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Editorial: The grey side of the blue bioeconomy: assessing unreported transactions and financial drainage in blue bioeconomy sectors

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Editorial on the Research Topic
The grey side of the blue bioeconomy: assessing unreported transactions and financial drainage in blue bioeconomy sectors

Editorial

The blue bioeconomy has become a central pillar of sustainable development for coastal nations (Lees et al., 2025), contributing directly to several of the United Nations Sustainable Development Goals (UN, 2016; Vieira et al., 2020). Its growing importance is reflected in strategic policy frameworks adopted by major economies, including the European Union (EC, 2025) and China (Zhang et al., 2022), which envision a future driven by biotechnology, innovation, sustainable resource use, and effective governance. Despite this momentum, research has largely focused on the opportunities offered by the blue bioeconomy, while its "grey side", namely the informal, unreported, and poorly regulated activities that undermine environmental sustainability, economic performance, and governance has warranted relatively little attention. This apparent imbalance is also visible in the scientific literature.

Using equivalent targeted queries in the Scopus and Web of Science Core Collection (Clarivate) (see https://doi.org/10.5281/zenodo.21428102), we identified only eleven publications (ten original research articles and one review article) addressing themes at the intersection of the blue bioeconomy and its proposed "grey side", published between 2016 and 2026 – see the full dataset at https://doi.org/10.5281/zenodo.21285844. This relatively underexplored research area comprises 41 authors, with an international co-authorship rate of 27.27%. The eleven publications have received 193 citations, with nearly 80% accounted

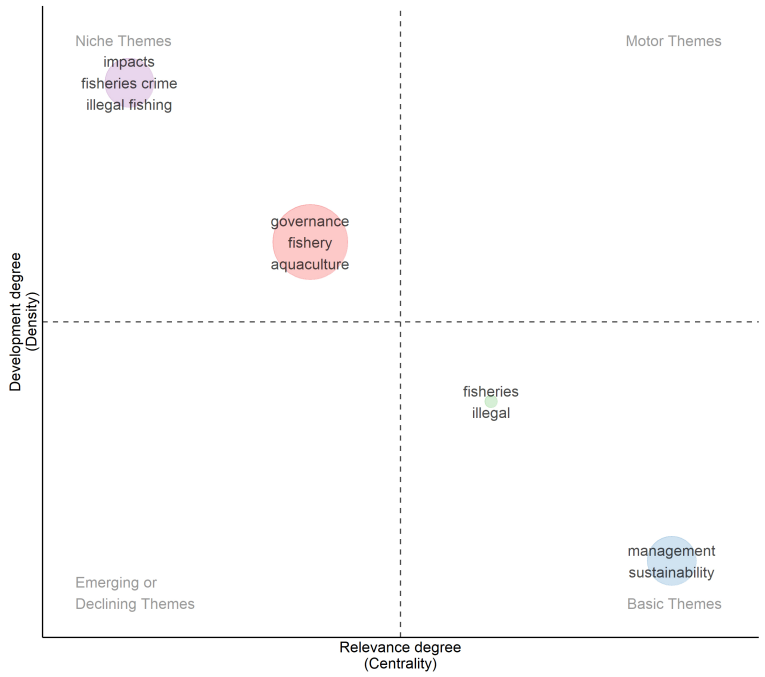


FIGURE 1
Thematic map.

for by the three most highly cited articles[123]. Excluding the review article, which adopts a global perspective, the remaining ten empirical studies were conducted across Southeast Asia (Indonesia, n = 2; Vietnam, n = 2), the Americas (Mexico, n = 2; Brazil, n = 1), South Asia (India, n = 1), the Middle East (Saudi Arabia, n = 1), and Africa (Cameroon, n = 1). Although no clear temporal growth trend is evident over the ten-year study period, the thematic map (Figure 1) reveals the emergence of distinct research domains within this developing field.

Thematic map

As shown in Figure 1, governance, fisheries, and aquaculture constitute the central thematic cluster, highlighting the importance of institutional arrangements for achieving sustainable blue bioeconomy outcomes. A second, more specialized cluster groups illegal fishing, fisheries crime, and their associated impacts, indicating a well-developed but relatively isolated research niche focused on the illicit exploitation of marine resources. By contrast, management and sustainability appear as basic themes with high centrality but comparatively low thematic development, suggesting that they underpin much of the existing literature without being explicitly integrated as yet with hidden economic activities or governance failures. Together, while these thematic domains indicate that research has predominantly addressed governance and fisheries-related challenges, the broader conceptual integration of hidden economic processes within the blue bioeconomy remains limited.

Drawing upon the common conceptual elements identified across the retrieved literature, we propose the following definition: The Grey Side of the Blue Bioeconomy refers to the often-overlooked latent institutional and economic dimension of the blue bioeconomy that encompasses informal, opaque, underreported, and illicit practices, together with the governance deficiencies that enable them, resulting in financial leakage, inefficient resource use, and reduced sustainability outcomes across blue bioeconomy value chains. This definition provides a conceptual framework through which the contributions to this Research Topic can be interpreted, highlighting the diverse manifestations of hidden economic activities and institutional shortcomings across blue bioeconomy sectors. In this context, the Research Topic was established to advance understanding of the hidden (and, in some cases, visible) drivers of unreported activities, financial leakages, and governance failures affecting the blue bioeconomy. The individual contributions illustrate these dimensions across different blue bioeconomy sectors and geographical contexts.

Research from the Saudi Arabian Gulf (Alhowaish), the Turkish Black Sea (Seyhan et al.), and the Lebanese Mediterranean coast (Msayleb et al.) collectively emphasizes participatory governance, institutional coordination, and resilience planning as key elements of sustainable coastal development. Specifically, Alhowaish identifies institutional fragmentation, weak regulatory enforcement, and

1 i) Grafeld, S., Oleson, K. L. L., Teneva, L., & Kittinger, J. N. (2017). Follow that fish: Uncovering the hidden blue economy in coral reef fisheries. PloS One, 12 (8), e0182104. doi: 10.1371/journal.pone.0182104. [65 citations]

2 ii) Chapsos, I., & Hamilton, S. (2019). Illegal fishing and fisheries crime as a transnational organized crime in Indonesia. *Trends in Organized Crime, 22*(3), 255-273. doi: 10.1007/s12117-018-9329-8. [54 citations]

3 iii) Tolentino-Zondervan, F., Ngoc, P. T. A., & Roskam, J. L. (2023). Use cases and future prospects of blockchain applications in global fishery and aquaculture value chains. Aquaculture, 565, 739158. doi: 10.1016/j.aquaculture.2022.739158. [35 citations]

environmental degradation as major barriers to implementing the blue economy in arid coastal regions. Seyhan et al. demonstrate how multi-stakeholder engagement can identify regional priorities and strengthen governance through cross-sector collaboration, whereas Msayleb et al. present a participatory assessment framework that identifies vulnerabilities in coastal tourism following the COVID-19 pandemic and proposes resilience strategies for future health emergencies. Complementing these regional studies, Sumaila and Villasante examine the growing conflicts among blue economy sectors and advocate integrated management approaches capable of balancing ecological, economic, and societal objectives.

Several studies further examine the economic and institutional conditions required for a transparent, resilient, and sustainable blue bioeconomy. Building upon the governance challenges identified in his first contribution, Alhowaish's second study investigates informal markets, unreported transactions, and financial leakages, demonstrating how institutional weaknesses and limited transparency contribute to hidden economic losses. Fisheries-focused contributions provide additional examples of governance challenges. Araújo et al. show that diesel fuel subsidies may mask the true economic sustainability of a Brazilian industrial shrimp fishery, recommending a reassessment of this policy to safeguard its long-term viability. Similarly, Castrejón and Defeo demonstrate that the longline ban in the Galápagos Marine Reserve has not eliminated illegal and ghost fishing, highlighting the need for ecosystem-based management approaches that reconcile shark conservation with the livelihoods of local fishing communities. Other studies focus on enabling conditions for a sustainable blue bioeconomy by emphasizing the need to strengthen blue biotechnology education to develop a skilled workforce aligned with the European Union's blue bioeconomy strategy (Kataržytė et al.); on the other hand, Li et al. propose innovative blue carbon trading mechanisms to better recognize and valorize marine ecosystem services within China's emerging blue carbon market. Together, these contributions illustrate that the blue bioeconomy not only relies on scientific and technological innovation, but it is also equally dependent on effective governance, transparent institutions, informed policies, and stakeholder engagement.

Collectively, the studies of this Research Topic demonstrate that addressing the 'grey economy' within the blue bioeconomy sector is fundamental to achieving sustainable development. Strengthening transparency, governance, and institutional capacity while reducing unreported activities and financial leakages will be essential to ensure that blue bioeconomy policies deliver lasting environmental, economic, and social benefits. By bringing these often-overlooked dimensions into focus, this Research Topic contributes to a more comprehensive understanding of the challenges and opportunities that will shape the future of the global blue bioeconomy.

Author contributions

RM: Writing – review & editing, Writing – original draft. GB: Writing – original draft, Writing – review & editing.

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