

When Conservation Conflicts with Livelihoods: A Systematic Review of Ecological–Socioeconomic Trade-offs in Coastal Resource Management

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ABSTRACT

Coastal resource management is increasingly challenged by ecological–socioeconomic trade-offs arising from competing conservation and livelihood objectives. This study conducts a systematic review to synthesize global evidence on the types, drivers, governance responses, and outcomes of such trade-offs in coastal systems. Following a PRISMA-based approach, the review identifies recurring patterns across diverse contexts, highlighting temporal, spatial, and stakeholder-based trade-offs driven by coastal development, overfishing, aquaculture expansion, tourism, and climate change. The findings reveal that governance plays a critical role in shaping outcomes, yet remains constrained by fragmented institutions and limited stakeholder inclusion. While some approaches, such as co-management and ecosystem-based strategies, show promise, their effectiveness is context-dependent. This study proposes an integrated conceptual framework linking drivers, trade-offs, governance, and outcomes, emphasizing that trade-offs are inevitable but manageable. The results underscore the need for adaptive, inclusive, and integrated governance to achieve sustainable and equitable coastal resource management

INTRODUCTION

Coastal areas are among the most productive and valuable ecosystems on Earth, providing a wide range of ecological functions and ecosystem services that support both biodiversity and human well-being (Lakshmi, 2021; Lopez-Rivas & Cardenas, 2024; Zhao et al., 2024). Mangroves, seagrass beds, and coral reefs contribute to shoreline protection, carbon sequestration, fisheries productivity, and habitat provision for numerous marine species (Mason, 2008; Sanger et al., 2013; Yuan et al., 2024). At the same time, these ecosystems underpin the livelihoods of millions of people worldwide, particularly in developing countries where coastal communities are highly dependent on natural resources for food security and income generation (Lau et al., 2019).

However, increasing anthropogenic pressures have intensified the competition over coastal resources, leading to growing conflicts between conservation objectives and socioeconomic needs (de Queiroz et al., 2024; Masalu, 2000; Saunders et al., 2024). Coastal development, overfishing, aquaculture expansion, tourism, and infrastructure projects often generate significant ecological degradation while simultaneously providing economic benefits. As a result, policymakers and resource managers are frequently confronted with difficult trade-offs, where actions aimed at environmental conservation may restrict local livelihoods, while livelihood-oriented activities may compromise ecosystem integrity. This tension represents a central challenge in contemporary coastal resource management (de Queiroz et al., 2024; Dwikora et al., 2024; Polette et al., 2026).

The concept of ecological-socioeconomic trade-offs has gained increasing attention in recent years as a framework to understand these conflicts. Trade-offs occur when improving one objective degrades another, reflecting competing priorities between environmental sustainability and human welfare (Hutton et al., 2018; Schoulund et al., 2024). In coastal systems, such trade-offs are often complex, multidimensional, and context-specific, shaped by governance structures, institutional capacity, socio-cultural dynamics, and economic pressures. Despite a growing body of case-specific studies, the existing literature remains fragmented, with limited efforts to synthesize patterns, drivers, and outcomes of these trade-offs at a global scale (Jacob et al., 2025; Mo & Xiao, 2026).

Nevertheless, several critical gaps remain insufficiently addressed in the existing literature. First, most studies tend to examine ecological impacts or socioeconomic outcomes in isolation, resulting in a lack of integrative analyses that explicitly capture the interdependencies and feedback mechanisms between these dimensions (Bowen & Riley, 2003; Loomis & Paterson, 2014; Zhou et al., 2026). Second, the majority of empirical research is highly context-specific, focusing on particular case studies or regions, thereby limiting the generalizability of findings and hindering the development of broader conceptual frameworks (Diep et al., 2025; Qiu et al., 2021; Roy et al., 2023). Third, while the notion of trade-offs is frequently acknowledged, there is still a lack of systematic classification and comparative understanding of different types of trade-offs across coastal sectors and geographical contexts (Drius et al., 2022; Feng et al., 2021). Finally, governance responses to these conflicts are often

discussed descriptively, with limited synthesis of which approaches are most effective in balancing conservation objectives with livelihood needs (Asio et al., 2026; Tucker et al., 2023). These limitations highlight the absence of a comprehensive, systematic synthesis that links ecological dynamics, socioeconomic implications, and governance responses within a unified analytical framework.

This gap highlights the need for a comprehensive and systematic review that not only consolidates existing knowledge but also identifies recurring patterns and critical gaps in current understanding. This study addresses this need by conducting a systematic review of ecological–socioeconomic trade-offs in coastal resource management. The novelty of this research lies in its integrative and comparative approach, which seeks to bridge ecological and socioeconomic perspectives while highlighting governance implications across diverse geographical settings. By synthesizing global evidence, this study aims to move beyond descriptive analyses toward a more structured understanding of trade-off dynamics and their implications for sustainable coastal management.

Specifically, this study aims to: (1) identify the main types of ecological–socioeconomic trade-offs in coastal resource management; (2) examine the key drivers and underlying factors that shape these trade-offs; (3) analyze how governance systems and policy frameworks address or exacerbate such conflicts; and (4) propose pathways and strategic approaches to better balance conservation objectives with livelihood needs.

The findings of this study are expected to advance knowledge in coastal and fisheries management by providing a comprehensive synthesis of trade-off dynamics and governance responses. Furthermore, this review offers practical insights for policymakers, practitioners, and researchers by highlighting strategies that can support more equitable and sustainable decision-making in coastal areas. In doing so, this study also contributes to broader global agendas, including sustainable development and integrated coastal zone management, by emphasizing the importance of balancing ecological integrity with human well-being.

LITERATURE REVIEW

Coastal Resource Management and Socio-Ecological Systems

Coastal resource management is inherently complex due to the dynamic interactions between ecological processes and human activities (Weinstein et al., 2007; Zhang et al., 2023). Coastal areas are widely recognized as socio-ecological systems (SES), where natural and human components are interdependent and continuously influence one another. In this context, ecosystems such as mangroves, coral reefs, and seagrass beds are not only ecological entities but also critical assets that support human livelihoods, economic development, and cultural values (Hossain et al., 2020; Smith et al., 2025; Wawo, 2017)

The socio-ecological systems framework emphasizes that environmental problems cannot be understood or managed in isolation from social dimensions (Fischer et al., 2015; Virapongse et al., 2016). Instead, sustainable coastal management requires an integrated approach that accounts for feedback loops, adaptive capacity, and cross-scale interactions. This perspective is particularly

relevant in coastal areas, where resource-use decisions often generate cascading effects on both ecological integrity and human well-being (Heslinga et al., 2017; Hossain et al., 2024; Refulio-Coronado et al., 2021).

Ecological–Socioeconomic Trade-offs: Concepts and Characteristics

The concept of trade-offs is central to understanding conflicts in coastal resource management. Ecological–socioeconomic trade-offs arise when actions that enhance one objective—such as economic development or livelihood improvement—result in negative consequences for ecological sustainability, or vice versa. These trade-offs reflect competing priorities and limited resource availability, making them unavoidable in many decision-making contexts (Cheung & Sumaila, 2008; Diep et al., 2025; Neumann et al., 2017).

Trade-offs can manifest in various forms. They may occur across temporal scales (short-term economic gains versus long-term ecological sustainability), spatial scales (local benefits versus regional or global environmental impacts), or stakeholder groups (resource users versus conservation actors) (Musselli & Sonderegger, 2025; Rodríguez et al., 2006). In coastal systems, trade-offs are often intensified by high population density, economic dependency on natural resources, and increasing external pressures such as globalization and climate change (He & Silliman, 2019; Hernández-Delgado, 2024).

Importantly, trade-offs are not merely technical or ecological issues but are deeply embedded in social, economic, and political contexts. As such, understanding trade-offs requires a multidimensional perspective that integrates ecological science with socioeconomic analysis (Langemeyer et al., 2024; Mo & Xiao, 2026).

Conservation–Livelihood Conflict in Coastal Systems

Conflicts between conservation and livelihoods are among the most prominent manifestations of ecological–socioeconomic trade-offs (Cheung & Sumaila, 2008; Zulfiqar et al., 2026). Conservation initiatives such as marine protected areas (MPAs), fishing restrictions, or habitat restoration are often designed to preserve ecosystem integrity and biodiversity. However, these measures can constrain access to resources, particularly for small-scale fishers and coastal communities that rely heavily on natural resources for survival (Bachman et al., 2025; Bell-James et al., 2025; Boubekri et al., 2026).

On the other hand, livelihood-driven activities such as fishing intensification, coastal development, and aquaculture expansion may provide immediate economic benefits but often lead to habitat degradation, biodiversity loss, and declines in ecosystem services. This creates a dilemma where neither conservation nor development objectives can be pursued independently without generating unintended consequences (Haenssger et al., 2021; Rahman et al., 2025; Stacey et al., 2021; Warren & Steenbergen, 2021).

The conservation–livelihood conflict is therefore not simply a binary opposition but a complex negotiation process involving multiple stakeholders with differing interests, power relations, and levels of dependency on coastal resources. Recognizing this complexity is essential for developing more balanced

and inclusive management strategies (Chepkwony et al., 2025; Frerks et al., 2014; Ssekajja, 2024).

Governance and Institutional Responses

Governance plays a critical role in shaping how trade-offs are managed and resolved. Coastal governance refers to the structures, processes, and institutions through which decisions about resource use and management are made and implemented. Effective governance systems are expected to mediate competing interests, reduce conflicts, and promote sustainable outcomes (Bellanger et al., 2020; Syam et al., 2026; Van Assche et al., 2020).

Different governance approaches have been developed to address coastal resource challenges, including top-down regulatory frameworks, community-based management, and co-management arrangements (Asio et al., 2026; Botero et al., 2025). In recent years, there has been increasing recognition of the importance of participatory and adaptive governance, which emphasizes stakeholder involvement, flexibility, and learning-based approaches (Akamani, 2020; Karpouzoglou et al., 2016).

However, governance systems often face significant limitations, particularly in developing countries. Weak institutional capacity, overlapping regulations, lack of enforcement, and unequal power distribution can exacerbate trade-offs rather than resolve them. As a result, understanding governance is essential for identifying pathways to better balance ecological conservation with socioeconomic needs (Hamzani et al., 2025; Manu, 2026).

Toward Integrated and Adaptive Coastal Management

In response to the complexity of coastal trade-offs, there has been a growing shift toward integrated and adaptive management approaches. Concepts such as Integrated Coastal Zone Management (ICZM), Ecosystem-Based Management (EBM), and Marine Spatial Planning (MSP) aim to reconcile competing objectives by considering ecological, social, and economic dimensions simultaneously (Domínguez-Tejo et al., 2016; Le Tissier, 2020).

These approaches emphasize the need for cross-sectoral coordination, long-term planning, and evidence-based decision-making. They also highlight the importance of resilience, defined as the capacity of socio-ecological systems to absorb disturbances while maintaining essential functions and structures (Kanan & Giupponi, 2024; Liang & Li, 2020).

Despite their conceptual strengths, the implementation of these approaches often remains challenging due to institutional fragmentation, conflicting policy objectives, and limited stakeholder engagement. Therefore, examining how these frameworks address ecological-socioeconomic trade-offs is critical for advancing more effective coastal resource management (G. Wu et al., 2026).

Conceptual Framework

To better conceptualize the complex interactions between ecological and socioeconomic dimensions in coastal resource management, this study proposes a conceptual framework that illustrates the dynamic relationships among key drivers, trade-offs, governance responses, and resulting outcomes. This framework is intended to provide a structured lens for understanding how conflicts between conservation objectives and livelihood needs emerge and are managed across different contexts.

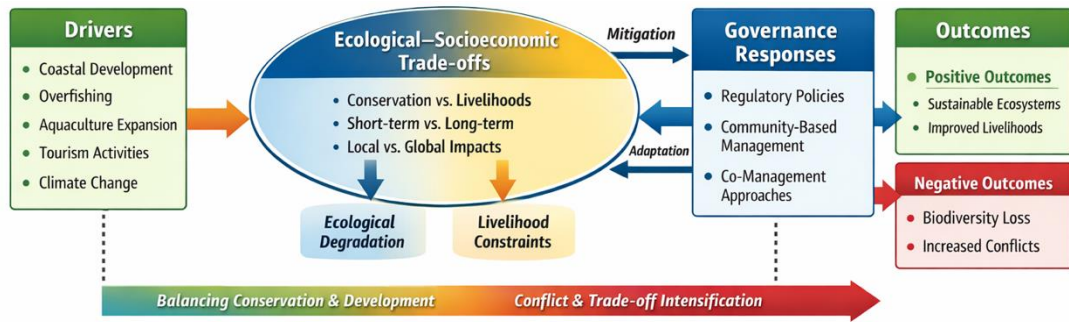


Figure 1. Conceptual Framework of Ecological–Socioeconomic Trade-Offs in Coastal Resource Management

The conceptual framework (Figure 1) demonstrates that multiple anthropogenic drivers, such as coastal development, overfishing, and climate change, act as primary pressures that generate ecological–socioeconomic trade-offs in coastal systems. These trade-offs reflect inherent tensions between conservation and livelihood objectives, often resulting in ecological degradation or constraints on local livelihoods. The framework further highlights the role of governance responses, ranging from regulatory policies to community-based and co-management approaches, in mediating these conflicts through mitigation and adaptation strategies. The effectiveness of these governance mechanisms ultimately determines the outcomes, which may lead to either sustainable ecosystems and improved livelihoods or, conversely, biodiversity loss and intensified conflicts. Overall, the framework underscores the dynamic and interconnected nature of coastal socio-ecological systems, emphasizing that while trade-offs are inevitable, their impacts can be managed through adaptive and integrated governance.

METHODOLOGY

Study Design

This study employs a systematic review approach to synthesize existing knowledge on ecological–socioeconomic trade-offs in coastal resource management. The review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a transparent, replicable, and rigorous process in identifying, screening, and analyzing relevant literature. This approach enables a comprehensive and structured assessment of global research trends, key themes, and knowledge gaps related to conservation–livelihood conflicts in coastal systems (Baihaqi & Annida, 2026b; Pusingha et al., 2026).

Data Sources and Search Strategy

A comprehensive literature search was conducted using major academic databases, including Scopus, Web of Science, and Google Scholar, to capture a broad range of peer-reviewed studies relevant to the topic. The search focused on English-language articles and was designed to identify studies that address ecological–socioeconomic trade-offs in coastal and marine resource management contexts. A combination of keywords and Boolean operators was applied, including terms such as “coastal management,” “coastal resource management,” “marine resource management,” “trade-offs,” “conflict,” “conservation vs livelihoods,” and “socioeconomic conflict,” along with context-specific terms such as “fisheries,” “coastal communities,” and “marine ecosystems.” To ensure the relevance and timeliness of the literature, the search was limited to publications from 2000 to 2025, a period that reflects the growing global emphasis on sustainability and integrated coastal management (Baihaqi & Annida, 2026a, 2026b; Gusenbauer & Haddaway, 2020).

Inclusion and Exclusion Criteria

To ensure consistency and relevance in the selection of studies, a set of inclusion and exclusion criteria was applied throughout the review process. The review included peer-reviewed journal articles that focus on coastal or marine resource management and explicitly address ecological–socioeconomic trade-offs or conservation–livelihood conflicts. Both empirical and review-based studies were considered, provided they contributed to understanding interactions between ecological and socioeconomic dimensions. Only articles published in English were included. Studies were excluded if they were not peer-reviewed (e.g., reports, theses, or conference abstracts) or if they did not directly relate to coastal systems. In addition, studies that focused solely on either ecological or socioeconomic aspects without addressing trade-offs were excluded, as were duplicate records identified across databases.

Screening and Selection Process

The article selection process followed the PRISMA framework, consisting of four main stages: identification, duplicate removal, screening, eligibility, and inclusion. Initially, all records retrieved from the databases were compiled into a single dataset, and duplicate entries were removed. The remaining articles were then screened based on their titles and abstracts to assess their relevance to the research objectives. Articles that met the initial screening criteria were subsequently subjected to full-text review to determine their eligibility. Only studies that fully satisfied the inclusion criteria were selected for the final analysis. The overall selection process is illustrated in a PRISMA flow diagram (Figure 2), which provides a transparent overview of the number of studies included and excluded at each stage.

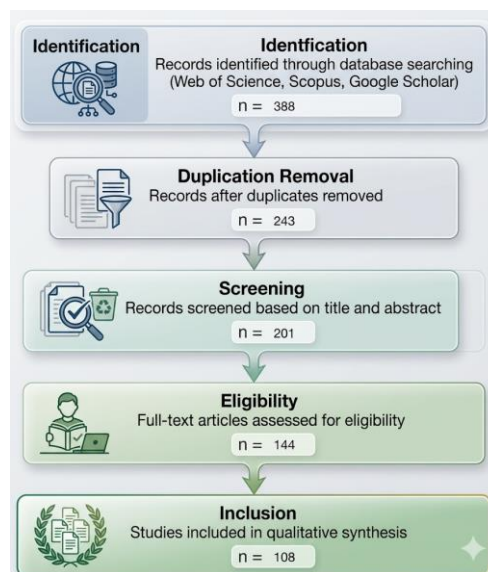


Figure 2. PRISM Flow Diagram

Data Extraction and Analysis

Data from the selected studies were systematically extracted using a standardized data extraction framework to ensure consistency and comparability. The extracted information included key aspects such as the study's geographical location, the type of coastal ecosystem examined (e.g., mangroves, coral reefs, fisheries), the nature and types of trade-offs identified, the main drivers of conflict, the governance approaches applied, and the reported ecological and socioeconomic outcomes. The analysis was conducted using a qualitative synthesis approach, supported by thematic coding to identify recurring patterns and dominant themes across the literature. Trade-offs were further categorized by their characteristics, including temporal, spatial, and stakeholder dimensions, while governance responses were analyzed for their capacity to mitigate conflicts and balance conservation objectives with livelihood needs.

Limitations of the Study

Despite efforts to ensure a comprehensive and systematic review, several limitations should be acknowledged. First, the analysis is restricted to English-language publications, potentially excluding relevant studies published in other languages. Second, the reliance on selected academic databases may lead to the omission of some regionally published or less-indexed studies. Third, the qualitative nature of the synthesis entails some interpretive judgment in categorizing trade-offs and governance responses. Nevertheless, the structured and transparent approach adopted in this study helps to minimize potential biases and enhances the robustness and reliability of the findings.

RESULT AND DISCUSSION

Overview of Selected Studies

The systematic review identified a diverse body of literature examining ecological-socioeconomic trade-offs in coastal resource management across different geographical regions and socio-political contexts (Lachs & Oñate-Casado, 2020; Schoulund et al., 2024). The selected studies span various coastal ecosystems, including mangroves, coral reefs, seagrass beds, and small-scale fisheries, reflecting the multidimensional nature of coastal systems (Arifanti et al., 2025; Herrera et al., 2022; Pellowe et al., 2023). Geographically, the literature is dominated by studies from the Global South, particularly Southeast Asia, Africa, and Latin America, where coastal communities exhibit high dependence on natural resources and are more vulnerable to environmental and economic changes (Dar & Dar, 2025; Hernández-Blanco et al., 2022; Sumaila, 2016).

The increasing number of publications over time indicates a growing recognition of trade-offs as a central issue in coastal management. However, the distribution of studies remains uneven, with certain regions and sectors receiving more attention than others. This suggests the presence of geographical and thematic biases in the literature, which may influence the generalizability of current knowledge.

Types of Ecological-Socioeconomic Trade-offs

The analysis reveals that ecological-socioeconomic trade-offs in coastal systems can be broadly categorized into three main types: temporal, spatial, and stakeholder-based trade-offs (Gonçalves et al., 2020; Preiser et al., 2018).

Temporal trade-offs are among the most commonly identified, typically involving short-term economic gains at the expense of long-term ecological sustainability. For example, intensive fishing practices and coastal development projects often generate immediate income but lead to resource depletion and ecosystem degradation over time (Napitupulu et al., 2022; Qiu et al., 2021; Stacey et al., 2021).

Spatial trade-offs occur when benefits and impacts are distributed unevenly across locations. Coastal development or conservation initiatives may provide advantages at national or global levels while imposing costs on local communities. For instance, the establishment of marine protected areas (MPAs) may enhance biodiversity conservation but restrict access to nearby fishing grounds (Gutierrez et al., 2025).

Stakeholder-based trade-offs reflect conflicts among groups with competing interests, such as government agencies, private-sector actors, and local communities. These trade-offs are often shaped by power asymmetries, in which more influential stakeholders are better positioned to benefit from resource-use decisions, potentially marginalizing vulnerable groups (Delgado-Serrano, 2017; Fortnam et al., 2023).

These findings highlight that trade-offs are not uniform but vary depending on temporal, spatial, and social dimensions, reinforcing the complexity of coastal resource management.

Key Drivers of Trade-offs

The review identifies several key drivers that consistently contribute to the emergence and intensification of ecological–socioeconomic trade-offs. Coastal development, including infrastructure expansion and urbanization, is a major driver that alters natural habitats while generating economic opportunities (Steven et al., 2020). Similarly, overfishing and unsustainable fishing practices reduce fish stocks, creating tensions between conservation efforts and livelihood needs (Annida et al., 2021; Baihaqi & Annida, 2025; Fauzan & Khotimah, 2025).

Aquaculture expansion has also emerged as a significant driver, particularly in mangrove areas, where it often leads to habitat conversion and ecological degradation despite providing economic benefits (Jayanthi et al., 2022; L. Wu et al., 2022). In addition, tourism development contributes to both economic growth and environmental pressure, depending on the scale and management practices (Annida et al., 2025, 2026).

Climate change acts as a cross-cutting driver, exacerbating existing trade-offs by increasing environmental uncertainty and vulnerability. Sea-level rise, ocean warming, and extreme weather events further complicate the balance between ecological sustainability and socioeconomic resilience. Overall, these drivers interact in complex ways, often reinforcing each other and amplifying trade-off dynamics in coastal systems (Castro-Cadenas et al., 2022; Kanan & Giupponi, 2024; Tomej et al., 2026).

Governance Responses and Their Effectiveness

Governance responses play a critical role in shaping how trade-offs are managed. The reviewed studies highlight a range of governance approaches, including regulatory policies, community-based management, and co-management systems (Brown et al., 2009; Setiawan et al., 2025; Van Assche et al., 2020).

Top-down regulatory approaches, such as fishing restrictions and protected area designations, are effective in achieving ecological objectives but often face challenges related to compliance and social acceptance (Botero et al., 2025; Lees et al., 2025; Nomura, 2008). In contrast, community-based management approaches tend to enhance local participation and legitimacy but may be limited by resource constraints and institutional capacity (Annida & Baihaqi, 2024; Gisevius et al., 2025; Wiranti et al., 2025).

Co-management arrangements, which involve collaboration between governments and local stakeholders, are increasingly recognized as a promising

approach for balancing conservation and livelihood objectives. These systems can improve trust, knowledge integration, and adaptive capacity, although their success depends on effective coordination and equitable power distribution (Asio et al., 2026; Masud et al., 2022; Voorberg & Van der Veer, 2020).

Despite these efforts, many governance systems remain fragmented and sectoral, limiting their ability to address trade-offs in an integrated manner. This suggests that governance effectiveness is determined not only by the approach but also by its implementation context and institutional coherence (Asio et al., 2026; Lismawati et al., 2026; Setiawan et al., 2025).

Outcomes of Trade-offs: Sustainability or Conflict

The outcomes of ecological–socioeconomic trade-offs vary widely depending on how they are managed. Positive outcomes are typically associated with well-designed, inclusive governance systems that effectively balance ecological and socioeconomic objectives. These outcomes include improved ecosystem health, enhanced resilience, and sustainable livelihoods (da Silva et al., 2025; Ekebil et al., 2025; You et al., 2024).

Conversely, poorly managed trade-offs often lead to negative outcomes, such as biodiversity loss, declines in ecosystem services, and increased social conflicts. In many cases, the failure to adequately address trade-offs leads to a cycle of environmental degradation and socioeconomic vulnerability, further exacerbating existing inequalities. The findings suggest that achieving positive outcomes requires not only effective policies but also inclusive decision-making processes that consider the needs and perspectives of different stakeholders (Drius et al., 2022; Qiu et al., 2021; Sale et al., 2014).

Synthesis and Conceptual Implications

The findings of this review reinforce the conceptual framework proposed in this study, highlighting the dynamic interactions between drivers, trade-offs, governance responses, and outcomes. Trade-offs emerge as an inherent feature of coastal socio-ecological systems, rather than as anomalies that can be entirely eliminated.

Importantly, the analysis suggests that the key challenge lies not in avoiding trade-offs but in managing them to minimize negative impacts while maximizing synergies. This requires integrated, adaptive, and participatory governance approaches that are capable of addressing the complexity and uncertainty of coastal systems.

Furthermore, this review identifies a critical need for more comparative and cross-regional studies that can enhance the generalizability of findings and support the development of more robust conceptual frameworks. Future research should also focus on evaluating the long-term effectiveness of governance interventions and exploring innovative strategies for balancing conservation and livelihood objectives.

Linkages to Sustainable Development Goals (SDGs)

The findings of this study are closely aligned with several Sustainable Development Goals (SDGs), particularly those addressing environmental sustainability and human well-being in coastal systems. Most prominently, this review contributes to SDG 14 (Life Below Water) by highlighting the persistent challenges in balancing marine conservation with the livelihood needs of coastal communities. The identified ecological–socioeconomic trade-offs also demonstrate strong linkages with SDG 1 (No Poverty) and SDG 2 (Zero Hunger), as many coastal populations depend on marine resources for income and food security. In addition, the study relates to SDG 8 (Decent Work and Economic Growth), given the importance of fisheries, aquaculture, and tourism in supporting coastal economies, and it also reveals the risks of unsustainable exploitation.

Furthermore, the governance dimension emphasized in this review is closely connected to SDG 16 (Peace, Justice, and Strong Institutions), as ineffective institutions and unequal power relations often intensify conflicts between conservation and livelihoods. The role of climate change as a cross-cutting driver also links this study to SDG 13 (Climate Action), underscoring the need for adaptive and resilient management strategies. Overall, the findings suggest that trade-offs are central to understanding the practical challenges of SDG implementation in coastal regions, and that achieving these goals requires integrated and adaptive governance approaches capable of balancing ecological sustainability with socioeconomic needs.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study synthesizes global evidence on ecological–socioeconomic trade-offs in coastal resource management, highlighting the persistent tensions between conservation objectives and livelihood needs. The findings confirm that such trade-offs are inherent in coastal socio-ecological systems and are driven by multiple interacting pressures, including coastal development, overfishing, aquaculture expansion, tourism, and climate change. These trade-offs manifest across temporal, spatial, and stakeholder dimensions, reflecting the complex and context-dependent nature of coastal resource use.

The review underscores the central role of governance in shaping trade-off outcomes. While various approaches, ranging from regulatory frameworks to community-based and co-management systems, have been implemented, their effectiveness remains uneven due to institutional limitations and fragmented policy structures. This study contributes to the literature by offering an integrated conceptual understanding that links drivers, trade-offs, governance responses, and outcomes, emphasizing that the key challenge lies not in eliminating trade-offs but in managing them through adaptive, inclusive, and context-sensitive governance.

Recommendations

To improve the management of ecological–socioeconomic trade-offs, it is essential to adopt integrated and ecosystem-based approaches, such as Integrated Coastal Zone Management (ICZM) and Marine Spatial Planning (MSP), which enable more holistic and coordinated decision-making. Strengthening participatory governance is equally important to ensure that local communities, particularly small-scale resource users, are actively involved in management processes, thereby enhancing policy legitimacy and long-term sustainability.

In addition, improving institutional capacity and coordination is crucial to address fragmented governance systems and enhance policy implementation. This should be complemented by the adoption of adaptive management strategies that respond to environmental uncertainty and change, particularly in the context of climate impacts. Finally, incorporating equity considerations into coastal policies is necessary to ensure a fair distribution of costs and benefits, reduce social conflicts, and support more sustainable and inclusive coastal development.

ADVANCED RESEARCH

Future research on ecological–socioeconomic trade-offs in coastal systems should move beyond descriptive and case-specific analyses toward more integrative and predictive approaches. There is a growing need to develop quantitative, model-based frameworks to simulate trade-off dynamics across different management and environmental scenarios. The integration of spatial analysis tools, such as Geographic Information Systems (GIS), remote sensing, and marine spatial modeling, offers significant potential to map and predict the distribution of trade-offs across scales. In addition, the application of interdisciplinary approaches—combining ecological modeling, economic valuation, and social assessment—can provide a more comprehensive understanding of how trade-offs evolve and interact within complex socio-ecological systems.

Furthermore, advancing research in this field requires stronger emphasis on longitudinal and comparative studies that evaluate the long-term effectiveness of governance interventions across different regions. Emerging approaches such as participatory modeling, scenario planning, and resilience-based frameworks can enhance stakeholder engagement and support adaptive decision-making under uncertainty. The incorporation of big data, machine learning, and data-driven policy analysis also presents new opportunities to identify patterns and optimize management strategies. Ultimately, future research should aim to bridge the gap between science and policy by generating actionable insights that support more adaptive, inclusive, and evidence-based coastal resource governance.

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