sustainability

MDPI

Review

Tides of Change for a Sustainable Blue Economy: A Systematic Literature Review of Innovation in Maritime Activities

Jennifer Elston [1,2], Hugo Pinto [1,2,3,*] and Carla Nogueira [1,2]

[1] Research Centre for Tourism, Sustainability and Well-Being (CinTurs)—Gambelas, 8005-139 Faro, Portugal; jnelston@ualg.pt (J.E.); cfnogueira@ualg.pt (C.N.)
[2] Faculty of Economics, University of Algarve, Portugal—Gambelas, Edifício 8, 8005-139 Faro, Portugal
[3] CES—Centre for Social Studies, Colégio de São Jerónimo, University of Coimbra, 3000-995 Coimbra, Portugal
* Correspondence: hpinto@ualg.pt

Abstract: The Blue Economy, a dynamic field intertwining ocean sustainability, innovation, and economic progress, stands as a beacon of hope for fostering inclusive growth while advancing sustainable practices. This systematic literature review embarks on a journey to unravel the intricate relationship between innovation and sustainable practices within the Blue Economy, to uncover how innovation transforms and promotes sustainability, and to pinpoint barriers to adoption of innovative technologies and processes. By delving into the multifaceted landscape of sustainability and innovation studies within the Blue Economy, this study illuminates the potential of innovative approaches to drive sustainability in coastal and marine areas. With global attention shifting toward ocean sustainability due to survival risks and resource scarcity, this study addresses two central questions: how does innovation drive sustainable practices within the Blue Economy, and what barriers prevent the widespread adoption of these innovations? Using this interrogation as a compass to navigate the existing literature, and through a comprehensive analysis of the role of innovation in promoting sustainable practices, this review aims to provide hints for the main directions for a sustainable Blue Economy.

Keywords: blue economy; sustainability; sustainable development; innovation; blue growth; ocean resource management

Citation: Elston, J.; Pinto, H.; Nogueira, C. Tides of Change for a Sustainable Blue Economy: A Systematic Literature Review of Innovation in Maritime Activities. *Sustainability* **2024**, *16*, 11141. https://doi.org/10.3390/su162411141

Academic Editors: Vaggelis Saprikis, Ioannis Antoniadis and Konstantina Ragazou

Received: 5 November 2024
Revised: 12 December 2024
Accepted: 17 December 2024
Published: 19 December 2024

1. Introduction

The oceans play a fundamental role in sustaining life on Earth, acting as vital reservoirs of biodiversity, resources, and ecosystem services supporting human well-being and environmental balance. However, the surge in human population and industrial advancements have significantly strained marine ecosystems, resulting in critical issues such as pollution, overfishing, biodiversity loss, and climate change [1–5].

Understanding transformations in marine environments, including institutional and ecological changes, is crucial for ensuring sustainable development [6]. These shifts not only affect biodiversity but also influence governance frameworks essential for fostering long-term sustainability.

In response to these challenges, the concept of the Blue Economy has emerged as a sustainable approach to using marine resources for economic growth, improved livelihoods, and job creation, while preserving the health of the ocean [7–9]. According to [10], the Blue Economy refers to the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems". This definition underscores the balance between economic development and environmental conservation.

The Blue Economy comprises a variety of activities, including traditional sectors such as fisheries and marine transport, as well as emerging industries such as aquaculture, marine biotechnology, renewable energy, and coastal tourism. Each of these sectors presents opportunities for innovation to drive sustainability while addressing environmental challenges [11,12].

Grounded in ecosystem ingenuity, the Blue Economy leverages nature's innovative capacities to provide humanity with sustainable products, enhancing quality of life and supporting societal renewal. It responds to the urgency of the planet's limited renewal capacity. This approach counters the consequences of resource-wasting production practices, which lead to risks, crises, and developmental instability, uncertainty, and volatility [13]. Governments in various countries have adopted policies and strategies to mitigate these challenges by fostering sustainable practices and promoting innovation in sectors such as marine biotechnology and renewable energy [8,14,15]. For example, advancements in marine biotechnology hold potential for developing sustainable products, while renewable energy technologies such as offshore wind offer cleaner energy solutions.

As governments, organizations, and communities worldwide embrace the Blue Economy concept, there is a growing recognition of the need to move beyond business as usual and consider economic development and ocean health as compatible propositions [16]. The research question, 'How does innovation contribute to the development of sustainable practice in the Blue Economy, and what barriers exist to their widespread adoption?', is particularly significant owing to its focal point on the critical juncture of innovation and sustainability within the framework of the Blue Economy.

Innovation is essential for economic growth, job creation, and environmental protection within the Blue Economy framework. By exploring barriers such as resistance to innovation and financial uncertainties, this research aims to provide insights into overcoming challenges hindering the realization of a truly sustainable Blue Economy [17].

This article systematically examines the Blue Economy framework, employing a structured approach to analyze the intersection of innovation and sustainability. Section 2 details the systematic literature review methodology, which forms the foundation for a robust analysis. Section 3 presents the key findings, providing insights into the state of the research and its practical implications. Section 4 explores the role of innovation in advancing sustainable practices within the Blue Economy, emphasizing its transformative potential. Finally, Section 5 synthesizes the findings, offering conclusions and actionable recommendations for future research. This comprehensive examination underscores how innovation can serve as a catalyst for sustainability, fostering a resilient and mutually beneficial relationship between humanity and marine ecosystems.

2. Materials and Methods

A systematic literature review (SLR) is a fundamental aspect of academic research across various disciplines. This study follows the guidelines of Tranfield et al. [18]; this methodological approach serves as a cornerstone for evidence-based practice, offering a structured and rigorous framework for synthesizing existing knowledge, identifying gaps in research, and informing future investigations. By systematically searching, selecting, appraising, and synthesizing relevant studies, the SLR provides a comprehensive overview of current knowledge, facilitating evidence-based decision-making and advancing scholarly discourse.

To develop the keywords for this SLR, a preliminary exploratory analysis was conducted of existing studies on the Blue Economy. This initial review identified recurring terms and themes central to the intersection of sustainability, innovation, and economic activities in marine-related sectors. By analyzing frequently cited studies and their terminology, we synthesized a set of keywords to ensure a comprehensive and focused scope for this research.

In the literature, the Blue Economy is described using varied and sometimes interchangeable terms such as "Ocean Economy", "Marine Economy", "Blue Growth", and "Maritime Clusters" [14]. These terms are used synonymously within the literature, which underscores the need to address and comprehend these various terms to ensure a comprehensive understanding of the concepts related to sustainable practices and innovation within the Blue Economy. Figure 1 illustrates the key concepts found in the literature related to the Blue Economy. It visualizes the interrelationship between innovation, sustainability, and the various sectors involved in this economy.

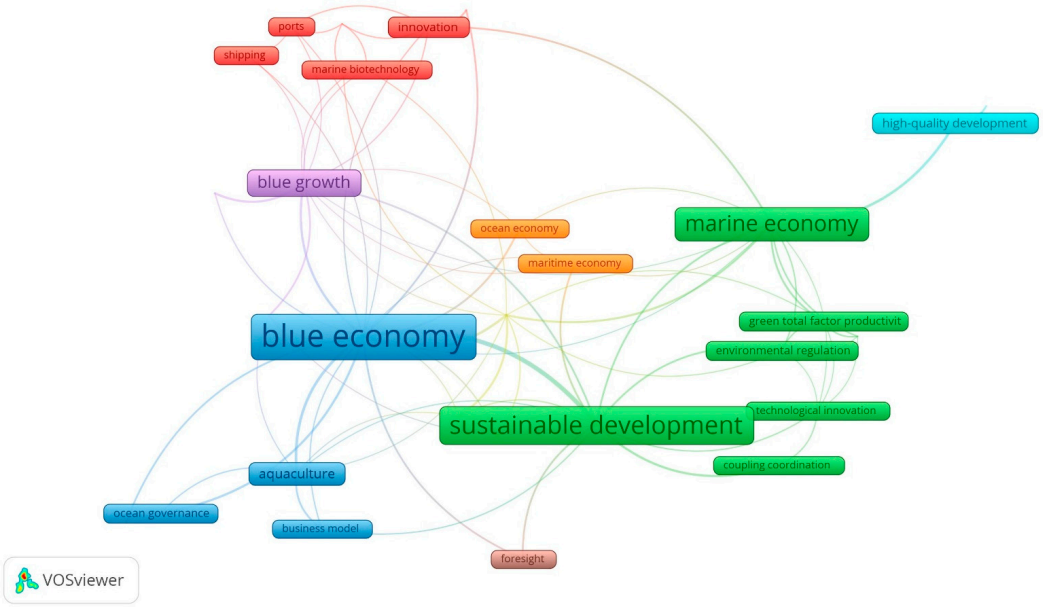

Figure 1. Concepts present in the Blue Economy literature. Source: VosViewer 1.6.19 output.

Figure 1 visualizes how various sectors and themes within the Blue Economy literature, such as fisheries, marine biotechnology, renewable energy, and coastal tourism, intersect with innovation and sustainability. These connections emphasize the role of innovation in enabling sustainable practices across industries. This figure demonstrates the intricate relationship between these fields, and the synonyms used within the literature helping to frame the scope of this review.

Figure 2 illustrates the keywords identified for inclusion in the systematic search, highlighting critical intersections such as innovation, sustainability, and marine economy. These keywords guide the literature review process by capturing the thematic scope of the Blue Economy and ensuring that studies relevant to sustainable practices and innovation are considered. This approach enhances the rigor and depth of the systematic review, providing a robust foundation for analyzing the interplay between innovation and sustainability within the Blue Economy.

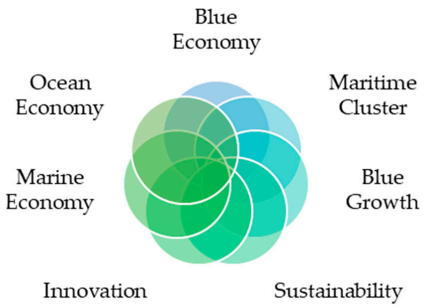

Figure 2. Keywords identified to be included in the search, own elaboration.

Scopus and Web of Science were selected as the primary databases for their extensive multidisciplinary coverage and access to high-quality, peer-reviewed articles relevant to the research objectives [16,19,20]. The search string outlined in Table 1 was used to locate articles on how innovation contributes to sustainability in the Blue Economy.

Employing the search string delineated in Table 1, the aim is to shed light on the innovative methodologies and technologies pivotal in nurturing sustainable development and environmental preservation within the domain of the Blue Economy. The data extraction completed in October 2023 encompasses all articles identified during the initial phase of this review. The earliest publication within this dataset dates to 2015. This timeframe

provides a thorough and up-to-date overview of the scholarly discourse at the intersection of the Blue Economy, sustainability, and innovation.

Table 1. Composition of search string, own elaboration.

Databases	Search String
Scopus Web of Science	(TITLE-ABS-KEY (“blue economy” OR “blue growth” OR “marine economy” OR “ocean economy” OR “maritime cluster”) AND TITLE-ABS-KEY (“Sustainab*”) AND TITLE-ABS-KEY (“Innovat*”)) AND (LIMIT-TO (DOCTYPE, “article”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “Journal”)) AND (LIMIT-TO (PUBSTAGE, “Final”))

Adhering to the structured guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method [21], as delineated in Figure 3, the final sample analyzed for this research comprises 98 articles. Although not all 98 articles are directly cited in the results due to issues of repetition or relevance, they were included in the review process and contributed to the overall analysis. All 98 articles remain listed in the references for transparency.

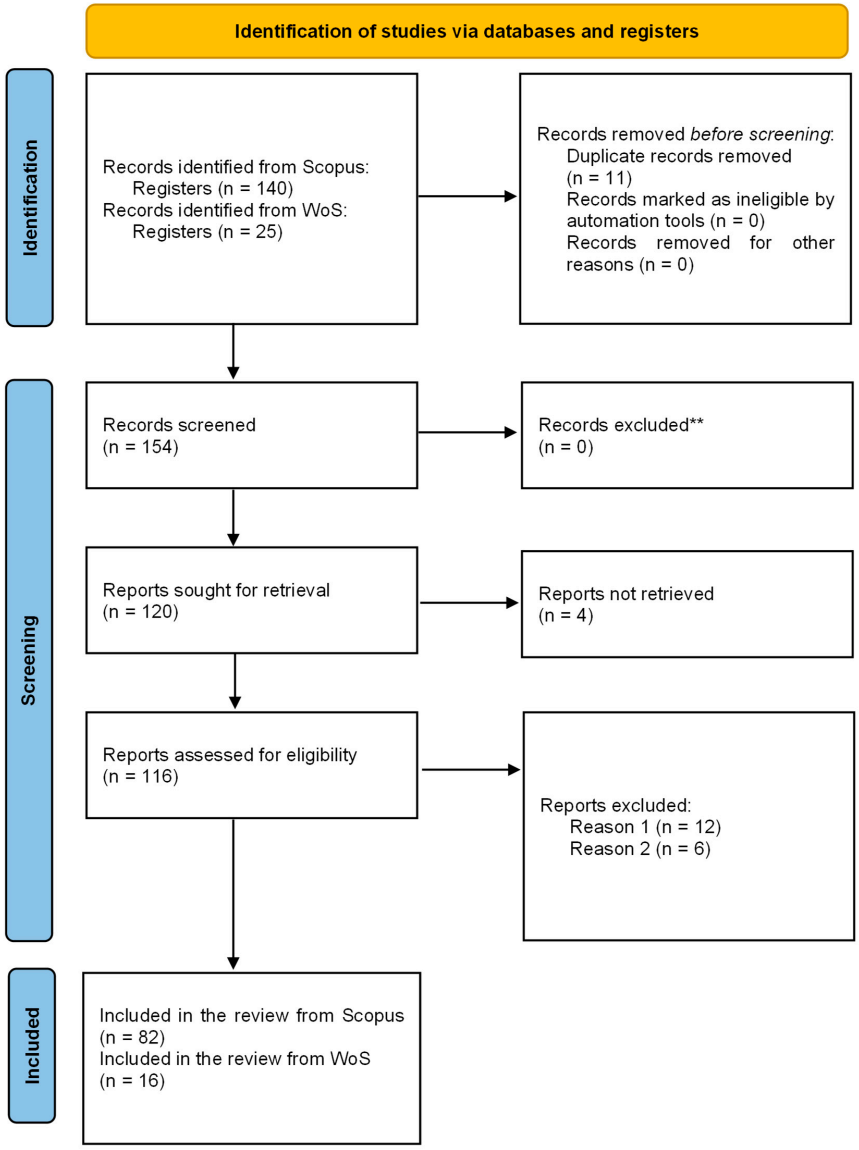

Figure 3. PRISMA Flowchart (adapted from [21]). ** If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

This systematic review was registered with the Open Science Framework (OSF) to ensure transparency and adherence to best practices. The registration DOI is https://doi.org/10.17605/OSF.IO/J9BEX, which provides access to the review protocol, including the search strategy, inclusion/exclusion criteria, and planned analyses.

Figure 3 presents the PRISMA flowchart, illustrating the article selection process used in this systematic literature review. The flowchart details each step, from the initial identification of records through database searches to the final inclusion of articles in the review. This transparent visualization demonstrates the rigor of the selection criteria, helping readers understand how the final sample of 98 articles was determined based on relevance to the research question. The PRISMA method ensures that the review is comprehensive and methodologically sound, adhering to best practices for systematic literature reviews.

The selection of articles to include in this SLR was based on their direct relevance to the research question, with a specific emphasis on investigations into how innovation propels sustainable development within the Blue Economy while also identifying impediments to its adoption. Inclusion criteria, as shown in Table 2, were crafted to capture nuanced insights into the pivotal role of innovation in advancing sustainable practices and addressing challenges inherent in the Blue Economy.

Table 2. The eligibility and exclusion criteria for the SLR, own elaboration.

Criteria	Inclusion Criteria	Exclusion Criteria
Timeline	From 2015 to 28th of October	After 28th of October
Type of Literature	Peer-reviewed scientific articles	Conference proceedings, grey literature, non-peer-reviewed literature, publications based on the same study, news items
Publication Status	Published and available online	Published but resource not available online; other
Language	English	Non-English
General topics	Studies that provided an analysis of general issues concerning economic development, innovation, and sustainable development in the Blue Economy or any activity or industry that is part of the Blue Economy	1. Studies that concerned biological themes related to the Blue Economy, from diseases and farming techniques, to nutritional contents of produces of aquaculture or other farming activities 2. Studies that did not elaborate on innovation or sustainability in any way related to the Blue Economy

Table 2 outlines the eligibility and exclusion criteria applied to the systematic review, ensuring that only relevant and high-quality studies were included. Articles were selected based on criteria such as publication timeline, type of literature, publication status, language, and topic relevance. This structured approach excludes non-peer-reviewed and non-English studies while focusing on peer-reviewed articles that analyze the role of innovation in sustainable practices within the Blue Economy. These criteria were crucial in filtering the literature to ensure a focus on evidence-based findings that contribute to the objectives of this research.

3. Results

3.1. Defining the Blue Economy

The concept of the Blue Economy has emerged as an application of the broader green economy paradigm, focusing specifically on the marine and coastal environment [7–9]. From the articles reviewed, a common theme is the Blue Economy's role in supporting both economic and environmental goals through innovation. The Blue Economy model highlights coastal regions as hubs for economic innovation, blue activities, and the empowerment of resource-dependent communities [2,8].

While there is no universally agreed definition across all 98 articles, the majority align with the view that the Blue Economy integrates economic activities and environmental stewardship. Several sources (e.g., [1,22]) emphasize that this framework must promote long-term sustainability through innovative practices that minimize environmental impacts.

The concept of the Blue Economy has been defined in various ways across the literature, reflecting its multidisciplinary and evolving nature. For instance, the World Bank defines the Blue Economy as "the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems" [10]. In contrast, academic literature often highlights the ecosystem-based approach, focusing on the interconnectedness of ecological and economic systems [23,24].

Furthermore, definitions differ in their emphasis on specific sectors. While some focus on traditional industries such as fisheries and marine transport, others incorporate emerging sectors like marine biotechnology and renewable energy [7,14]. Regional perspectives also influence definitions, with SIDS focusing on resilience and equity to address their unique vulnerabilities [23,25].

These variations highlight the need for a comprehensive understanding that balances economic, social, and environmental priorities. However, they also present challenges in aligning stakeholders and measuring progress, as different definitions prioritize distinct objectives and indicators.

This paradigm shift recognizes the economy as a subsystem of society and nature, serving as a tool to achieve a socially just and environmentally stable future [8,13,14]. Through sustainable business practices that respect both local resources and cultural traditions while responding to basic needs, the aim is to avoid negative impacts on the environment [2].

The Blue Economy focuses on utilizing locally available resources in cascade systems, where the waste from one product becomes the input to create a new cash flow. This model imitates natural processes to achieve sustainable and environmentally friendly economic development [7,25].

The expansion of the Blue Economy paradigm is crucial at both national and global levels, particularly among Small Island Developing States (SIDS). Technological innovations, investment, and multilateral cooperation are facilitating progress in sectors related to the Blue Economy [26]. This momentum has led to initiatives such as the sustainable development goal (SDG) 'Life below Water', adopted in 2015, which emphasizes the sustainable management and protection of marine and coastal ecosystems, scientific knowledge enhancement, and transfer of sustainable marine technologies [7,25].

Various definitions of the Blue Economy exist among organizations, with common features emphasizing ocean health, sustainability, equity, and resilience as core principles [23]. The World Bank and the United Nations agreed that "the Blue Economy aims to move beyond business as usual and to consider economic development and ocean health as compatible propositions" [22].

To conclude, the Blue Economy represents an emerging concept that promotes better oversight of ocean resources while highlighting the close relationship between oceans, climate change, and human well-being within marine and coastal regions through innovative approaches that drive sustainable development and resource management.

Key Sectors and Activities in the Blue Economy

The Blue Economy encompasses a diverse range of economic activities directly or indirectly linked to the ocean, including traditional sectors such as fisheries, marine trade, and tourism, as well as emerging industries such as aquaculture, seabed extractive operations, marine biotechnology, offshore renewable energy, and bioprospecting [1,2,5,8,11,22,27,28].

In the review of the literature, we found that innovation plays a key role in these sectors, driving sustainable development while promoting economic growth and job creation. For instance, aquaculture is increasingly leveraging technological advancements to enhance sustainable fish production, while renewable energy (e.g., offshore wind) is emerging as a major player in reducing carbon footprints within the Blue Economy.

The key sectors and activities within the Blue Economy, as identified in various studies and outlined by [11], include, but are not limited to, the following:

1. Living Resources: This encompasses fish, crustaceans, and mollusks, with a significant emphasis on fisheries and aquaculture. Technological innovations, in areas such as sustainable aquaculture practices, are helping meet the growing global demand for seafood while preserving marine biodiversity [29].
2. Non-living Resources: This includes offshore oil, natural gas, and minerals such as gravel and sand. Innovations in cleaner extraction methods are critical for reducing the environmental impact of resource extraction.
3. Shipbuilding and Repair: The shipbuilding industry is embracing innovations aimed at reducing environmental footprints, such as the development of greener fuels and technologies that improve energy efficiency in vessels.
4. Maritime Transport: Maritime transport is crucial for moving goods globally, and innovations in fuel efficiency and emissions reductions are essential to ensure that this sector grows sustainably.
5. Coastal and Oceanic Tourism: Tourism remains a vital economic resource, but it is necessary to strike a balance between the economic benefits and environmental conservation. Innovative eco-tourism models are emerging as a solution to this challenge.
6. Ecosystem Services: These include carbon sequestration, coastal protection, and biodiversity conservation. Digital tools and remote sensing technologies are enhancing the ability to manage and protect these critical services [24].
7. Renewable Energy: Offshore renewable energy, including wind and wave energy, is one of the most promising sectors for innovation within the Blue Economy. The development of renewable energy sources is central to reducing reliance on fossil fuels and promoting sustainable growth.

The European Union's taxonomy regulation aims to classify economically sustainable activities with a focus on the marine environment, ensuring the sustainable use of marine ecosystem services while preventing or reducing inputs that harm marine environments [30]. This regulation provides a standardized framework for determining which activities can be classified as sustainable, further supporting the goals of the Blue Economy.

These key sectors offer immense potential for innovation, and demonstrate a holistic approach, which can drive sustainable development while preserving ocean health and supporting coastal communities [7,11]. This supports the broader framework of the Blue Economy, which focuses on leveraging marine resources for both economic and environmental gains.

3.2. Sustainability

The importance of sustainability in the Blue Economy cannot be overstated, as it serves as a vital component for preserving ecological balance, minimizing environmental impact, and supporting economic activity within marine ecosystems without depleting resources [7,31]. Sustainability within the Blue Economy framework is crucial for maintaining the health of marine and aquatic environments, ensuring the continuous availability of resources, and mitigating the negative effects of human activities on aquatic ecosystems [2,32,33]

The genesis of sustainable development discussions can be traced back to the Conference on the Human Environment in Stockholm, 1972, where visions of sustainability emerged. Since then, sustainable development has evolved into a comprehensive agenda, transcending disciplines, and aiming to safeguard Earth's ecological systems from adverse human activities [34].

The term "sustainable development" refers to a concept that aims to meet the needs of the present without compromising the ability of future generations to meet their own needs [35]. Sustainability within the Blue Economy relies on innovations that minimize environmental impact while optimizing resource utilization. For instance, technological advancements in aquaculture contribute to more sustainable fish production by reducing bycatch and habitat destruction. In renewable energy, innovations in offshore wind

and wave energy are playing a crucial role in lowering carbon emissions [1,29]. Collectively, these innovations ensure the sustainable use of marine resources while fostering economic growth. However, the success of these innovations depends on their ability to be scaled responsibly, ensuring long-term resilience in both ecosystems and economic frameworks [22,25].

In the context of the Blue Economy, sustainability encompasses the responsible use of marine resources to balance ecological preservation, economic development, and social equity [10]. This framework relies on innovations that address challenges such as marine biodiversity loss, resource depletion, and climate change impacts. For example, ecosystem-based aquaculture systems help reduce bycatch and enhance habitat conservation [15,29,36,37], while offshore wind and wave energy technologies represent a transition to low-carbon solutions that mitigate climate change and foster economic opportunities in coastal regions [15]. These advancements highlight how the Blue Economy can balance economic growth with environmental sustainability and social well-being by integrating sustainable practices into marine industries [22,38]. However, the scalability and long-term resilience of these innovations remain critical to achieving a truly sustainable Blue Economy.

The incorporation of diverse sectors and geographic scopes within the Blue Economy underscores its focus on sustainability, with many of the articles in our review highlighting how innovation is central to achieving these goals [39]. The United Nations Decade of Ocean Science for Sustainable Development, as explained by Pace and Borch, et al. [40], provides a platform to engage scientists in identifying critical oceanic priorities and advancing interdisciplinary approaches to achieve ocean sustainability within the Blue Economy framework by the year 2030.

The alignment of the Blue Economy with the SDGs, emphasizing that the Blue Economy concept is rooted in sustainability and its association with the 2030 Agenda action plan, which aims to achieve shared social, economic, and environmental priorities. The SLR reveals that six specific SDGs, namely SDG 3 (Health and Welfare), SDG 12 (Consumption and Responsible Production), SDG 14 (Life on Water), SDG 15 (Land Life), SDG 16 (Peace, Justice, and Strong Institutions), and SDG 17 (Partnerships and Means of Implementation) are most frequently linked to Blue Economy practices. These goals reflect the potential for economic sectors of the Blue Economy to use the SDGs as a parameter and core of sustainable development [14,24].

The review of the existing literature confirms that these goals align with the growing body of research that calls for technological and policy innovations to support sustainable marine resource management. Many stressing that sustainable growth in these sectors can be achieved by fostering collaboration between governments, industries, and local communities, using innovative technologies and practices.

The goals set by the UN for sustainable development showcase contemporary policies focused on economic competitiveness, sustainable innovation, renewable technologies, reducing emissions, and minimizing environmental impact [41,42]. Advancing a Blue Economy framework to promote the sustainable use of ocean resources entails integrating economic activities within effective ocean governance systems, complying with international agreements such as the United Nations Convention on the Law of the Sea, and aligning with the 2030 Sustainable Development Agenda and Goals [23].

By embracing sustainability principles in marine resource management, fostering collaboration among stakeholders, and promoting innovative solutions, the literature highlights that nations striving to develop ocean resources sustainably are simultaneously fostering economic growth. As nations strive to develop the ocean space in a sustainable manner, they are concurrently fostering economic growth. This growth serves as the foundation for realizing economic advantages within the Blue Economy and promoting blue growth [17,22].

3.3. The Role of Innovation

The role of innovation within the Blue Economy is multifaceted, serving as a driving force behind new technologies, practices, and approaches that enhance the efficient utilization of marine resources [5,8]. Innovations in the Blue Economy take various forms, ranging from radical to incremental and exploitative to explorative, each playing a pivotal role in ushering in revolutionary changes or reinforcing the dominance of established firms [43,44].

Innovation is key in utilizing the undiscovered possibilities of marine and coastal resources, generating fresh business prospects rooted in clean, climate-resilient, and sustainable activities [40]. For example, technological advancements in aquaculture are boosting sustainable seafood production, reducing the ecological footprint of fisheries, and providing new jobs in coastal regions [45]. Innovations in renewable energy, such as offshore wind technology, are helping to reduce carbon emissions while fostering economic growth. These innovations must be backed by collaborative frameworks that involve stakeholders at all levels, from local communities to international organizations. Innovation acts as a catalyst for promoting both closer collaboration and rivalry, encouraging the development of new business strategies while enhancing competitiveness within regional cooperation [46,47].

Advancements in the digital, physical, and biological realms facilitate advancements across various sectors, such as marine equipment, shipbuilding, ocean observation, and marine construction. These efforts are directed toward minimizing economic, ecological, and social trade-offs, emphasizing sustainable practices for both the economy and the environment [2,13,34,43,48,49]. Such initiatives not only contribute to economic growth but also address global crises such as climate change, food security, energy, natural resources, and medicines [5,43].

Marine engineering equipment and marine technology play an irreplaceable role in driving innovation within the Blue Economy. These tools enable sustainable practices, improve resource efficiency, and reduce environmental impacts across various sectors. For example, advancements in offshore wind turbines, wave energy converters, and tidal power systems are transforming renewable energy production [49,50]. Technologies such as autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs) have revolutionized marine exploration by providing critical data for seabed mapping, biodiversity assessment, and resource monitoring [29,48].

In maritime transport, green shipping technologies, including hydrogen-powered vessels and AI-driven navigation systems, are significantly reducing carbon emissions and improving operational efficiency [51]. Meanwhile, advances in marine robotics and digitalization are optimizing aquaculture operations, improving productivity, and minimizing environmental impacts [29,50]. These innovations highlight the potential of marine engineering and technology to foster sustainable growth while addressing the Blue Economy's pressing challenges.

However, despite their transformative potential, these technologies face challenges such as high development costs, technological dependency, and ecological risks [46,52]. Collaborative strategies involving governments, industries, and research institutions are essential to promote sustainable scaling, ensure compatibility with marine ecosystems, and bridge the gap between innovation and practical implementation [47,49].

Innovation plays a crucial role in transforming traditional Blue Economy practices, leading to better resource management and conservation (Figure 4), and reduced environmental impacts [13].

Figure 4 illustrates how innovation drives sustainability in the Blue Economy through a cyclical process. The central role of innovation in sectors such as sustainable energy, digital technologies, modernized industrial practices, ecological compensation, and maritime spatial planning leads to the following key outcomes: resource conservation, economic growth, climate resilience, and efficient resource use. The arrows between outcomes highlight their interconnectedness, showing how innovations enhance sustainable marine

resource management and conservation, creating a balance between economic activities and environmental preservation.

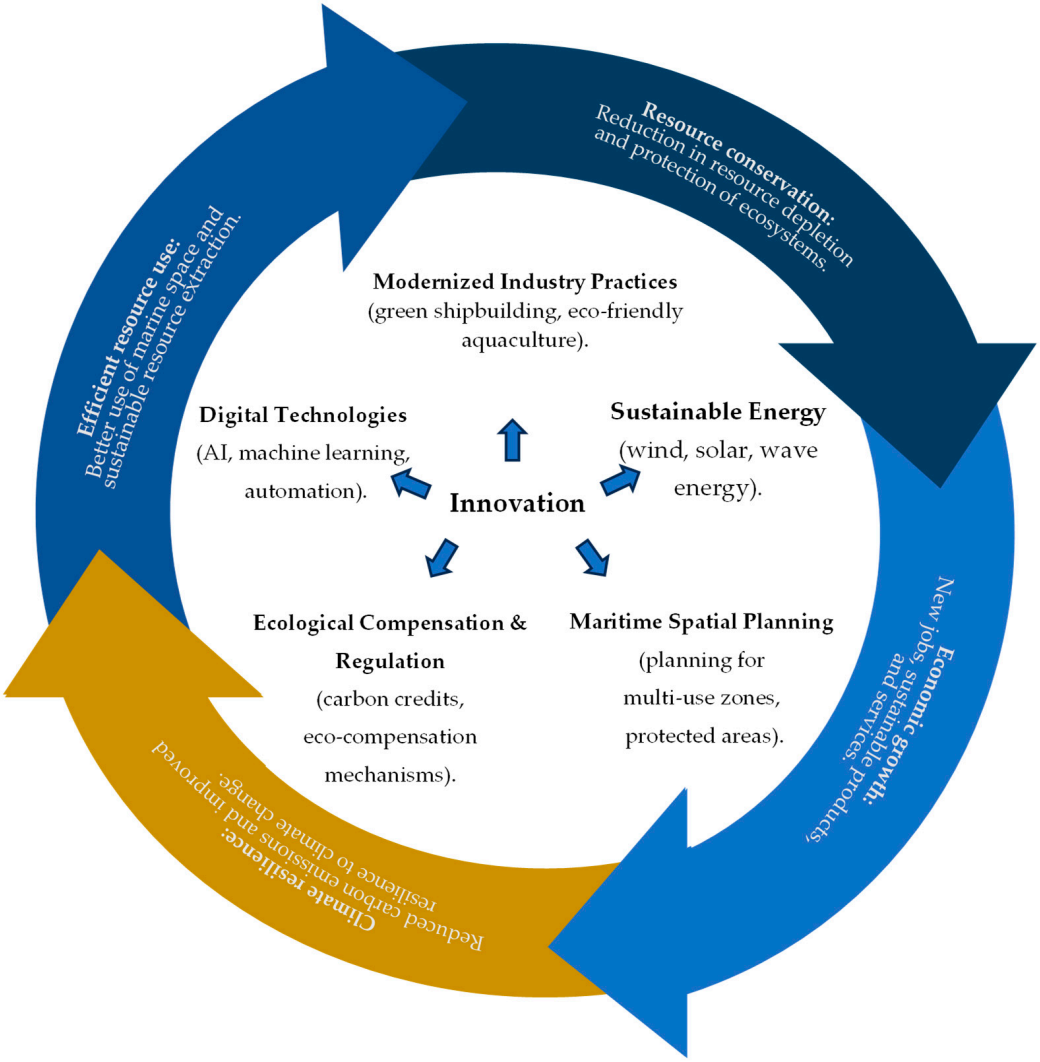

Figure 4. Innovations transforming traditional Blue Economy practices, own elaboration.

By fostering the development of innovative technologies and approaches, innovation enables effective utilization of marine resources while creating new job opportunities and driving economic growth in a sustainable manner [5,8]. Moreover, innovation enhances sustainable economic growth within the Blue Economy by driving competitiveness and fostering collaboration among nations and regions [7].

By embracing innovative practices, businesses can enhance efficiency, reduce costs, and develop new products and services that meet market demands sustainably. Innovation in the Blue Economy leads to the creation of value-added products and services, opening new markets and revenue streams [51]. This not only boosts economic growth but also ensures long-term sustainability by aligning economic development with environmental preservation and social well-being [1].

Figure 5 illustrates the dynamic interaction between innovation and its dual impact on new market creation and sustainability goals. Innovation drives the development of emerging industries, value-added products, and job creation, fostering economic growth. At the same time, it supports sustainability goals such as resource conservation, circular economy practices, and climate resilience. The feedback loops between new markets and sustainability demonstrate that progress in one area reinforces advancements in the other,

ultimately leading to sustainable economic growth, environmental resilience, and social well-being.

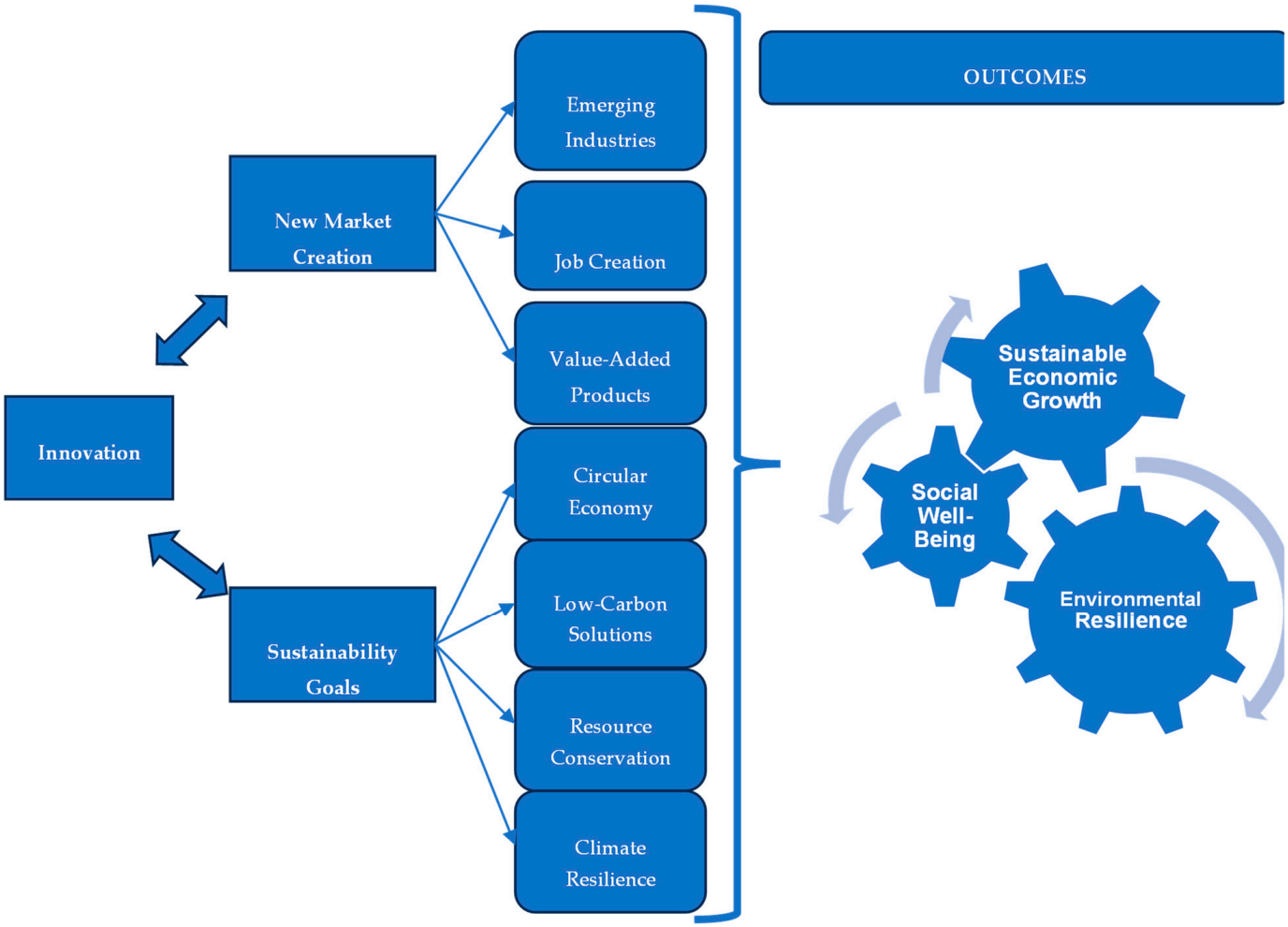

Figure 5. Innovations driving new market creation and sustainable growth, own elaboration.

Furthermore, innovation fosters collaboration in the Blue Economy by encouraging knowledge sharing, technology transfer, and joint research initiatives among stakeholders [5,16,33]. Collaborative efforts driven by innovation lead to the development of sustainable solutions to complex challenges through co-creation [50]. Collaboration on innovative projects enables organizations to pool their strengths, resources, and expertise to achieve shared objectives (Figure 6).

Figure 6 demonstrates how innovation acts as a driving force behind various forms of collaboration and partnerships in the Blue Economy. The diagram highlights how innovation acts as a catalyst through which collaboration occurs, such as open innovation, policy support, and clusters. These collaborative efforts lead to co-creation and knowledge sharing, where stakeholders such as governments, industries, and local communities work together to solve complex challenges [24,52]. The feedback loop emphasizes that these collaborative innovations further fuel progress toward sustainable development goals, creating a cycle of continuous improvement.

Policy innovation, social innovation, and open innovation play pivotal roles in promoting stakeholder involvement and collaborations within the Blue Economy. Policy innovation is crucial for promoting sustainable marine resource management and facilitating community engagement. It can lead to economic opportunities, community engagement, and the generation of scientific knowledge essential for evidence-based decision-making [16,53,54].

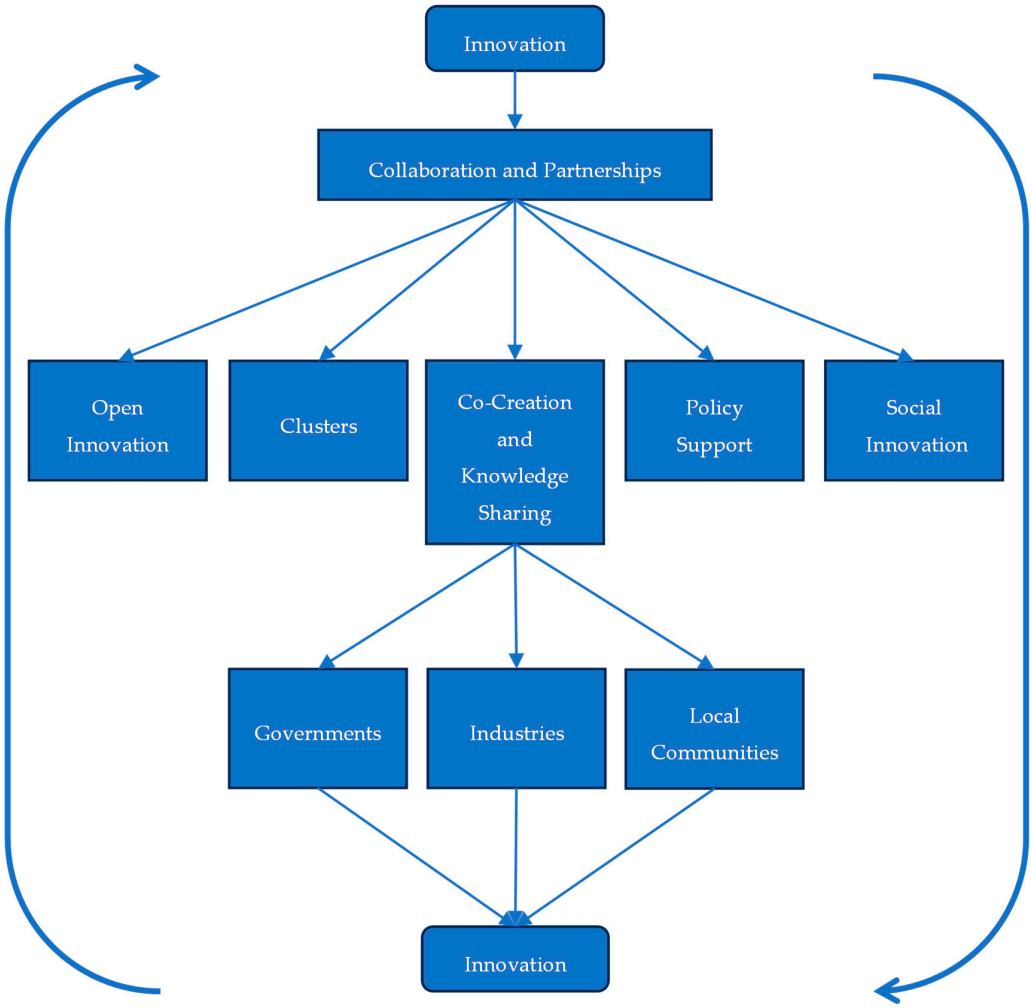

Figure 6. Collaborative innovation in the Blue Economy, own elaboration.

Social innovation in particular enhances a smart, sustainable, and inclusive Blue Economy by fostering behavioral changes across institutional settings and encouraging bottom-up responsible inventiveness [9]. Open innovation serves as a cornerstone fostering collaboration and creativity among stakeholders, including scientists, fishers, ecologists, aquaculture producers, medical professionals, biohackers, feed producers, entrepreneurs, investors, and governmental entities. This collaboration facilitates continuous learning, improvement, and drives technological and economic prosperity in marine-related sectors [29].

Despite the positive impact of innovations on resource management, conservation, economic growth, and collaboration in the Blue Economy, barriers hinder their widespread adoption (Figure 7). Challenges such as bureaucratic inefficiencies, modernization of legislation, financial support for sustainable practices, and the influence of powerful economic actors limit the optimal utilization, management, and conservation of marine resources [5,7,23,55].

Figure 7 outlines the main barriers to innovation within the Blue Economy, divided into five categories: Technological Readiness, Financial Constraints, Regulatory Challenges, Market Dynamics, and Behavioral Change. Each barrier is associated with specific challenges that hinder the adoption of sustainable innovations. These include resistance to new technologies, limited access to funding, unclear policies, competition from traditional industries, and reluctance to change cultural or consumer behavior. Addressing these barriers enables stakeholders to advance the broader adoption of sustainable practices in the Blue Economy, enhancing both economic and environmental outcomes.

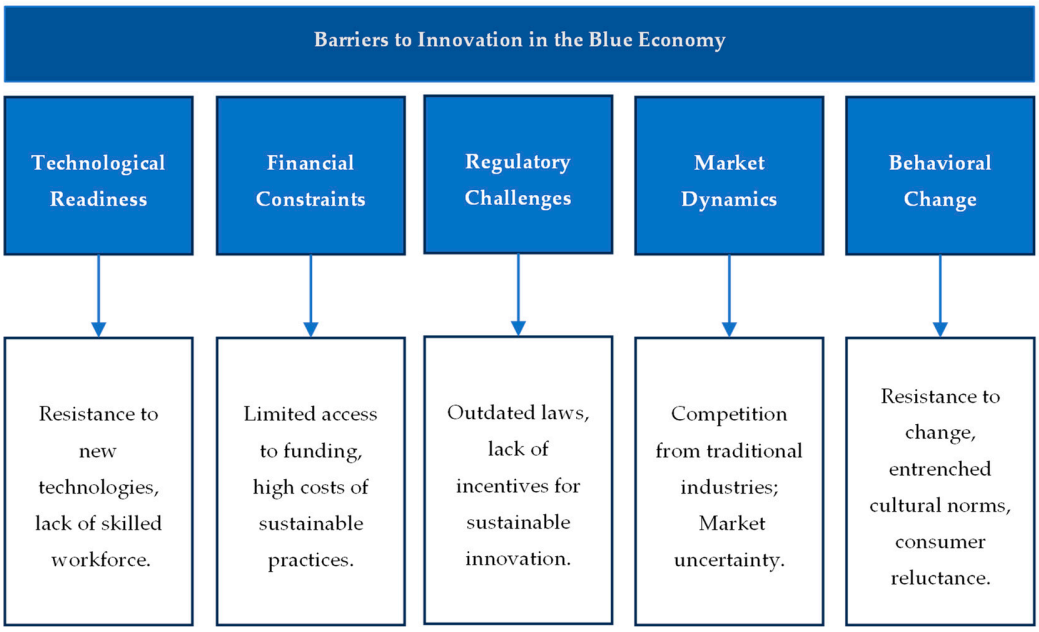

Figure 7. Barriers to innovations' widespread adoption in the Blue Economy, own elaboration.

Advancing innovation across sectors is critical to achieving sustainable growth in the Blue Economy, ensuring the alignment of economic activities with ecological and social objectives. Addressing resistance to innovation, sector rigidity, and financial risks is essential to fully realize the potential of innovations within the Blue Economy. Prioritizing science and research that caters to sustainable Blue Economy needs ensures that pertinent knowledge guides decisions towards its realization [50].

The transformative power of innovation in the Blue Economy is evident in its ability to shift traditional economic paradigms towards sustainable practices that balance economic prosperity with environmental protection [5]. The integration of innovation into the Blue Economy framework aligns with global SDGs.

Innovation within the Blue Economy is a catalyst for unlocking the potential of marine resources, driving economic growth, creating employment opportunities, preserving the environment, and fostering diverse collaborations. By embracing innovative approaches and technologies that prioritize sustainability and resilience, stakeholders can harness the full benefits of the Blue Economy while ensuring a harmonious balance between economic activities, social well-being, and ecological conservation [5,16,23].

4. Discussion

4.1. Key Elements for a Sustainable Blue Economy

4.1.1. Engage Stakeholders in Decision-Making

Stakeholder engagement is essential for inclusive and effective governance in the Blue Economy. Engaging stakeholders fosters intersectoral and intergovernmental collaboration [16]. By co-designing policy interventions, stakeholders, from local communities to industry leaders, can share ownership and responsibility for sustainable initiatives [56]. This is particularly crucial in conservation efforts, where local insights can lead to better regulatory compliance and long-term stewardship [2,25,33]. Innovation in digital platforms, such as participatory decision-making tools, supports this integration by ensuring transparent and timely communication [50].

4.1.2. Infrastructures

Investment in sustainable infrastructure, including ports, logistics hubs, and renewable energy installations, is foundational for driving maritime connectivity, international collaboration, and ecological resilience [57]. Innovative technologies, such as smart logistics

systems and climate-resilient infrastructure materials contribute to this goal. Coastal communities benefit economically from improved infrastructure, while the ecological impact is minimized through green construction standards and eco-friendly technologies [23].

4.1.3. Funding

Financial mechanisms, such as blue bonds and impact investments, are becoming central to funding the Blue Economy [46]. The innovation here lies in creating financial products that balance profit with sustainability goals. Revolving funds for coastal communities, for instance, provide both economic incentives for local industries (fishing, aquaculture) and contribute to environmental conservation [1]. Aligning these funds with international financing bodies ensures coherent efforts across national and global initiatives.

4.1.4. Environmental Data

Using environmental data is crucial for informed decision-making. Advanced technologies, such as remote sensing, GIS, and AI-based analytics, allow for the more accurate monitoring of marine environments [35,39,50]. These tools enable stakeholders to assess the environmental impacts of their activities, implement regulatory frameworks, and measure progress toward sustainability goals. Co-created digital platforms foster cross-sector dialogue, promoting data sharing and innovation in real-time responses within various socio-economic, political, and cultural contexts [50].

4.1.5. Maritime Spatial Planning (MSP)

MSP is pivotal in ensuring the optimal and sustainable use of marine spaces. By quantifying sector trade-offs, MSP minimizes conflicts between industries such as fishing, tourism, and energy, while promoting conservation [17]. Innovative MSP tools include ecosystem modeling software that simulates future scenarios and allows for adaptive management [2]. The cultural dimensions of planning, such as including Indigenous knowledge, add another layer of innovation, integrating social equity into spatial decisions.

4.1.6. Development of Coastal Economic and Technological Strategies

Developing strategies that adapt to political, environmental, and market shifts are key for coastal resilience. These strategies, often driven by public–private partnerships and innovations in coastal technologies, help mitigate the impacts of climate change and ensure long-term sustainability [47]. By integrating these strategies with holistic policy frameworks, decision-makers can create adaptive approaches that respond to dynamic marine ecosystems and shifting socio-political environments [11,24,58].

Ecosystem-Based Approaches

Ecosystem-based approaches offer a holistic method for conserving marine resources by ensuring their sustainable use and maintaining ecological balance [59,60]. These policies not only contribute to economic growth by supporting the livelihoods of coastal communities and developing markets for sustainable seafood products, but also reflect a strong commitment to environmental stewardship. By fostering resilience to environmental changes and ensuring long-term sustainability, ecosystem-based approaches enhance the Blue Economy's reputation and attract responsible investment in marine sectors [7,38].

Smart Specialization Strategy

The Smart Specialization Strategy is a mission-oriented policy used at international, national, and regional levels to identify and capitalize on regional assets. By encouraging strategic investments that complement a country's or region's existing strengths, this strategy fosters competitive advantages and promotes future domestic capability [17,61]. It focuses on fostering sustainable mobility, zero-residual technology, energy efficiency, and digital innovations, including blockchain technologies for marine industries [48]. This specialization enhances knowledge spillovers, promotes regional collaboration, and

supports the development of resilient economies that are better equipped to manage environmental and market shifts [27].

4.1.7. Mechanisms for Ecological Compensation and Regulation

A comprehensive framework of ecological compensation and regulation is essential for promoting sustainable practices across the Blue Economy. These mechanisms incentivize industries to minimize their environmental footprint by internalizing ecological costs and encouraging the preservation of biodiversity [62,63]. By integrating tools such as carbon pricing, biodiversity offsets, and blue carbon credits, these regulatory systems ensure industries are held accountable for their environmental impacts while simultaneously promoting economic growth through sustainability [52].

Compensation Mechanisms

Compensation mechanisms play a vital role in preserving marine biodiversity and promoting ecosystem resilience. They extend beyond monetary compensation and include legal penalties, administrative measures, and environmental restoration mandates. These strategies aim to restore and conserve marine resources while maintaining the adaptability of oceanic ecosystems [31]. For example, blue carbon credits provide an innovative way to tie economic rewards to the conservation of marine natural capital, allowing industries to contribute to both ecological restoration and financial sustainability [64].

Ecological Taxation System

The ecological taxation system integrates environmental costs into the economic activities of marine industries, ensuring that externalities, such as pollution or resource depletion, are accounted for within market mechanisms. This approach incentivizes industries to adopt sustainable practices by making it more costly to engage in environmentally harmful activities [24]. By aligning taxation with environmental stewardship, this system helps to regulate industrial impacts on marine ecosystems, promoting a market-driven approach to sustainability.

Other Mechanisms

Additional mechanisms, such as eco-labeling and the pursuit of carbon neutrality, further support the Blue Economy by educating consumers and incentivizing industries to adopt sustainable practices [24]. Eco-labeling enables consumers to make environmentally responsible choices, while carbon neutrality goals encourage industries to offset their carbon emissions through conservation efforts or technological innovations [65]. These efforts represent critical strides toward environmental stewardship and sustainable economic development within the marine sector [53].

4.1.8. Clusters

Maritime clusters represent a dynamic organizational approach that orchestrates diverse maritime activities within a cohesive strategy. These clusters are composed of interconnected entities such as companies, suppliers, service providers, and research institutions, which collaborate to enhance the performance and growth of the maritime and marine industries [57,66]. Through shared infrastructure, knowledge exchange, and joint initiatives in research and development, these clusters foster the cross-pollination of ideas and innovation, which are crucial for sustainable growth in regional development [27,55].

By bringing together stakeholders from both the public and private sectors, maritime clusters promote cooperation and knowledge spillovers that lead to increased productivity and efficiency. These collaborative ecosystems not only advance the Blue Economy but also contribute to national competitiveness by encouraging the exploration of innovative solutions and optimizing resources at the regional level [22,43,57,66,67].

4.1.9. Circular Economy

The circular economy maximizes resource efficiency by turning waste into valuable inputs for other industries, mimicking natural systems [13,67,68]. This contrasts with the linear "take, make, dispose" model, prioritizing long-lasting design, maintenance, repair, and recycling [67]. Innovations in product design, maintenance, and recycling close the loop, minimizing waste and environmental degradation.

The concept of circularity within the Blue Economy encompasses two vital sustainability dimensions: environmental sustainability and supply sustainability. Environmental sustainability refers to practices that aim to use natural resources in a way that minimizes negative impacts on the environment, ensuring that the resources can continue to be available for future generations. Additionally, supply sustainability is also paramount, indicating the ability to maintain a continuous and stable supply of a resource over time without depletion or environmental harm [68].

Table 3 provides an overview of how innovation impacts sustainability across key Blue Economy elements. Each row outlines a specific element (e.g., Stakeholders, Environmental Data) and shows how innovation fosters sustainability in that domain, including environmental conservation, economic resilience, and social equity. For example, leveraging digital technologies such as remote sensing for environmental data allows for real-time decision-making, ensuring that marine resource extraction is balanced with conservation efforts. Similarly, the implementation of circular economy principles in sectors such as fisheries reduces waste and promotes resource efficiency. Through this table, stakeholders can identify actionable strategies that incorporate innovation into sustainable Blue Economy practices.

Table 3. Impact of innovation and influence on sustainability in key elements of Blue Economy.

Key Elements	Innovation	Influence on Sustainability
Stakeholders	Implementing participatory decision-making processes, fostering multi-stakeholder governance models to support innovation in Blue Economy practices [33,35,53].	Enhances social acceptance of Blue Economy initiatives, fosters partnerships for sustainable development, promotes accountability, and aligns stakeholder interests with environmental conservation goals for long-term success [16,33].
Environmental Data	Utilizing advanced technologies such as remote sensing, GIS, and big data analytics for environmental monitoring [29,39,50].	Enables informed decision-making, facilitates targeted interventions for environmental protection and resource management, supports ecosystem-based management [39].
Coastal Economic and Technological Strategies	Developing adaptive and innovative technologies to mitigate climate change impacts and external economic pressures [11,47,69].	Promotes economic growth while ensuring long-term environmental resilience and minimizing ecological degradation [24,38].
Circular Economy	Implementing circular business models that prioritize resource efficiency, waste reduction, and closed-loop systems to promote sustainable consumption and production practices [67,68].	Reduces resource depletion, minimizes environmental impact, fosters innovation in sustainable product design, and contributes to a more resilient economy [68].
Infrastructures	Integrating green infrastructure designs and renewable energy solutions (offshore wind, wave energy) to enhance operational efficiency while minimizing environmental impact [57].	Facilitates sustainable practices in Blue Economy operations, improves connectivity, reduces carbon footprint, and increases resilience to climate change [27,57].
Funding	Leveraging innovative financial mechanisms such as green bonds, public–private partnerships, and impact investments to support sustainable projects with positive environmental and social outcomes [46,70].	Enables execution of sustainable projects by providing necessary resources for innovation adoption, technology deployment, and capacity-building programs [23].

Table 3. *Cont.*

Key Elements	Innovation	Influence on Sustainability
Maritime Spatial Planning	Using geospatial technologies, such as GIS mapping tools, ecosystem modeling software, and MSP to optimize resource allocation and resolve sea-use conflicts [17,48,71].	Enhances ecosystem resilience by minimizing conflicts between marine sectors, promotes sustainable development, and safeguards biodiversity hotspots [48,65].
Mechanisms for Ecological Compensation and Regulation	Implementing mechanisms such as carbon pricing, biodiversity offsets, and eco-labeling schemes to promote environmental stewardship and regulate human activities [31,58,64].	Encourages responsible behavior, mitigates negative environmental impacts, promotes sustainable marine practices, and ensures compliance with environmental standards [31,52].
Clusters	Formation of maritime clusters that bring together industries, researchers, and policymakers to foster innovation and encourage knowledge sharing [57,66].	Stimulates innovation, fosters competitiveness, promotes knowledge exchange among stakeholders, and enhances regional development through shared infrastructure and collaboration [22,27].
Resource Management	Adopting sustainable resource management practices, including responsible extraction methods, conservation strategies, and ecosystem-based approaches [47,60,72].	Ensures resource availability for current and future generations, balancing economic development with environmental protection through sustainable resource utilization strategies [38,69].

4.2. Regional Perspectives on the Development of the Blue Economy

The Blue Economy has become a pivotal element in sustainable development, leveraging marine and coastal resources to balance economic growth, environmental preservation, and social equity. However, the pathways to its realization are not uniform across regions. Asia, Europe, and North America exhibit distinct approaches shaped by their economic priorities, governance frameworks, and technological capacities. This section examines the unique characteristics of the Blue Economy in these regions, identifying both their strengths and challenges.

4.2.1. Asia: Rapid Expansion Amidst Environmental Concerns

Asia is at the forefront of Blue Economy expansion, driven by its extensive coastline, rich marine biodiversity, and reliance on maritime industries. Coastal nations like China, Japan, and South Korea prioritize aquaculture, port development, and renewable marine energy to sustain economic growth [73]. For instance, China has integrated the Blue Economy into its national strategies, emphasizing technological innovation and marine industry modernization [74].

However, rapid industrialization has led to significant environmental challenges, such as habitat degradation, overfishing, and pollution [75]. China's "maritime silk road" initiative and stricter environmental policies are steps toward mitigating these issues [76]. However, governance gaps and uneven technological adoption across countries remain barriers to regional cohesion in advancing the Blue Economy [4].

4.2.2. Europe: Innovation and Integration for Sustainability

Europe positions itself as a global leader in the sustainable Blue Economy, leveraging its robust governance frameworks and advanced research capabilities. The European Union's Blue Economy Strategy focuses on climate neutrality, ecosystem preservation, and innovation-driven growth [1]. Key industries include offshore wind energy, marine biotechnology, and sustainable fisheries [50].

Europe's strength lies in its collaborative approach, promoting cross-border projects and stakeholder engagement [23]. The European Green Deal exemplifies efforts to integrate Blue Economy goals with broader climate action, creating synergies across industries and policies. However, the region still faces challenges in balancing industrial activities with ecological conservation, particularly in coastal ecosystems under pressure from tourism, shipping, and resource exploitation [51].

4.2.3. North America: Balancing Economic Potential and Environmental Sustainability

In North America, the Blue Economy is a vital component of economic strategies in the United States and Canada. The U.S. prioritizes offshore energy, fisheries, and maritime transportation, integrating technological advances to enhance sustainability [12]. Canada takes a unique approach by incorporating social equity, particularly through the involvement of Indigenous communities, into its Blue Economy policies. This focus on equitable transitions is evident in regions like Newfoundland and Labrador [33].

Despite these advancements, North America grapples with reconciling industrial expansion with ecological preservation. Offshore oil and gas development often conflicts with climate commitments and environmental justice concerns. Addressing these tensions will require robust governance and long-term planning [49].

To conclude, while Asia demonstrates rapid industrial growth and resource utilization, it faces environmental sustainability challenges that call for enhanced governance and cooperation. Europe excels in integrating sustainability with economic innovation, though ecological pressures persist. North America showcases diverse strategies, from technological innovation to inclusive policymaking, but struggles with aligning economic development with ecological commitments. These regional differences underscore the importance of tailoring Blue Economy strategies to local contexts while fostering global collaboration to address shared challenges.

This comparative analysis provides a nuanced understanding of how regional approaches to the Blue Economy reflect and respond to their unique environmental, economic, and social landscapes.

4.3. Identified Gaps in the Literature

This subsection examines the key gaps in existing research concerning the challenges discussed in the Blue Economy. The findings from the systematic literature review reveal several areas requiring further investigation and development to address the elements described in this section effectively.

4.3.1. Stakeholder Engagement

While stakeholder engagement is widely recognized as vital for inclusive governance, current studies focus more on theoretical frameworks than on practical implementation strategies. For instance, mechanisms for integrating marginalized communities, such as small-scale fishers or Indigenous populations, into decision-making processes remain underexplored [3,16]. Furthermore, few studies examine the long-term effectiveness of participatory decision-making tools, leaving a gap in the understanding of how these platforms foster sustained collaboration and compliance [17,75].

4.3.2. Sustainable Infrastructure

The literature highlights the importance of green ports and climate-resilient infrastructure; however, there is limited empirical analysis of their real-world economic and environmental impacts [22,24]. Research is sparse on scalable models that can be adapted to developing coastal nations, which often lack the financial and technological resources to implement such solutions [51,77].

4.3.3. Innovative Financial Mechanisms

Although blue bonds and impact investments are frequently mentioned, studies rarely evaluate their effectiveness in achieving sustainability goals across diverse regions [1,78,79]. There is also a lack of research on aligning local financial mechanisms with international frameworks to create cohesive funding strategies [50]. The role of public–private partnerships in enhancing financial innovation remains underexplored [23,80].

4.3.4. Environmental Data Utilization

While advancements in remote sensing, GIS, and AI-based analytics have revolutionized marine monitoring, few studies critically assess the accessibility and applicability of these technologies in resource-constrained regions [33,40]. Furthermore, there is insufficient attention to how co-created digital platforms can foster cross-sectoral data sharing, especially in regions with fragmented governance [25,28].

4.3.5. Maritime Spatial Planning (MSP)

MSP tools, such as ecosystem modeling software, are well-documented for resolving sector trade-offs [17,43]. However, the literature lacks longitudinal studies that assess the socio-economic and ecological impacts of MSP initiatives. Additionally, there is limited integration of cultural dimensions, such as Indigenous knowledge systems, into existing MSP frameworks [9,30]

4.3.6. Coastal Economic and Technological Strategies

Adaptive strategies tailored to shifting political and environmental contexts are essential for coastal resilience. While public–private partnerships and innovative technologies have been discussed, there is a lack of comparative studies evaluating their effectiveness in diverse socio-economic settings [5,26]. Additionally, the integration of regional collaboration frameworks remains underexplored [22,35].

4.3.7. Ecosystem-Based Approaches

Although ecosystem-based approaches are heralded for their holistic conservation benefits, their scalability and adaptability across varying marine ecosystems are not well addressed [7,34]. Current research also cannot evaluate how these approaches balance economic growth with ecological preservation [64], particularly in regions where marine resources are heavily exploited [15,37].

4.3.8. Compensation and Regulation Mechanisms

Mechanisms such as blue carbon credits and biodiversity offsets show promise, yet their adoption is hampered by limited empirical data on their effectiveness [4,31]. Research often neglects the challenges of integrating such mechanisms into existing regulatory frameworks, especially in low-income nations [13,33].

4.3.9. Maritime Clusters

Maritime clusters are recognized for fostering innovation through collaboration; however, there is insufficient research on their sustainability contributions within the Blue Economy [34,45]. Some studies highlight their role in enhancing regional development, such as leveraging shared infrastructure and inter-industry cooperation. Few studies explore the dynamics of knowledge spillovers in clusters or the role of cross-border collaborations in maximizing their impact [6,48].

4.3.10. Circular Economy

The circular economy is gaining traction as a sustainable model for resource management, with its implementation in sectors like fisheries and aquaculture being discussed in recent studies [10,29]. However, research rarely addresses successful transitions from linear to circular models in marine industries. Limited case studies exist to illustrate how circular economy principles can be operationalized at scale [32,50].

4.3.11. Literature Distribution Analysis

To provide transparency and rigor in how the key elements of the Blue Economy were identified, a distribution analysis of the 98 papers from the systematic literature review was conducted. Each paper was categorized based on its primary focus, aligning with the key elements described in this study. The results are presented in the radar

chart (Figure 8), which visually summarizes the distribution of research efforts across the identified elements.

Figure 8. Literature distribution analysis of 98 articles, own elaboration.

As shown in Figure 8, Sustainable Infrastructure (15 articles) and Ecosystem-Based Approaches (14 articles) emerge as the most frequently addressed topics in the articles included in the SLR. This significant representation highlights their foundational role in the Blue Economy, reflecting the focus of academic efforts on ensuring resilient infrastructure and promoting holistic ecosystem management. Additionally, Stakeholder Engagement (12 articles) and Coastal Economic and Technological Strategies (11 articles) receive substantial attention, underlining the emphasis on fostering collaborative governance and developing adaptive strategies to mitigate environmental and economic challenges.

Environmental Data Utilization (10 articles), Maritime Spatial Planning (MSP) (9 articles), and Innovative Financial Mechanisms (8 articles) demonstrate moderate levels of research attention. These elements are instrumental for operationalizing the Blue Economy, particularly in optimizing resource allocation, improving decision-making through advanced data tools, and financing sustainable practices. However, the moderate representation suggests the need for further investigation into region-specific barriers, technological scalability, and effective integration into policy frameworks.

Compensation and Regulation Mechanisms (8 articles), Maritime Clusters (7 articles), and Circular Economy (4 articles) are the least explored areas in the literature. This limited representation reveals significant gaps, particularly regarding the practical implementation of circular economy principles and the potential of maritime clusters to drive innovation and regional development. The under-representation of these critical topics underscores the need for targeted research to unlock their contributions to sustainable economic growth and environmental conservation.

The radar chart illustrates an uneven distribution of research efforts across the key elements, with critical gaps evident in areas such as Circular Economy and Maritime Clusters. Addressing these disparities is crucial for achieving a holistic, inclusive, and equitable approach to the Blue Economy. Furthermore, the disproportionate focus on certain elements, such as Sustainable Infrastructure and Ecosystem-Based Approaches, suggests an opportunity for interdisciplinary research to bridge underexplored areas with these well-studied domains.

This analysis provides an evidence-based foundation for prioritizing research efforts in the Blue Economy. By aligning future studies with under-represented areas and integrating them with well-established elements, the Blue Economy can better advance sustainability goals and address persistent implementation challenges.

4.4. Long-Term Impacts and Future Directions

Innovation within the Blue Economy has proven instrumental in driving sustainable development, but long-term success will depend on addressing critical challenges. Scalability and inclusivity remain central issues. Technologies that thrive in well-funded regions often face adoption barriers in resource-constrained areas, particularly in developing coastal nations. Overcoming these challenges requires mechanisms for technology transfer, capacity building, and fostering inclusive access to innovation across diverse socioeconomic contexts [23,33]. For example, innovations such as marine spatial planning (MSP) and renewable energy projects, which are effective in developed regions, may require significant adaptation to be successful in developing regions [17].

Another critical factor is technological dependency. Innovations such as remote sensing, automation, and artificial intelligence have revolutionized marine resource management, but they create dependencies on advanced infrastructure and continuous technical support. This dependency can become a vulnerability if local governments or private stakeholders lack the resources to maintain and adapt these technologies [29]. The rapid pace of technological advancement also introduces the need for constant policy adaptation and workforce training, which may strain less-developed regions that lack sufficient resources or expertise [38].

Environmental risks also deserve careful consideration. While innovations such as offshore wind farms and aquaculture offer sustainable alternatives, they can also pose unintended ecological consequences if not carefully managed. For instance, offshore renewable energy projects may disrupt marine biodiversity, particularly if marine spatial planning frameworks fail to keep pace with technological expansion [50]. Similarly, even innovative aquaculture techniques may lead to over-exploitation or pollution if sustainability benchmarks are not strictly enforced [38,47].

Another pressing concern is social inclusivity. While innovations such as stakeholder engagement frameworks and co-designed policies have shown promise in promoting social equity, continuous evaluation is needed to ensure that these frameworks empower all relevant groups, particularly marginalized communities. Without initiative-taking measures to involve Indigenous groups, small-scale fishers, and coastal residents in decision-making, innovation could exacerbate existing inequalities in access to marine resources and economic opportunities [16,33].

Moving forward, international cooperation will play a key role in addressing these long-term challenges. As marine resource management technologies and innovations evolve, the need for the global harmonization of policies and standards becomes increasingly important. Collaborative frameworks, such as those under the United Nations or the World Bank, can help ensure that best practices are shared globally, and that developing regions are not left behind [52]. Multilateral efforts are crucial to advancing technology transfer, capacity building, and establishing uniform environmental and economic standards for marine sectors.

In conclusion, while innovation holds immense promise for driving the Blue Economy forward, its long-term success will depend on addressing key challenges related to scalability, technological dependency, environmental risks, and inclusivity. Developing holistic, inclusive governance frameworks and policies will be essential for ensuring that the Blue Economy can continue to grow sustainably and equitably [17,33,52].

4.5. Policy and Governance Implications

The effective integration of innovative practices within the Blue Economy requires robust policy and governance frameworks. These frameworks must not only support

the successful implementation of technological innovations but also ensure that such innovations are sustainable and inclusive. Governance systems at both the national and international levels will be pivotal in aligning the Blue Economy with global sustainability goals while fostering economic growth.

4.5.1. International Policy Frameworks

At the international level, foundational agreements such as the United Nations Convention on the Law of the Sea (UNCLOS) and the sustainable development goals (SDGs) provide critical guidance for ocean governance. SDG 14 focuses specifically on the conservation and sustainable use of the oceans, seas, and marine resources [81]. As the Blue Economy evolves, these frameworks must adapt to new technological innovations, particularly in emerging sectors such as offshore renewable energy, marine biotechnology, and aquaculture. Effective international cooperation is needed to ensure that innovations align with environmental goals and do not exacerbate inequalities [23]. For example, initiatives such as marine spatial planning (MSP), supported by international agreements, can help balance competing demands for marine space while conserving biodiversity [17].

4.5.2. National and Regional Policy Implementation

On a national and regional scale, Marine/Maritime Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) are vital tools for regulating the use of marine spaces and promoting the sustainable coexistence of various industries [52]. Countries that have adopted comprehensive Blue Economy strategies, such as those in the European Union, provide successful examples of policy implementation. For instance, the EU Blue Growth Strategy fosters collaboration between private industries, research institutions, and governments to drive sustainable innovation [23]. However, challenges remain in ensuring that SIDS and low-income coastal nations can equally benefit from these innovations. Financial assistance and capacity-building programs from international bodies will be crucial in ensuring that less-resourced regions can actively participate in the Blue Economy [50].

4.5.3. The Role of Public–Private Partnerships

Public–private partnerships (PPPs) represent a key strategy for driving innovation within the Blue Economy. By offering tax incentives, subsidies, and grant funding, governments can encourage private-sector investment in sustainable marine industries. PPPs foster collaboration between public institutions and private companies, ensuring that innovations are aligned with long-term environmental sustainability and social equity [1] These partnerships are especially important in sectors such as offshore renewable energy, where private investment can accelerate the development of sustainable technologies while public regulation ensures that environmental goals are met.

4.5.4. Regulation and Compliance

Governments play a central role in regulating marine industries to ensure sustainability. This includes enforcing environmental protection standards, regulating the extraction of marine resources, and establishing carbon pricing and biodiversity offsets to hold industries accountable for their environmental impacts [52]. Policies that support ecological compensation mechanisms, such as blue carbon credits and payment for ecosystem services, can incentivize sustainable practices in industries such as fisheries, tourism, and aquaculture [64].

4.5.5. Capacity Building and Knowledge Transfer

A critical element of governance in the Blue Economy is the promotion of capacity building and knowledge transfer. International knowledge-sharing initiatives, such as workshops, research collaborations, and open innovation platforms, are essential for spreading best practices and ensuring that resource-constrained countries can benefit from

sustainable innovations [50]. These efforts can bridge gaps between developed and developing coastal regions, enabling all stakeholders to engage meaningfully in the Blue Economy [23].

To sum up, the success of the Blue Economy relies not only on technological and business innovation but also on robust and adaptive policy frameworks. International agreements, national governance structures, and public–private partnerships all play essential roles in guiding innovation toward sustainable and inclusive development. As new technologies emerge, policymakers must ensure that regulatory frameworks evolve alongside them, promoting global equity and ecological resilience in the face of climate change [23,52].

5. Conclusions

The exploration of sustainability, innovation, and their impact on the Blue Economy reveals a complex interplay of factors influencing the utilization, management, and conservation of marine resources. The findings highlight the pivotal role of science and innovation in realizing the Blue Economy's full potential. Innovations in sectors such as marine biotechnology, aquaculture, and renewable energy are driving sustainable growth. However, bridging the gap between research and commercialization, prioritizing "fit-for-purpose" science, and promoting innovation across diverse sectors are essential for long-term development [45].

The looming threat of the "tragedy of the commons" underscores the risk of unsustainable practices that threaten both marine ecosystems and sustainable development goals [5]. Key factors such as climate change impacts, market fluctuations, and regulatory changes introduce complexities in resource allocation and policy formulation, potentially leading to unintended consequences [82]. Moreover, the absence of a shared definition of the Blue Economy's geographical scope and industrial activities complicates the transition toward sustainability [50].

Challenges such as incomplete data, stemming from diverse sources, uncertainties, and biases, continue to impede effective decision-making processes [24,47]. Additionally, environmental degradation, regulatory misalignment, and insufficient stakeholder engagement further undermine the Blue Economy's potential to foster sustainable practices [7]. Addressing these challenges involves embracing technological advancements, such as green technologies, digitalization, and sustainable energy solutions, to enhance efficiency and reduce environmental impact [83].

The development of artificial intelligence (AI) and machine learning (ML) holds significant potential for addressing these challenges and shaping the future trajectory of the Blue Economy. AI and ML can optimize fisheries management through real-time data analysis, enhance maritime safety with predictive navigation systems, and improve renewable energy efficiency through advanced modeling [40,50]. These technologies could also provide new tools for environmental monitoring and marine resource conservation, driving progress toward a more sustainable and resilient Blue Economy. While this study does not explore these technologies in depth, future research should examine their transformative potential to better understand their implications for sustainability and economic growth.

Multilateral cooperation is crucial, with collaboration among local communities, industries, and policymakers being key to achieving SDGs and fostering innovation adoption [17]. Harmonizing regulations and ensuring that the Blue Economy benefits both present and future generations require the alignment of international efforts [16]. Furthermore, involving local communities in decision-making processes ensures social equity, cultural preservation, and sustainable development that aligns with the needs of coastal regions [17].

Overcoming sector rigidity, financial risks, and scalability challenges is critical to unlocking the transformative potential of sustainability and innovation in the Blue Economy [9]. Embracing a comprehensive approach that integrates economic, ecological, and social dimensions will be essential to achieving a Blue Economy [9].

In conclusion, the journey towards sustainable growth and development requires urgent and concerted efforts to bridge knowledge gaps, foster collaboration, and overcome barriers. Continued research, policy refinement, and the collective commitment of all stakeholders are essential to unlocking the full potential of the Blue Economy. Through innovation, alignment with sustainable development goals, and diverse perspectives, we can foster a Blue Economy that thrives economically, safeguards the environment, and ensures social equity and a future where oceans and coastal regions flourish, supporting livelihoods, biodiversity, and prosperity for future generations.

Several research gaps remain unaddressed within the Blue Economy, particularly regarding the long-term impacts of sustainable practices and innovations on economic growth, employment, and environmental preservation. Addressing these research opportunities will allow stakeholders to formulate evidence-based strategies that ensure economic growth, environmental preservation, and social inclusivity within the Blue Economy.

While this study contributes valuable insights to the field of Blue Economy, it is essential to acknowledge several limitations inherent in the systematic review process. The reliance on English-language publications may have excluded valuable non-English research, leading to a potential limitation in the diversity of perspectives included [84]. Furthermore, the selection of keywords, databases, and inclusion/exclusion criteria could introduce biases that influence the study's findings [85].

Author Contributions: Conceptualization, J.E., H.P. and C.N.; methodology, J.E., H.P. and C.N.; validation, J.E., H.P. and C.N.; formal analysis, J.E., H.P. and C.N.; investigation, J.E., H.P. and C.N.; data curation, H.P. and C.N.; writing—original draft preparation, J.E.; writing—review and editing, H.P. and C.N.; visualization, J.E., H.P. and C.N.; supervision, H.P. and C.N.; project administration, J.E., H.P. and C.N. All authors have read and agreed to the published version of the manuscript.

Funding: J.E. research was funded by Sustainable Horizons (HORIZON) with the grant agreement ID: 101071300, DOI: 10.3030/101071300. H.P. is supported by the FCT (UIDB/04020/2020 and CEEC—INST/00052/2021/CP2792/CT0001).

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Proczek, M.; Garbarczyk, M. EU Involvement in the Financing of the Blue Economy. *Stud. Eur. Stud. Eur. Aff.* **2023**, *27*, 149–161. [CrossRef]
2. Mdlalose, M. Seaside Community Industrial Hubs. *Int. J. Soc. Ecol. Sustain. Dev.* **2022**, *13*, 1–20. [CrossRef]
3. Chen, S.; De Bruyne, C.; Bollempalli, M. Blue Economy: Community Case Studies Addressing the Poverty–Environment Nexus in Ocean and Coastal Management. *Sustainability* **2020**, *12*, 4654. [CrossRef]
4. Li, B.; Tian, C.; Shi, Z.; Han, Z. Evolution and Differentiation of High-Quality Development of Marine Economy: A Case Study from China. *Complexity* **2020**, *2020*, 5624961. [CrossRef]
5. Upadhyay, D.K.; Mishra, M. Blue economy: Emerging global trends and India's multilateral cooperation. *Marit. Aff. J. Natl. Marit. Found. India* **2020**, *16*, 30–45. [CrossRef]
6. Banikoi, H.; Schlüter, A.; Manlosa, A.O. Understanding transformations in the marine coastal realm: The explanatory potential of theories of institutional change. *Mar. Policy* **2023**, *155*, 105791. [CrossRef]
7. Penca, J. Blue economy in the euro-mediterranean: Implications of the policy paradigm. *Int. J. Euro-Mediterr. Stud.* **2019**, *12*, 69–92.
8. Dziura, B.; Cernota, M. Blue economy: The new model for sustainable development. *Actual Probl. Econ.* **2015**, *169*, 34–38.
9. Soma, K.; van den Burg, S.W.K.; Hoefnagel, E.W.J.; Stuiver, M.; van der Heide, C.M. Social innovation—A future pathway for Blue growth? *Mar. Policy* **2018**, *87*, 363–370. [CrossRef]
10. World Bank; United Nations Department of Economic and Social Affairs. *The Potential of the Blue Economy: Increasing Long-Term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries*; World Bank: Washington, DC, USA, 2017. [CrossRef]
11. Martínez-Vázquez, R.M.; Milán-García, J.; Manso, J.R.P.; De Pablo Valenciano, J. Impact of blue economy sectors using causality, correlation and panel data models. *Front. Mar. Sci.* **2023**, *10*, 1034054. [CrossRef]
12. Fusco, L.M.; Schutter, M.S.; Cisneros-Montemayor, A.M. Oil, Transitions, and the Blue Economy in Canada. *Sustainability* **2022**, *14*, 8132. [CrossRef]
13. Nikitenko, V.; Voronkova, V.; Kaganov, Y. The concept of developing a 'blue economy' as a basis for sustainable development. *Balt. J. Econ. Stud.* **2022**, *8*, 139–145. [CrossRef]

14. Martínez-Vázquez, R.M.; Milán-García, J.; de Pablo Valenciano, J. Challenges of the Blue Economy: Evidence and research trends. *Environ. Sci. Eur.* **2021**, *33*, 61. [CrossRef]
15. Campana, E.F.; Ciappi, E.; Coro, G. The role of technology and digital innovation in sustainability and decarbonization of the Blue Economy. *Bull. Geophys. Oceanogr.* **2021**, *62*, 123–130.
16. Arzaman, A.F.M.; Damaianti, I.; Shafi, S.; Aziz, N.A.A.; Jusoh, M.H.; Kadir, F.K.A.; Baharuddin, S.A.; Hashim, H.M.; Pham, L.H.H.P.; Embong, A.M. A Systematic Review: Mirror-Mirror on the Wall, What is the Relationship Between Blue Economy and Community Development? *Int. J. Sustain. Dev. Plan.* **2023**, *18*, 991–997. [CrossRef]
17. Kyvelou, S.S.I.; Ierapetritis, D.G. How to make blue growth operational? A local and regional stakeholders perspective in Greece. *WMU J. Marit. Aff.* **2019**, *18*, 249–280. [CrossRef]
18. Tranfield, D.; Denyer, D.; Smart, P. Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *Br. J. Manag.* **2003**, *14*, 207–222. [CrossRef]
19. Abrizah, A.; Zainab, A.N.; Kiran, K.; Raj, R.G. LIS journals scientific impact and subject categorization: A comparison between Web of Science and Scopus. *Scientometrics* **2013**, *94*, 721–740. [CrossRef]
20. Cortez, P.; Moro, S.; Rita, P.; King, D.; Hall, J. Insights from a text mining survey on Expert Systems research from 2000 to 2016. *Expert Syst.* **2018**, *35*, e12280. [CrossRef]
21. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G.; PRISMA Group, T. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Public Libr. Sci.* **2009**, *151*, 264–269. [CrossRef]
22. Qi, X. The conceptual framework of the national blue economic system: A multiagent perspective. *Mar. Policy* **2022**, *145*, 105287. [CrossRef]
23. Benzaken, D.; Voyer, M.; Pouponneau, A.; Hanich, Q. Good governance for sustainable blue economy in small islands: Lessons learned from the Seychelles experience. *Front. Political Sci.* **2022**, *4*, 1040318. [CrossRef]
24. Karani, P.; Failler, P.; Gilau, A.M.; Ndende, M.; Diop, S.T. Africa Blue Economy Strategies Integrated in Planning to Achieve Sustainable Development at National and Regional Economic Communities (RECs). *J. Sustain. Res.* **2022**, *4*, e220011. [CrossRef]
25. Hassanali, K. Examining Institutional Arrangements toward Coordinated Regional Ocean Governance and Blue Economy Policy Development in the Caribbean Community (CARICOM). *Coast. Manag.* **2022**, *50*, 385–407. [CrossRef]
26. Gerhardinger, L.C.; de Andrade, M.M.; Corrêa, M.R.; Turra, A. Crafting a sustainability transition experiment for the brazilian blue economy. *Mar. Policy* **2020**, *120*, 104157. [CrossRef]
27. Meyer, C. Integration of Baltic Small and Medium-Sized Ports in Regional Innovation Strategies on Smart Specialisation (RIS3). *J. Open Innov. Technol. Mark. Complex.* **2021**, *7*, 184. [CrossRef]
28. Sarwar, S. Impact of energy intensity, green economy and blue economy to achieve sustainable economic growth in GCC countries: Does Saudi Vision 2030 matters to GCC countries. *Renew. Energy* **2022**, *191*, 30–46. [CrossRef]
29. Rubilar, T.; Cardozo, D. Blue Growth: Sea Urchin Sustainable Aquaculture, Innovative Approaches. *Rev. Biol. Trop.* **2021**, *69* (Suppl. S1), S474–S486. [CrossRef]
30. Schøning, L.; Hausner, V.H.; Morel, M. Law and sustainable transitions: An analysis of aquaculture regulation. *Environ. Innov. Soc. Transit.* **2023**, *48*, 100753. [CrossRef]
31. Cziesielski, M.J.; Duarte, C.M.; Aalismail, N.; Al-Hafedh, Y.; Anton, A.; Baalkhuyur, F.; Baker, A.C.; Balke, T.; Baums, I.B.; Berumen, M.; et al. Investing in Blue Natural Capital to Secure a Future for the Red Sea Ecosystems. *Front. Mar. Sci.* **2021**, *7*, 603722. [CrossRef]
32. Pu, R.; Li, X.; Chen, P. Sustainable development and sharing economy: A bibliometric analysis. *Probl. Perspect. Manag.* **2021**, *19*, 1. [CrossRef]
33. Cisneros-Montemayor, A.M.; Moreno-Báez, M.; Reygondeau, G.; Cheung, W.W.; Crosman, K.M.; González-Espinosa, P.C.; Lam, V.W.; Oyinlola, M.A.; Singh, G.G.; Swartz, W.; et al. Enabling conditions for an equitable and sustainable blue economy. *Nature* **2021**, *591*, 396–401. [CrossRef] [PubMed]
34. Kitada, M.; Bhirugnath-Bhookhun, M. Beyond business as usual: The role of women professionals in maritime clusters. *WMU J. Marit. Aff.* **2019**, *18*, 639–653. [CrossRef]
35. Blažauskas, N.; Grigelis, A.; Gelumbauskaitė, L.Ž.; Gulbinskas, S.; Suzdalev, S.; Ferrarin, C. Towards sustainable use of marine resources in the south-eastern Baltic Sea (Lithuania): A review. *Baltica* **2015**, *28*, 179–188. [CrossRef]
36. Salas-Leiton, E.; Hachero-Cruzado, I.; Asensio, E.; Vilas, C.; Zerolo, R.; Cañavate, J.P. Valorisation and enhanced sustainability of Senegalese sole (*Solea senegalensis*) aquaculture by dietary use of ditch shrimp (*Palaemonetes varians*) meal. *Aquaculture* **2020**, *522*, 735104. [CrossRef]
37. O'Shea, R.; Collins, A.; Howe, C. Offshore Multi-use setting: Introducing integrative assessment modelling to alleviate uncertainty of developing Seaweed Aquaculture inside Wind Farms. *Environ. Chall.* **2022**, *8*, 100559. [CrossRef]
38. Zhang, Y.; Fang, Z.; Xie, Z. Coordinated Development of Marine Economy and Ecological Environment in Coastal Areas of China: Development Level, Coupling Coordination Measurement, and Obstacle Analysis. *Sustainability* **2023**, *15*, 9122. [CrossRef]
39. Franz, G.; Garcia, C.A.; Pereira, J.; de Freitas Assad, L.P.; Rollnic, M.; Garbossa, L.H.P.; Da Cunha, L.C.; Lentini, C.A.; Nobre, P.; Turra, A.; et al. Coastal Ocean Observing and Modeling Systems in Brazil: Initiatives and Future Perspectives. *Front. Mar. Sci.* **2021**, *8*, 681619. [CrossRef]
40. Pace, L.A.; Borch, K.; Deidun, A. Bridging Knowledge Gaps towards 2030: The Use of Foresight for the Strategic Management of a Sustainable Blue Economy. *Sustainability* **2023**, *15*, 10026. [CrossRef]

41. Spaniol, M.J.; Rowland, N.J. Anticipated innovations for the blue economy: Crowdsourced predictions for the North Sea Region. *Mar. Policy* **2022**, *137*, 104874. [CrossRef]
42. Spaniol, M.J.; Rowland, N.J. Business ecosystems and the view from the future: The use of corporate foresight by stakeholders of the Ro-Ro shipping ecosystem in the Baltic Sea Region. *Technol. Forecast. Soc. Chang.* **2022**, *184*, 121966. [CrossRef]
43. Rupo, D.; Perano, M.; Centorrino, G.; Vargas-Sanchez, A. A Framework Based on Sustainability, Open Innovation, and Value Cocreation Paradigms—A Case in an Italian Maritime Cluster. *Sustainability* **2018**, *10*, 729. [CrossRef]
44. De Ungria, S.T.; Fernandez, L.T.T.; Sabado, S.E.F.; Santos, J.P.E.; Sararaña, A.R.B.; VinceCruz-Abeledo, C.C. How is fish market waste managed in the Philippines? *Environ. Sci. Pollut. Res.* **2023**, *30*, 49512–49522. [CrossRef]
45. Wang, C.; Li, J. The Investment Model of Marine Projects for the Sustainable Development of Marine Economy. *J. Coast. Res.* **2020**, *112*, 158–160. [CrossRef]
46. Thompson, B.S. Blue bonds for marine conservation and a sustainable ocean economy: Status, trends, and insights from green bonds. *Mar. Policy* **2022**, *144*, 105219. [CrossRef]
47. Caswell, B.A.; Klein, E.S.; Alleway, H.K.; Ball, J.E.; Botero, J.; Cardinale, M.; Eero, M.; Engelhard, G.H.; Fortibuoni, T.; Giraldo, A.J.; et al. Something old, something new: Historical perspectives provide lessons for blue growth agendas. *Fish Fish.* **2020**, *21*, 774–796. [CrossRef]
48. Pudzis, E.; Adlers, A.; Pukite, I.; Geipele, S.; Zeltins, N. Identification of Maritime Technology Development Mechanisms in the Context of Latvian Smart Specialisation and Blue Growth. *Latv. J. Phys. Tech. Sci.* **2018**, *55*, 57–69. [CrossRef]
49. Waheed, R. Energy Challenges, Green Growth, Blue Indicators, and Sustainable Economic Growth: A Study of Saudi Arabia. *Eval. Rev.* **2022**, *47*, 983–1024. [CrossRef]
50. Pace, L.A.; Saritas, O.; Deidun, A. Exploring future research and innovation directions for a sustainable blue economy. *Mar. Policy* **2023**, *148*, 105433. [CrossRef]
51. Nogué-Algueró, B. Growth in the docks: Ports, metabolic flows and socio-environmental impacts. *Sustain. Sci.* **2020**, *15*, 11–30. [CrossRef]
52. Ge, H.; Zhong, C.; Zhang, H.; Hu, D. The Effect of Environmental Regulation on Marine Economic Transformation under the Decentralized System: Evidence from Coastal Provinces in China. *Sustainability* **2022**, *14*, 16622. [CrossRef]
53. Villaseñor-Derbez, J.C.; Amador-Castro, I.G.; Hernández-Velasco, A.; Torre, J.; Fulton, S. Two Decades of Community-Based Marine Conservation Provide the Foundations for Future Action. *Front. Mar. Sci.* **2022**, *9*, 893104. [CrossRef]
54. Chen, Z.; Ma, L. Research on Spatial Pattern and Spatial Effect of Marine Science and Technology Innovation Efficiency in China's Coastal Provinces. *J. Coast. Res.* **2020**, *115*, 42. [CrossRef]
55. Gifford, E.; McKelvey, M.; Saemundsson, R. The evolution of knowledge-intensive innovation ecosystems: Co-evolving entrepreneurial activity and innovation policy in the West Swedish maritime system. *Ind. Innov.* **2021**, *28*, 651–676. [CrossRef]
56. Lyons, P.; Mynott, S.; Melbourne-Thomas, J. Enabling Indigenous innovations to re-centre social licence to operate in the Blue Economy. *Mar. Policy* **2023**, *147*, 105384. [CrossRef]
57. Volosiuk, M.; Vdovychenko, L.; Sirenko, I. Maritime clusters as an innovative form of development of coastal regions of Ukraine. *Balt. J. Econ. Stud.* **2022**, *8*, 44–50. [CrossRef]
58. Frohlich, M.; Fidelman, P.; Dutton, I.; Haward, M.; Head, B.W.; Maynard, D.; Rissik, D.; Vince, J. A network approach to analyse Australia's blue economy policy and legislative arrangements. *Mar. Policy* **2023**, *151*, 105588. [CrossRef]
59. Vierros, M.K.; Harden-Davies, H. Capacity building and technology transfer for improving governance of marine areas both beyond and within national jurisdiction. *Mar. Policy* **2020**, *122*, 104158. [CrossRef]
60. Sea, K.G.; Keer, N.R.; Yadav, R. Ecosystem service approach for community-based management towards sustainable blue economy. *Indian J. Anim. Sci.* **2021**, *91*, 1122–1126.
61. Gifford, E.; McKelvey, M. Knowledge-Intensive Entrepreneurship and S3: Conceptualizing Strategies for Sustainability. *Sustainability* **2019**, *11*, 4824. [CrossRef]
62. Ni, X.; Quan, Y. Measuring the Sustainable Development of Marine Economy Based on the Entropy Value Method: A Case Study in the Yangtze River Delta, China. *Sustainability* **2023**, *15*, 6719. [CrossRef]
63. Schneider, X.T.; Stroil, B.K.; Tourapi, C.; Rebours, C.; Gaudêncio, S.P.; Novoveska, L.; Vasquez, M.I. Responsible Research and Innovation Framework, the Nagoya Protocol and Other European Blue Biotechnology Strategies and Regulations: Gaps Analysis and Recommendations for Increased Knowledge in the Marine Biotechnology Community. *Mar. Drugs* **2022**, *20*, 290. [CrossRef]
64. Qu, Q.; Tsai, S.-B.; Tang, M.; Xu, C.; Dong, W. Marine Ecological Environment Management Based on Ecological Compensation Mechanisms. *Sustainability* **2016**, *8*, 1267. [CrossRef]
65. Spaniol, M.J.; Hansen, H. Electrification of the seas: Foresight for a sustainable blue economy. *J. Clean. Prod.* **2021**, *322*, 128988. [CrossRef]
66. Koliousis, I.G.; Papadimitriou, S.; Riza, E.; Stavroulakis, P.J.; Tsioumas, V. Scarcity theory and maritime clusters: From paradox to modelling. *Mar. Policy* **2018**, *93*, 40–46. [CrossRef]
67. Paulauskas, V. Blue Growth Circular Innovation. *TransNav Int. J. Mar. Navig. Saf. Sea Transp.* **2018**, *12*, 813–818. [CrossRef]
68. Rotter, A.; Bacu, A.; Barbier, M.; Bertoni, F.; Bones, A.M.; Cancela, M.L.; Carlsson, J.; Carvalho, M.F.; Cegłowska, M.; Dalay, M.C.; et al. A New Network for the Advancement of Marine Biotechnology in Europe and Beyond. *Front. Mar. Sci.* **2020**, *7*, 278. [CrossRef]

69. Cappelletto, M.; Villanova, L.M.; Trincardi, F.; Fava, F.; Barbanti, A.; Palamà, D.; Sarretta, A.; Bonanno, A.; Nardelli, B.B.; Sprovieri, M.; et al. Codevelop research and innovation for blue jobs and growth in the Mediterranean—The Bluemed initiative. *Environ. Eng. Manag. J.* **2018**, *17*, 2313–2327. [CrossRef]
70. Babb, A.C. Industrial Development Within the Blue Economy: 'What these Ithacas mean'. *Development* **2015**, *58*, 587–593. [CrossRef]
71. He, S.; Zhai, R.; Pan, Y. Modeling Analysis of the Relationship between the Exploitation and Utilization of Marine Resources and the Sustainable Development of the Marine Economy. *J. Coast. Res.* **2019**, *83*, 964. [CrossRef]
72. Zhang, L.; Yang, W. Modelling of coordinated development between marine agglomeration industry ecological industry chain and natural environment. *Int. J. Heavy Veh. Syst.* **2022**, *29*, 565–578. [CrossRef]
73. Wang, W. On the Development and Structural Evolution of China's Ocean Foreign Trade. *J. Coast. Res.* **2020**, *115*, 223. [CrossRef]
74. An, D.; Shen, C.; Yang, L. Evaluation and Temporal-Spatial Deconstruction for High-Quality Development of Regional Marine Economy: A Case Study of China. *Front. Mar. Sci.* **2022**, *9*, 916662. [CrossRef]
75. Zheng, H.; Zhang, J.; Zhao, X.; Mu, H. Exploring the affecting mechanism between environmental regulation and economic efficiency: New evidence from China's coastal areas. *Ocean Coast. Manag.* **2020**, *189*, 105148. [CrossRef]
76. Huo, X.; Zhao, L.; Li, J. Evaluation of Marine Economy Influence Factors: A Top-level Factor Analysis. *J. Coast. Res.* **2020**, *106*, 152. [CrossRef]
77. Seisdedos, M.R.; Carrasco, P.F. Port Projects in Blue Economy: Port of Motril-Granada. *J. Coast. Res.* **2020**, *95*, 940. [CrossRef]
78. Tirumala, R.D.; Tiwari, P. Innovative financing mechanism for blue economy projects. *Mar. Policy* **2020**, *139*, 104194. [CrossRef]
79. Wang, C.; Wang, X.; Wei, Y.; Ding, W. Analysis of Financial Needs and Financial Support Models for the Development of Marine Economy. *J. Coast. Res.* **2020**, *115*, 232. [CrossRef]
80. An, H.; Li, J. Financial Support for Marine Economic Development and Industrial Structure Optimization. *J. Coast. Res.* **2020**, *110*, 171–174. [CrossRef]
81. *United Nations Transforming Our World: The 2030 Agenda for Sustainable Development*; Division for Sustainable Development Goals: New York, NY, USA, 2015.
82. Carrà, G.; Monaco, C.; Peri, I. Local management plans for sustainability of small-scale fisheries: A case study. *Qual. Access Success* **2017**, *18*, 116–121.
83. Shi, X.; Jiang, H.; Li, H.; Wang, Y. Upgrading port-originated maritime clusters: Insights from Shanghai's experience. *Transp. Policy* **2020**, *87*, 19–32. [CrossRef]
84. Walpole, S.C. Including papers in languages other than English in systematic reviews: Important, feasible, yet often omitted. *J. Clin. Epidemiol.* **2019**, *111*, 127–134. [CrossRef]
85. Drucker, A.M.; Fleming, P.; Chan, A.W. Research Techniques Made Simple: Assessing Risk of Bias in Systematic Reviews. *J. Investig. Dermatol.* **2016**, *136*, e109–e114. [CrossRef] [PubMed]