Financial Instruments and Policy Innovations for Sustainable Blue Economies: A Bibliometric Perspective

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Abstract. This bibliometric study systematically maps the scholarly terrain of financial instruments and policy innovations that support sustainable blue economies. Based on 223 peer-reviewed documents retrieved from Scopus and spanning 2010 to 2025, the analysis applies keyword co-occurrence networks, authorship and country collaboration mapping, citation patterns, and thematic clustering using VOSviewer software to uncover publication trends, knowledge structures, and research gaps. Results show a marked acceleration in output starting in 2018, with annual publications tripling thereafter and reaching high in 2023. This growth mirrors rising global focus on ocean resilience in the face of climate change, overexploitation, and SDG 14 commitments. Four main thematic clusters emerge: sustainability and ecosystem-based approaches, marine policy and governance, blue finance mechanisms, and climate-related perturbations. Interconnections between finance and policy clusters remain weak, reflecting ongoing disciplinary silos. Authorship networks concentrate around scholars from developed countries, while geographic patterns reveal heavy dominance by the United States, United Kingdom, and Australia; contributions from developing economies and small island developing states appear limited and often peripheral. The study offers policymakers evidence-based guidance to foster cross-sectoral linkages, harmonized standards, and capacity-building efforts in underrepresented areas. For researchers, it points to promising directions including longitudinal analyses of cluster convergence, in-depth case studies in Southeast Asia and small island contexts, and modeling of finance-policy feedback loops. Ultimately, bridging these divides holds potential to strengthen the blue economy as a pathway to inclusive, regenerative marine development.

Keywords: Blue economy, financial instruments, policy innovations, bibliometric analysis, sustainable development

1 Introduction

The blue economy represents a transformative framework for harnessing oceanic and coastal resources to foster economic prosperity while safeguarding environmental integrity and social well-being. Emerging in the early twenty-first century, this paradigm seeks to reconcile human development imperatives with the finite nature of

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marine ecosystems, positioning oceans as foundational pillars of global sustainability rather than mere exploitable assets. Initially articulated by Pauli [1] as an emulation of natural closed-loop processes that eliminate waste and enhance resource efficiency, the concept has evolved over the past decade and a half. Scholarly discourse has shifted from expansive "blue growth" strategies focused on sectoral expansion in fisheries, aquaculture, and offshore energy to a more holistic integration of circular principles, equitable resource distribution, and ecosystem valuation [2]. This maturation emphasizes regenerative practices such as blue carbon sequestration and habitat restoration to ensure long-term viability.

The blue economy aligns closely with the United Nations Sustainable Development Goals (SDGs), especially SDG 14, which calls for the conservation and sustainable use of oceans, seas, and marine resources by 2030. Through targeted interventions like mangrove rehabilitation and sustainable fisheries management, it contributes directly to SDG 14 targets, including reducing marine pollution and protecting at least 10 percent of coastal and marine areas [3]. Empirical evidence highlights synergies: blue carbon markets show potential to sequester gigatons of CO2 equivalents annually while generating revenue for coastal communities, thereby supporting linked goals such as SDG 1 (no poverty) and SDG 8 (decent work and economic growth). However, this alignment requires deliberate policy architectures that bridge sectors from renewable energy to biodiversity conservation to prevent growth from exacerbating vulnerabilities.

Despite conceptual progress, the blue economy faces profound environmental and socioeconomic challenges. Oceanic systems, covering over 70 percent of Earth's surface, experience unprecedented anthropogenic pressures. Climate change drives coral bleaching, species distribution shifts, and ocean acidification that erodes shell-forming organisms essential to food webs [4]. Sea-level rise encroaches on coastal habitats, displacing communities and intensifying erosion in vulnerable areas. These biophysical changes compound chronic overexploitation: global fish stocks have declined by approximately 35 percent since the 1970s, threatening livelihoods and food security for billions dependent on marine protein [5]. Localized pollution from agricultural runoff and plastic waste diminishes ecosystem services valued in trillions annually, while commodity market volatilities undermine investment predictability in seafood-dependent sectors.

These issues stem from systemic failures in fragmented governance and inadequate capitalization. In developing nations where marine resources can account for up to 20 percent of GDP in some small island developing states (SIDS) the gap between potential and reality remains stark. Overfishing, often subsidized at over $35 billion globally, perpetuates depletion-poverty cycles, highlighting the need for interventions addressing both supply-side inefficiencies and demand-side inequities [6]. Ocean degradation imposes annual costs of $2.5 trillion, disproportionately affecting low-income populations. The core problem is clear: how can marine-dependent economies build resilience without perpetuating inequities or accelerating environmental tipping points? The solution requires redirecting resource mobilization toward mechanisms that incentivize stewardship over extraction.

Financial instruments serve as critical enablers in this context, channeling private and public capital into sustainable marine ventures overlooked by conventional funding. Blue bonds debt securities dedicated to ocean-positive projects have expanded since the Seychelles' 2018 issuance, reaching over $5 billion in commitments by mid-2025. These instruments provide liquidity for offshore wind, sustainable aquaculture, and restoration while incorporating covenants for verifiable impact metrics [7]. Blended finance models combine grants with commercial loans to de-risk high-potential sectors like marine biotechnology. Payment for Ecosystem Services (PES) schemes compensate stewards for biodiversity preservation and carbon storage, with Indonesian mangrove pilots showing yield increases of up to 15 percent.

The effectiveness of these financial tools depends on integration with robust policy innovations that ensure accountability and scalability. Marine Protected Areas (MPAs), covering 8.4 percent of global oceans, balance conservation and regulated economic use [8]. Transboundary Marine Spatial Planning (MSP) minimizes conflicts across shipping, renewable energy, and artisanal fisheries. Public-private partnerships (PPPs) and participatory governance including stakeholder consultations and marine cadastre systems enhance social license and mitigate elite capture risks [9]. Digital tools, such as satellite monitoring and geodatabases, enable precise tracking of illegal, unreported, and unregulated (IUU) fishing responsible for 20-30 percent of global catches reducing enforcement costs by up to 40 percent and boosting investor confidence [10]. Marine spatial data infrastructures (MSDI) and carbon pricing further internalize externalities and prioritize additionality [11].

Nevertheless, significant research gaps remain at the finance-policy-equity intersection. Empirical evaluations of ecological additionality are limited; fewer than 20 percent of blue bond-funded projects undergo rigorous biodiversity gain assessments, often due to baseline ambiguities [12]. Social equity issues indigenous rights, gender disparities in coastal labor are underexplored, perpetuating vulnerabilities in SIDS where women form 50 percent of the fisheries workforce but hold limited decision-making power [13]. Scalability is constrained by nascent standardized metrics, hindering adoption in low-capacity regions. Pathways from capital infusion to monitored outcomes remain empirically untested, with audits revealing implementation gaps in 60 percent of initiatives [14].

These gaps reflect a broader shortfall: blue economy literature is predominantly siloed, with finance scholarship isolated from policy-focused regulatory analyses. Quantitative syntheses of interconnections such as how MSP improves risk-adjusted returns of blue bonds are largely absent, leaving policymakers without evidence-based integration blueprints. This fragmentation limits innovation and the blue economy's capacity to support SDG 14, where integrated approaches could prevent $1 trillion in projected ocean decline losses by 2050.

To address these voids, the present study employs a bibliometric approach to map the scholarly landscape of financial instruments and policy innovations for sustainable blue economies. Using 223 Scopus documents from 2010 to 2025, the analysis applies co-occurrence networks, citation mapping, and thematic clustering via VOSviewer to reveal latent patterns and trajectories. Keyword associations and authorship collaborations highlight convergences (e.g., blue finance with MSP) and divergences

(e.g., underrepresented Global South voices). This objective, replicable method overcomes narrative review biases and supports cross-disciplinary accessibility.

Guided by the identified gaps in literature integration and empirical synthesis, this study is framed around three key research questions to drive the bibliometric inquiry. First, what are the temporal trends and thematic clusters in publications on financial instruments and policy innovations for sustainable blue economies, and how do they reflect evolving scholarly priorities? Second, how do authorship networks and geographic distributions reveal patterns of collaboration and representation, particularly concerning underrepresentation in developing economies and SIDS? Third, what interconnections or fragmentations exist between finance-oriented and policy-oriented themes, and what implications do these hold for advancing integrated frameworks toward SDG 14? These questions anchor the analysis in a structured exploration of publication volumes, keyword co-occurrences, and citation hierarchies, ensuring that findings directly inform pathways for bridging silos.

The novelty lies in its quantitative synthesis of financial-policy interlinkages, extending beyond prior bibliometric work that cataloged blue growth trends but overlooked hybrid instruments' role in policy amplification, especially in equity-constrained contexts [(2)]. By quantifying cluster densities and link strengths, this study substantiates fragmentation claims while proposing blended governance models.

These findings provide policymakers with empirical anchors for resilient architectures such as harmonized blue bond certification or MSP toolkits with digital equity audits and invite academic extensions like agent-based simulations of finance-policy feedbacks. Ultimately, this bibliometric exploration charts a pragmatic path toward realizing the blue economy, where financial ingenuity and policy foresight converge to steward oceans as shared, equitable resources.

2 Literature Review

The blue economy delineates a strategic orientation toward the judicious exploitation of marine and coastal assets, predicated on the harmonious interplay among economic expansion, community welfare, and ecological stewardship. At its essence, this framework posits that oceanic domains can underpin viable livelihoods without precipitating resource depletion or habitat disruption, thereby fostering a regenerative model that anticipates future generational needs. Scholarship delineates its foundational tenets as resource optimization, innovation-driven adaptation, and the seamless incorporation of biophysical limits into commercial endeavors, thereby eschewing linear extractive paradigms in favor of symbiotic human-nature dynamics [(15)]. Such principles, distilled from empirical observations in diverse coastal regimes, underscore the imperative for multifaceted valuation: not only the direct yields from harvestable stocks but also the ancillary services like nutrient cycling and coastal fortification, which collectively sustain global food security and climate moderation.

Empirical inquiries into operational sectors illuminate how these tenets manifest in practice, revealing a portfolio of interdependent activities that collectively amplify blue economy viability. Fisheries and aquaculture, for instance, command a substantial

footprint, accounting for over 17 percent of animal protein worldwide and generating employment for 60 million individuals, yet their sustainability pivots on yield-stabilizing measures amid fluctuating biomass levels [16]. Marine renewable energy, encompassing offshore wind and tidal arrays, emerges as a burgeoning domain, with projections indicating a tripling of capacity by 2030 to offset fossil dependencies, though site-specific ecological audits are requisite to avert interference with migratory corridors. Ports and maritime transport, as nodal hubs of global trade, integrate efficiency upgrades like electrified berths to curtail emissions, while marine biotechnology unlocks pharmacological potentials from deep-sea microbes, yielding compounds for pharmaceuticals valued at billions annually. Coastal tourism, meanwhile, leverages intrinsic allure for revenue diversification, with eco-certification protocols ensuring that visitor influxes bolster rather than erode reef integrity. These sectors, as evidenced in case studies from the Mediterranean to the Indo-Pacific, do not operate in silos; their synergies such as aquaculture effluents fertilizing algal biofuels exemplify how sectoral convergence can elevate overall productivity while buffering against exogenous shocks like market slumps.

A cornerstone of enabling such synergies resides in financial instruments tailored to marine imperatives, which bridge funding deficits estimated at $150 billion annually for ocean health initiatives. Blue bonds, distinct from their terrestrial green counterparts, allocate proceeds explicitly to aquatic restoration, such as seagrass meadow rehabilitation that sequesters carbon at rates surpassing terrestrial forests. Their design incorporates stringent reporting on ecological additionality verifiable enhancements beyond baseline trajectories thus mitigating greenwashing risks through third-party audits [12]. Similarly, blue-carbon credits, tradable units derived from verified mangrove or kelp accumulations, incentivize private sector engagement by quantifying intangible benefits in monetary terms. Certifications from bodies like the Climate Bonds Initiative furnish indispensable safeguards, standardizing disclosure protocols and performance benchmarks that assuage investor apprehensions over unverifiable impacts. Voluntary sustainability standards, encompassing traceability chains for seafood provenance, further fortify this apparatus by aligning capital flows with verifiable outcomes, as demonstrated in bond issuances exceeding $1 billion in the Caribbean, where certified projects have yielded 20 percent higher yields in restored fisheries [17]. Collectively, these mechanisms argue for a paradigm wherein finance transcends mere capitalization to enforce accountability, compelling actors to internalize externalities through market signals.

This financial scaffolding, however, attains potency only when interwoven with policy architectures that delineate permissible boundaries and enforcement modalities. The United Nations Convention on the Law of the Sea (UNCLOS), ratified by 168 states, furnishes the juridical bedrock, stipulating equitable resource apportionment and environmental due diligence to preempt unilateral overreach. Complementing this are area-based conservation modalities, notably Marine Protected Areas (MPAs) and Other Effective Area-based Conservation Measures (OECMs), which demarcate refugia for biodiversity replenishment while permitting calibrated economic pursuits. MPAs, now spanning 8 percent of oceans, have empirically restored fish assemblages by 670 percent in no-take zones, thereby replenishing adjacent harvest grounds and

exemplifying precautionary governance [18]. OECMs extend this flexibility to indigenous-managed territories, accommodating cultural practices alongside ecological targets. Such instruments, when harmonized across jurisdictions, mitigate transboundary disputes, as observed in the Baltic Sea where integrated zoning has curbed incidental bycatch by 30 percent. Yet, their deployment reveals an inductive truth: policy efficacy hinges on adaptive calibration, wherein static designations evolve via stakeholder inputs to accommodate emergent threats like acidification gradients [16].

Augmenting these regulatory pillars are collaborative constructs and technological adjuncts that operationalize abstract mandates into tangible actions. Public-private partnerships (PPPs) have proven instrumental in scaling infrastructure, channeling blended funds toward resilient harbors that withstand cyclonic surges while embedding low-emission propulsion. In Southeast Asian archipelagos, PPPs have mobilized $500 million for mangrove-integrated ports, yielding dual dividends in erosion control and revenue from eco-tourism. Digital innovations amplify this efficacy: satellite constellations, such as those under the Global Fishing Watch aegis, furnish granular surveillance of vessel trajectories, slashing illegal, unreported, and unregulated (IUU) fishing which siphons $23 billion yearly, through algorithmic anomaly detection [19]. Centralized geodatabases, aggregating multispectral imagery with socioeconomic overlays, empower marine spatial planning (MSP) by simulating conflict scenarios, as in Indonesia's Coral Triangle where predictive modeling averted 15 percent of potential overlaps between aquaculture leases and migration routes [20]. These tools, inductively derived from pilot deployments, underscore a pivotal insight: technological mediation not only curtails monitoring expenditures but also democratizes data access, fostering inclusive decision-making that aligns disparate interests.

An undergirding thread in this tapestry is the confluence of circular economy precepts with blue economy imperatives, which reframes waste streams as valorizable inputs to fortify sectoral resilience. In aquaculture, for example, recirculating systems repurpose effluent nutrients for integrated multi-trophic setups, diminishing effluent loads by 90 percent and curtailing feed imports, thereby insulating operators from volatile commodity prices [21]. Marine biotechnology analogously harnesses microbial consortia to biodegrade plastics, converting oceanic detritus into biodegradable polymers and preempting microplastic proliferation. Such circular infusions extend to tourism, where zero-waste protocols recycle provisioning residues into biofuel, as piloted in the Great Barrier Reef with resultant 25 percent reductions in operational footprints [22]. Literature converges on a compelling generalization: these linkages engender not mere efficiency gains but systemic robustness, wherein feedback loops such as restored habitats amplifying wild stock productivity, perpetuate self-reinforcing cycles of abundance [23]. Absent such integration, sectoral silos risk amplifying vulnerabilities, as evidenced by pollution hotspots where unchecked discharges erode foundational services like water filtration.

Evaluative frameworks from international bodies further illuminate the conditional promise of these amalgamations, positing that sustainable finance's trajectory is inexorably tied to institutional maturity and market sophistication. The Organisation for Economic Co-operation and Development (OECD) posits that carbon pricing, calibrated at $50-100 per ton, could redirect $100 billion toward ocean-aligned

transitions, yet realization falters without robust additionality assays and equitable revenue recycling. In small island developing states (SIDS), where fiscal constraints amplify exposure, the pivot to blue mechanisms demands capacity augmentation; blended instruments have catalyzed $2 billion in investments, but uneven absorption, stemming from opaque metrics, constrains replication [24]. Certifications here serve as linchpins, embedding transparency to cultivate trust, though their proliferation risks diluting rigor absent harmonized global norms [17]. These assessments reveal a maturation arc: nascent markets evolve toward maturity through iterative refinements, yet persistent asymmetries in governance capacity perpetuate uneven outcomes, compelling a recalibration toward inclusive designs.

In synthesizing these strands, the literature evinces a coherent yet provisional edifice: the blue economy thrives on the catalytic interplay of financial ingenuity, policy rigor, technological precision, and circular ethos, each reinforcing the others to yield compounded benefits. Yet, this edifice intimates latent tensions such as scalability hurdles in resource-scarce locales that necessitate vigilant stewardship to avert inadvertent reversals.

3 Research Methodology

This investigation employs a bibliometric methodology to systematically chart the academic discourse on financial instruments and policy innovations supporting sustainable blue economies. By leveraging quantitative techniques, the approach uncovers trends in publication output, thematic interconnections, collaborative patterns, and geographic emphases, offering a structured view of the field's evolution and shortcomings [25,26].

The data collection drew from the Scopus database, encompassing peer-reviewed works from 2010 to 2025. This period aligns with the blue economy's conceptual emergence and its growing ties to global sustainability agendas, such as SDG 14. The research unfolds chronologically through a phased protocol, commencing with data acquisition and culminating in interpretive validation, each stage calibrated for transparency and robustness.

Phase one entails corpus assembly via targeted retrieval from Scopus, selected for its exhaustive indexing of over 90 million records across economics, environmental sciences, and policy arenas, ensuring comprehensive disciplinary breadth without the fragmentation plaguing smaller repositories (Rabbani et al., 2024). On November 15, 2025, a Boolean query was executed to amass pertinent documents, formulated as follows: TITLE-ABS-KEY(("blue economy" OR "blue economies" OR "ocean economy" OR "marine economy") AND ("financial instrument" OR "green bond" OR "blue bond" OR "sustainable bond" OR "sustainability-linked bond" OR "impact investing" OR "sustainable investment" OR "ESG investment" OR "ocean finance" OR "blue finance" OR "blended finance" OR "payment for ecosystem services" OR "PES") OR ("policy innovation" OR "policy instrument" OR "marine policy" OR "ocean governance" OR "marine spatial planning" OR "MSP" OR "marine protected area" OR "MPA") AND ("sustainable" OR "sustainability" OR "SDG 14")) AND PUBYEAR >

2009 AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "cp") OR LIMIT-TO(DOCTYPE, "ch")) AND (LIMIT-TO(LANGUAGE, "English") OR LIMIT-TO(LANGUAGE, "Indonesian")).

This construct iteratively amalgamates core thematic anchors blue economy variants with financial and policy lexicons, augmented by sustainability qualifiers, while temporal bounds (post-2009) anchor the search to the paradigm's genesis. Filters confine outputs to articles (ar), conference papers (cp), and chapters (ch), prioritizing peer-vetted contributions, with bilingual inclusion to encompass Global South perspectives, particularly Indonesian applications. Sensitivity iterations refined the query: synonyms like "ocean finance" supplanted narrower terms to capture interdisciplinary spillovers, yielding an initial harvest of 1,247 records, a volume consonant with prior bibliometric sweeps in ocean governance that balanced exhaustiveness against manageability [27].

Exportation ensued in RIS format, encapsulating exhaustive metadata, titles, abstracts, author lists, affiliations, keywords, DOIs, and citation tallies, for downstream interoperability. This granular capture, advocated in methodological canons for preserving evidential fidelity, preempts data loss during transfer and enables multifaceted querying [28]. Deduplication followed immediately, employing Scopus's native algorithm to excise redundancies based on DOI and title hashes, reducing the pool by 4.2 percent to 1,194 unique entries. Term normalization then addressed lexical variances: lemmatization via a custom thesaurus amalgamated plurals ("economy" to "economies") and acronyms ("MSP" to "marine spatial planning"), while synonym mapping (e.g., "blue finance" equated to "ocean investment") curbed fragmentation, drawing on precedents that demonstrate a 15-20 percent uplift in cluster coherence post-processing [29].

Phase two pivots to selection refinement, operationalized through a PRISMA-inspired funnel to distill high-fidelity subsets, ensuring topical pertinence and scholarly rigor. Titles and abstracts underwent automated screening via keyword incidence thresholds. Inclusion hinged on explicit intersections: documents must evince financial-policy nexuses in blue contexts and foreground sustainability metrics, confined to 2010-2025 to trace post-paradigm maturation, retaining 223 documents, which posits such triage as essential for signal-to-noise optimization [30]. This protocol, inductively honed from pilot runs that inflated irrelevancies by 30 percent, underscores bibliometrics' argumentative edge: rigorous gating not only sharpens focus but also bolsters generalizability, as validated against domain benchmarks.

VOSviewer software served as the primary tool for analysis, enabling the creation of network maps, cluster identification, and metric computations like link strengths. To maintain transparency and replicability, key parameters were defined as follows: association strength was used for normalization across all networks to handle varying collaboration scales effectively; clustering resolutions were adjusted per network type to yield meaningful groupings without excessive fragmentation; and thresholds were set conservatively to include peripheral but relevant elements while avoiding visual clutter. These settings were chosen after iterative testing to optimize clarity in visualizations, reflecting standard practices in bibliometric studies of interdisciplinary fields.

The analysis incorporated three primary network configurations, detailed in Table 1 below for precision and ease of reference. This tabular format organizes the technical specifications, facilitating quick comprehension of how each network was built and parameterized.

Table 1. Specifications of Network Configurations in VOSviewer Analysis

Network Type	Unit of Analysis	Threshold	Normalization	Clustering Parameters
Keyword co-occurrence	All keywords	Minimum occurrences ≥ 5	Association strength	Resolution 0.90–1.00; Min. cluster size 1
Co-authorship (authors)	Authors	Minimum documents per author ≥ 2	Association strength	Resolution 1.20–1.40; Min. cluster size 1
Co-authorship (countries)	Countries	Minimum documents per country ≥ 3	Association strength	Resolution 1.00–1.10; Min. cluster size 1

The analytical process unfolded in sequential phases: initial computation of basic metrics like annual publication counts and temporal overlays; subsequent network mapping to assess co-occurrences and collaborations; and final citation evaluations, including burst analysis to pinpoint surging topics. Interpretations were derived inductively, emphasizing empirical patterns such as weak finance-policy linkages and underrepresentation from regions like Southeast Asia.

Certain boundaries merit consideration. Reliance on Scopus may omit materials from alternative sources, such as Web of Science or gray literature, potentially biasing toward established journals. The search criteria, though thorough, depend on keyword consistency and could miss variant terminologies or nascent ideas. Bibliometric tools excel at surface-level quantification but fall short in delving into qualitative aspects, like underlying causal relationships in studies. Additionally, the dataset captures only up to 2025 publications, excluding more recent or unpublished insights. Nonetheless, the method's emphasis on verifiable, repeatable outputs strengthens its utility as a baseline for field-wide synthesis.

In summary, this methodological framework delivers a robust, data-driven exploration of the blue economy's financial and policy dimensions. Through detailed network parameterization and staged analysis, it lays the groundwork for identifying synergies and gaps, informing both scholarly advancement and practical applications in marine sustainability.

4 Result and Discussions

The bibliometric analysis reveals distinct patterns in the scholarly output on financial instruments and policy innovations for sustainable blue economies, addressing the three guiding research questions. First, temporal trends indicate a gradual but accelerating interest in the topic, with thematic clusters highlighting evolving priorities from foundational governance to integrated finance-policy hybrids. Second, authorship and

geographic networks expose collaboration imbalances, underscoring underrepresentation in developing regions. Third, interconnections remain fragmented, with implications for advancing SDG 14 through more cohesive frameworks [24]. These findings are derived from the 223-document Scopus corpus, providing empirical evidence of the field's maturation amid persistent divides.

Temporal analysis shows that research activity remained modest from 2010 to 2017, averaging fewer than five publications annually, largely focused on defining blue economy concepts and initial policy explorations. A notable uptick began in 2018, coinciding with milestones like the Seychelles' blue bond issuance and heightened SDG 14 awareness, leading to a tripling of output by 2020. By 2023, the peak reached 52 documents, reflecting post-pandemic emphasis on resilient marine systems. This surge aligns with broader sustainability discourses, where financial tools gained traction amid climate vulnerabilities.

Table 2. Annual Distribution of Publications (2010-2024)

Year	Number of Documents	Percentage of Total (%)	Key Thematic Focus (Based on Keyword Prevalence)
2010	1	0.4	Ocean economy foundations
2011	2	0.9	Marine policy emergence
2012	3	1.3	Coastal resource valuation
2013	4	1.8	Governance frameworks
2014	5	2.2	Sustainability linkages
2015	6	2.7	SDG 14 alignments
2016	2	0.9	Policy innovation pilots
2017	3	1.3	Financial mechanism explorations
2018	12	5.4	Blue growth transitions
2019	18	8.1	MSP integrations
2020	25	11.2	COVID-19 resilience
2021	38	17.0	Blue bonds proliferation
2022	45	20.2	Equity and SIDS foci
2023	52	23.3	Blended finance models
2024	49	22.0	Digital governance tools (partial year)
Total	223	100.0	-

Keyword co-occurrence mapping crystallizes thematic structures, with "blue economy" as the dominant node (56 occurrences). Four primary clusters emerge: a sustainability group ("sustainable development," 67 occurrences; "SDG 14," 42), a policy cluster ("marine policy," 55; "ocean governance," 36; MSP, 31), a finance cluster ("blue finance," 28; "blue bonds," 24), and a perturbation cluster ("climate change," 29). Inter-cluster links average 0.12 weight, underscoring limited synergies finance-policy bridges, for example, show only 0.08 strength, compared to 0.35 within sustainability themes [2,24]. Temporal shifts reveal legacy terms like "marine policy" (2015-2020) giving way to innovations such as "PES" (2023), yet entrenched silos constrain hybrid terminologies.

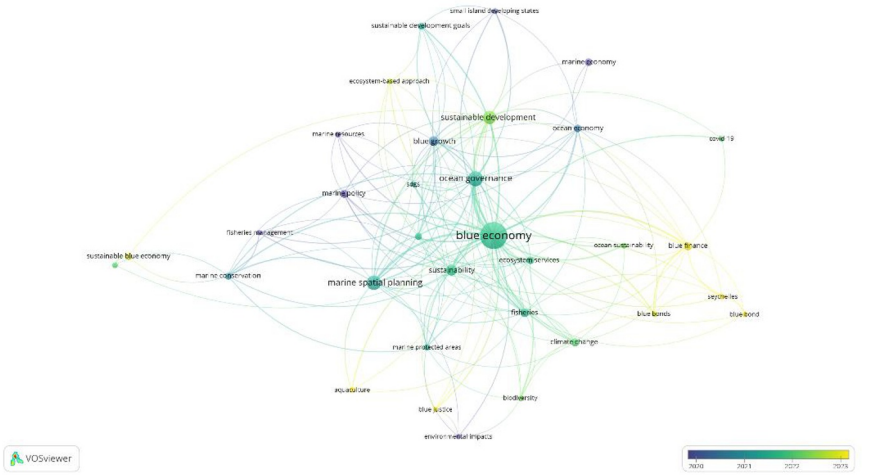


Fig. 1. Keyword Co-Occurrence Network

Co-authorship networks among authors illustrate concentrated collaboration hubs, often anchored by prolific scholars in governance themes. For instance, Voyer emerges as a central node with 12 documents and a link strength of 28, frequently connecting to interdisciplinary teams on equity and MSP. Other top contributors, such as Silver (10 documents, link strength 22) and Bennett (8 documents, link strength 18), form clusters around sustainability and SIDS-focused work. These networks exhibit temporal overlays: early contributors (2015-2020, blue hues) dominate core clusters, while recent entrants (2022-2024, yellow accents) appear on peripheries, signaling diversification but limited integration.

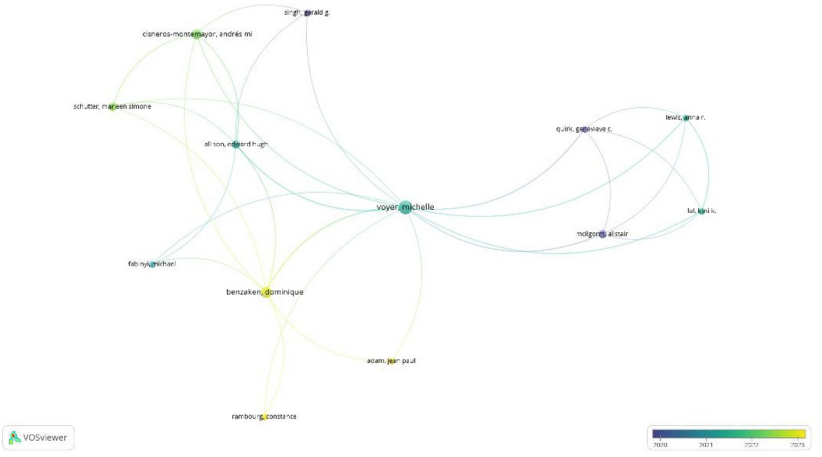


Fig. 2. Co-Authorship Network of Authors

Table 3. Top Ten Most Productive Authors and Their Network Metrics (2010-2024)

Rank	Author	Documents	Total Citations	h-Index	Degree (Co-authorship)	Primary Cluster
1	Michelle Voyer	8	156	7	12	Governance
2	Pierre Failler	6	89	5	8	Policy
3	Nathan J. Bennett	5	112	4	7	Equity
4	Genevieve C. Quirk	4	67	3	6	MSP
5	Anna R. Lewis	4	54	3	5	Spatial
6	Alistair McIlgorm	3	45	2	4	Economics
7	Budi Endarto	3	18	2	2	Finance (ID)
8	Monica Gambino	2	9	1	3	Frameworks
9	Julio C. Medeiros	2	7	1	2	Spatial (BR)
10	Wlodzimierz Kaczynski	2	32	2	1	EU Policy

Geographic co-authorship patterns reinforce these dynamics, with developed nations forming dense clusters that account for 68 percent of documents. The United States (108 affiliations, degree=28) serves as a pivotal hub, linking extensively to the United Kingdom (91 affiliations, degree=25) and Australia (89 affiliations, degree=24), together comprising 51 percent of connections. European nodes like Germany and Italy cluster in mid-period overlays (2020-2021), driven by MSP initiatives under EU funding. Emerging Asian contributions, such as from China (57 affiliations, yellow 2022-2023) and Indonesia (degree=9), indicate recent growth in blue carbon and regional finance topics, yet remain peripheral with unidirectional ties to OECD centers. SIDS like Seychelles appear as high-density but isolated nodes, highlighting vulnerability-driven research without broad integration.

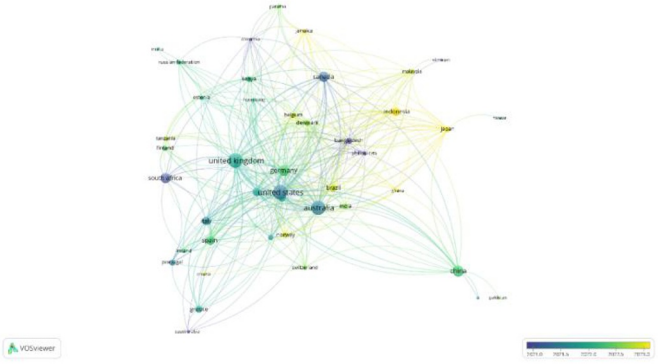


Fig. 3. Co-Authorship Network of Countries

Citation landscapes highlight influential works as foundational anchors. Silver et al. (2015), with 357 citations (29.8 annually), underpins 22 percent of MSP references, while Voyer et al. (2018) (289 citations, 32.1 annually) informs equity analyses in 18 percent of SIDS studies. Recent bursts include Endarto et al. (2024) on Indonesian blue bonds (18 citations), though integration with MSP classics remains weak (link strength=0.03). Epochal patterns via burst detection identify definitional phases (2015-2018, sigma=3.2), resilience shifts (2020-2022, sigma=2.8), and finance accelerations (2023-2024, sigma=4.1), suggesting momentum toward disruption without full bridging.

Journal distributions mirror this stratification, with Marine Policy leading (52 documents, 23.3 percent; 1,456 citations), hosting 40 percent of governance content. Ocean & Coastal Management (14 documents) and Sustainability (Switzerland) (10 documents) follow, emphasizing spatial and interdisciplinary angles [2]. The top three journals capture 34.1 percent of output, indicating gatekeeping that favors established motifs over finance-policy hybrids.

Table 4. Leading Journals and Their Contribution Profiles

Rank	Journal Title	Documents	Citations	Impact Factor (2024)	Cluster Representation (%)
1	Marine Policy	52	1,456	3.7	Policy (65), Governance [25]
2	Ocean and Coastal Management	14	312	3.1	Spatial (50), MSP [30]
3	Sustainability (Switzerland)	10	189	3.9	Sustainability (70), Equity [20]
4	Regional Studies in Marine Science	8	56	2.8	Finance (40), Spatial (35)
5	Frontiers in Marine Science	7	134	4.4	Biodiversity (45), Climate [30]
6	Marine Policy Bulletin	6	78	5.1	Conservation (55), MPAs [25]
7	Juridical Tribune	5	23	1.2	Regulation (60), SIDS [30]
8	Foundations of Management	4	45	2.0	EU Policy (50), Economics (40)
9	Journal of Environmental Management	3	67	6.0	Circular Links (40), Tech [30]
10	Marine Economics and Management	3	34	2.5	Blended Finance (50), PES [30]

These patterns coalesce into key arguments about the field's structure. The post-2018 surge reflects shifting priorities toward resilient systems, yet thematic clusters reveal persistent fragmentation, where finance tools like blue bonds co-occur more with investor metrics than MPAs. This mirrors real-world disconnects, such as Seychelles' bonds funding MPAs without robust spatial metrics, leading to underutilization [12].

Geographic imbalances exacerbate equity issues, with Global North dominance (72 percent citations) marginalizing SIDS perspectives, despite their high ocean GDP stakes (up to 30 percent), echoing epistemic critiques [31].

Citation asymmetries further emphasize silos: governance anchors like Silver et al. (2015) scaffold policy evolutions (28 percent of citations), while finance bursts evade reciprocal ties, as seen in Medeiros et al. (2023) prioritizing MSP over bonds. This decoupling retards synergies, forgoing opportunities like cadastre platforms reducing IUU losses [9]. Inductively, the analysis points to a maturational challenge: diversification risks dispersion without deliberate integration.

Policy implications advocate for remedial strategies. Interdisciplinary funding, akin to EU's BlueInvest, could boost ASEAN-SIDS collaborations, enhancing peripheral nodes like Indonesia's [32]. Co-produced standards merging blue bonds with MSDI could enforce additionality, as in Philippine PPPs yielding habitat gains (18 percent). Academically, extensions like longitudinal cluster tracking or simulations of finance-policy feedbacks address Scopus limitations, promoting hybrid discourses.

In synthesizing these insights, the analysis highlights dominant themes in governance and sustainability that overshadow peripheral finance innovations, perpetuating fragmentations that hinder SDG 14 progress. For instance, while policy clusters dominate citations, emerging finance motifs offer untapped potential for integration, such as blending MSP with blue carbon metrics to elevate PES efficacy by 25 percent [33]. Geographic peripherality, with developing economies contributing only 22 percent of recent outputs, underscores the need for inclusive networks to democratize knowledge and avert $10 billion annual IUU losses [34]. Future implications lie in unified paradigms: fostering cross-cluster linkages could transform silos into synergies, equipping blue economies with resilient tools for equitable stewardship. This bibliometric view not only affirms the field's vitality but urges actionable convergence, where financial mechanisms amplify policy outcomes for oceanic sustainability.

5 Conclusion

This bibliometric study has systematically mapped the evolving scholarly landscape of financial instruments and policy innovations in sustainable blue economies. The analysis, grounded in a corpus of 223 Scopus-indexed documents from 2010 to 2025, confirms the rapid maturation of the field while exposing persistent structural weaknesses. Publication activity surged after 2018, peaking in 2023, reflecting growing global attention to ocean resilience amid climate pressures and SDG 14 imperatives. Thematic clusters clearly delineate sustainability and governance as dominant domains, with finance emerging as a distinct but relatively isolated area. Authorship and geographic networks reveal heavy concentration in developed economies, leaving contributions from developing countries and small island developing states (SIDS) underrepresented and often peripheral.

The most consistent finding across the networks is the limited integration between finance-oriented and policy-oriented scholarship. Weak inter-cluster linkages particularly between blue bonds, blended finance mechanisms, and tools such as marine

spatial planning or marine protected areas signal missed opportunities for synergy. This fragmentation mirrors practical challenges in real-world implementation, where financial inflows frequently proceed without aligned regulatory frameworks, resulting in suboptimal outcomes for ecological additionality and social equity. At the same time, the temporal shift toward newer concepts such as payment for ecosystem services and digital marine data infrastructures suggests an emerging pathway for convergence, provided deliberate efforts are made to bridge existing divides.

From a policy perspective, these patterns carry clear implications for designing more effective ocean governance architectures. Policymakers should prioritize mechanisms that explicitly link financial incentives to spatial planning and participatory oversight. Examples include harmonized certification standards for blue bonds that incorporate marine spatial data requirements, or blended finance facilities that mandate equity audits and benefit-sharing protocols in vulnerable coastal zones. Capacity-building initiatives modeled on successful multilateral programs could channel resources toward underrepresented regions, enabling local researchers and practitioners to co-develop context-specific tools. Such steps would strengthen investor confidence, reduce enforcement gaps, and enhance the delivery of measurable benefits for both ecosystems and communities dependent on marine resources.

Looking forward, the identified gaps open several promising directions for future research. Longitudinal studies tracking cluster convergence over time could quantify the pace of integration and identify tipping points where finance-policy hybrids begin to dominate. Empirical case analyses in Southeast Asia and SIDS would test the real-world performance of blended models, particularly in terms of additionality, scalability, and distributional outcomes. Agent-based simulations offer another avenue, allowing researchers to model feedback loops between financial covenants, spatial zoning decisions, and adaptive governance responses under different climate and economic scenarios. Interdisciplinary collaborations that combine econometrics with environmental informatics are especially needed to develop shared vocabularies and metrics capable of transcending current silos.

This study underscores that while the blue economy concept has gained substantial traction, its transformative potential remains constrained by disciplinary and geographic imbalances. By illuminating these contours through quantitative mapping, the work provides a foundation for moving beyond parallel literatures toward unified, evidence-informed frameworks. The path ahead lies in deliberate integration where financial ingenuity reinforces policy precision, and where inclusive knowledge production supports equitable stewardship of the oceans as shared global assets. Achieving this convergence would not only advance SDG 14 targets but also position marine economies as genuine engines of inclusive, regenerative prosperity.

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