. Environmental Challenges.	Blue economy transition; marine democracy; environmental justice; participatory governance	Mixed-method empirical study using 42 cases, interviews, participatory GIS and in-depth case studies	Shows that marine democracy and integration of local ecological knowledge are critical for a just and sustainable blue economy transition.	Chile
23.	González-Laxe, F., Seijo-Villamizar, J., & Martín-Bermúdez, F. (2024) Twenty years of sustainable development and port authorities: A critical review of the literature. Marine Policy.	Port authorities; sustainability governance; indicators; ecological transition	Systematic and bibliometric review of 112 high-quality peer-reviewed studies	Identifies a paradigm shift toward ecosystem-based, indicator-driven port governance, while highlighting gaps in transformative and participatory authority roles.	Global (literature review)
24.	Almeida, M. et al. The needs and challenges of the Blue Economy sector in Portugal. Journal of Environmental Management.	Blue economy governance; stakeholder participation; policy alignment; innovation gaps	Participatory stakeholder workshops aligned with national and EU blue economy strategies	Identifies critical data gaps, governance fragmentation, and capacity-building needs; stresses stakeholder-driven policy alignment for effective Blue Economy implementation.	Portugal (national, EU-aligned)
25.	Afzal, A. et al. Assessing the blue economy's impact on carbon mitigation growth levels. Marine Policy.	Blue economy; carbon mitigation; trade growth; econometric modeling	Quantitative econometric analysis (FMOLS/DOLS) across 14 countries (1990–2021)	Demonstrates that expansion of blue economy sectors reduces carbon emissions while supporting trade and economic growth.	North & Latin America

26.	Kumiawan, S.B. et al. Tackling marine pollution in the blue economy. Marine Pollution Bulletin.	Marine pollution; wastewater treatment; circular economy; policy-technology integration	Comprehensive review of wastewater technologies and governance instruments	Finds that aligning advanced wastewater technologies with coherent policies is essential to protect marine ecosystems and sustain blue economy growth. It shows that effective maritime decarbonization depends on regulatory coherence, technological readiness, economic feasibility, and social acceptance.	Global
27.	Zincir, B.A. Transitioning to sustainable shipping: A multidimensional analysis. Ocean & Coastal Management.	Sustainable shipping; decarbonization; PESTEL analysis; maritime regulation	Multidimensional PESTEL-based assessment of emission reduction strategies		Global (IMO / EU focus)

4.2 Distribution of Studies by Year

The annual distribution of Blue Economy literature demonstrates a clear trend of maturation and acceleration over the period 2016–2025. Early publications (2016–2019) are sparse, with only one to two studies published per year, reflecting a predominantly conceptual and definitional phase following the emergence of the Blue Economy discourse after 2012.

From 2020 onwards, a marked increase is observed, coinciding with stronger alignment with the Sustainable Development Goals (SDGs), climate policy agendas, port sustainability initiatives, and evolving governance frameworks. This shift indicates a transition from primarily theoretical exploration to applied and policy-oriented research.

The peak observed in 2023 and 2024, with five publications in each year, reflects a period of intensified scholarly and policy attention. This growth appears to be driven by increasing decarbonisation pressures, the initiation of the IMO 2023 GHG Strategy, port transformation agendas, emerging blue justice debates, and the growing demand for measurable performance indicators.

Although 2025 shows a slight decline, publication volume remains relatively high, suggesting a phase of consolidation rather than a reduction in academic interest. Overall, this temporal distribution illustrates the evolution of the Blue Economy from a nascent conceptual framework into an operational, policy-relevant research field characterised by increasing sectoral depth and regional specificity.

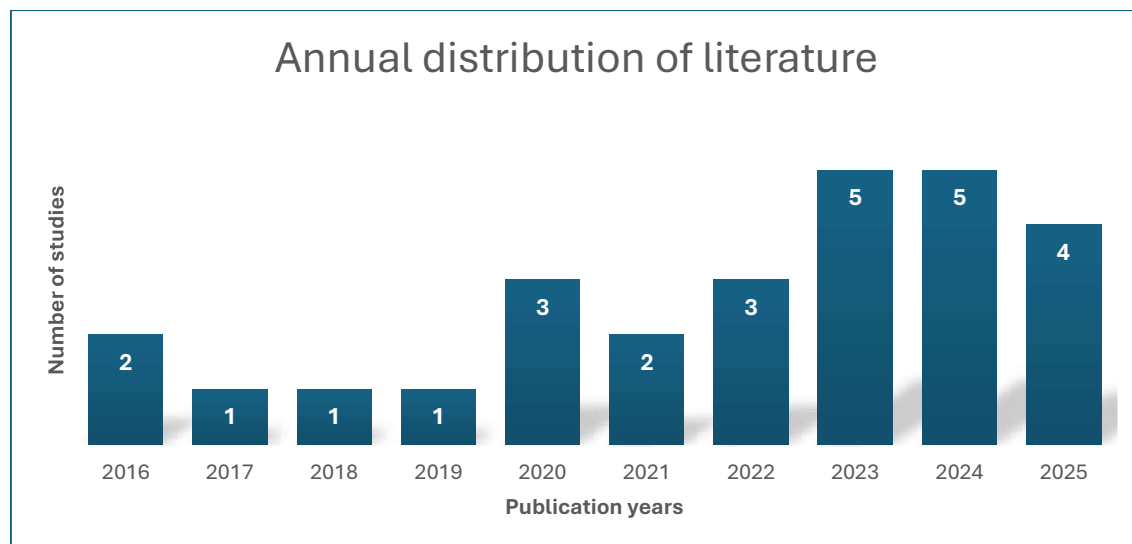


Figure 2. Distribution of number of studies in the literature by year

4.3 Distribution of Studies by Regions

The geographical distribution of the reviewed Blue Economy literature demonstrates a strong global orientation combined with targeted regional depth, reflecting both the universal relevance of the concept and its differentiated local applications. A substantial proportion of the studies adopt a global or multi-regional scope, often drawing on examples from Europe, Asia, the Americas, Africa, and Small Island Developing States, thereby underscoring the Blue

Economy's role as a transboundary, policy-driven framework aligned with international agendas such as the Sustainable Development Goals (SDGs) and International Maritime Organization (IMO) instruments.

At the same time, there is a clear concentration of region-specific case studies in strategically important maritime areas, including South Asia and the Bay of Bengal (notably Bangladesh), the Indian Ocean Rim and Western Indian Ocean, East Africa, and Small Island Developing States, where ocean-based activities are closely linked to economic development and environmental vulnerability.

Europe features prominently through EU-wide analyses and national case studies from Spain, Portugal, Denmark, and Greece, which often focus on ports, governance, and sustainability transitions. Latin America—particularly Chile—also emerges as a key region, reflecting growing scholarly interest in Blue Economy transitions, governance arrangements, and issues of equity and blue justice.

Overall, this geographical distribution reveals a literature base that balances global conceptual synthesis with geographically grounded empirical insights, highlighting both the worldwide applicability and the contextual specificity of Blue Economy implementation.

4.4 Themes of the Studies

4.4.1 Conceptual Foundations and Definitions of the Blue Economy

This theme establishes the normative and analytical baseline of the Blue Economy (Bari, 2017; Spalding, 2016). The literature converges on the idea that economic growth must be explicitly linked to ecological limits, ecosystem services valuation, and sustainability indicators, while noting the lack of a universally standardized definition (Wenhai et al., 2019).

4.4.2 Governance Frameworks, Policy Coherence, and Institutional Design

This body of work highlights governance as the central enabling condition for a functional Blue Economy. Persistent challenges include fragmented authority, weak indicators, and gaps between policy ambition and implementation capacity (Almeida et al., 2025; González-Laxe et al., 2025; Wenhai et al., 2019).

4.4.3 Ports as Blue Economy Enablers and Governance Nodes

Ports emerge as strategic leverage points in the Blue Economy, capable of driving decarbonization, environmental management, and innovation. However, governance design and performance measurement remain uneven across regions (Garrido Salsas et al., 2022; Taljaard et al., 2024; Vega-Muñoz et al., 2021).

4.4.4 Environmental Protection, Climate Action, and Nature-Based Solutions

This theme underscores that without strict environmental safeguards, Blue Economy expansion risks undermining its own sustainability goals (Afzal et al., 2025; Andersen et al., 2023; Vakili et al., 2020; Zincir, 2025). The literature increasingly emphasizes ecosystem-based management, NbS, and cumulative impact assessments (Afzal et al., 2025; Andersen et al., 2023).

4.4.5 Sector-Specific Blue Economy Pathways

Sectoral studies demonstrate uneven sustainability outcomes (Jelić Mrčelić et al., 2024), with traditional sectors dominating performance while emerging sectors show high growth potential but weak institutional support (Bari, 2017; Zincir, 2025).

4.4.6 Blue Justice, Marine Democracy, and Social Equity

This theme reveals a critical tension: Blue Economy initiatives often privilege capital-intensive port and infrastructure development at the expense of small-scale fishers and coastal communities (Ayilu, 2023; Thoya et al., 2022), calling for justice-cantered and participatory governance models (Anbleyth-Evans, 2023; Anbleyth-Evans et al., 2024).

4.4.7 Measurement, Indicators, and Assessment Tools

Measurement remains one of the weakest yet most critical pillars of Blue Economy implementation (Chen et al., 2023; Munim et al., 2020), with strong calls for harmonized, transparent, and SDG-aligned indicator systems.

Further research is recommended to develop an integrated Blue Economy port framework within port governance, addressing both the uneven implementation of initiatives and the fragmentation in existing literature, which has yet to converge into a coherent, cross-dimensional framework. Such a framework could be structured around the four analytical dimensions identified in the SLR: governance, environmental performance, operational practices, and innovation.

Standardization of environmental management and disclosure should be established as a minimum operational requirement to bridge persistent gaps in monitoring capacity within ports. While sustainability measures exist, their implementation varies across regions due to differences in governance and monitoring capabilities. This highlights the need to prioritize basic monitoring capacity before expanding broader sustainability commitments.

Additionally, enhancing port–city integration is recommended, particularly in ports experiencing growth in cruise tourism. This approach would support the development of ports as Blue Economy hubs rather than purely tourism nodes, thereby reducing long-term environmental risks related to waste and limited monitoring capacity. Structured stakeholder engagement is also essential to ensure inclusive decision-making and to mitigate risks associated with equitable resource distribution and blue justice.

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