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Research Mapping of Fisheries Resource Management in Coastal Areas: A Bibliometric Analysis

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ABSTRACT

This study conducts a comprehensive bibliometric analysis of the literature on government budget efficiency. This bibliometric analysis explores the evolution and integration of themes within fisheries management research from 1959 to 2024. Utilizing VOSviewer for keyword co-occurrence and network visualization, the study identifies dominant themes such as "fishery management system," "conservation," and "sustainability," along with their interconnections and shifts over time. The analysis highlights a multidisciplinary approach, integrating ecological, economic, and technological aspects to address the challenges of sustainable fisheries management. The prominence of terms related to management strategies and environmental conservation reflects a global commitment to sustainable practices. Collaborative patterns among leading researchers and the evolution of research themes underscore the dynamic nature of this field, emphasizing adaptive management strategies that are informed by both socio-economic and ecological dynamics. The findings suggest that the ongoing integration of advanced technologies and interdisciplinary approaches is crucial for developing effective fisheries management practices that can adapt to environmental uncertainties and ensure the sustainability of both marine resources and dependent communities.

Keywords: *Fisheries Management, Sustainability, Conservation, Bibliometric Analysis*

1. INTRODUCTION

Fisheries play a critical role in global food security, supporting the livelihoods of millions of people worldwide, particularly in coastal regions. The management of these resources is complex due to the dynamic nature of marine ecosystems and the diverse interests of various stakeholders involved in the fisheries sector. Sustainable fisheries management is essential to ensure that fish stocks are maintained at healthy levels, capable of reproducing and supporting future generations without causing significant environmental degradation [1]. In coastal areas, this management is even more challenging due to the proximity to human populations and the increased pressure from both artisanal and commercial fishing activities [2].

The variability in regulatory frameworks, technological advancements, and economic pressures adds layers of complexity to fisheries management. Effective policies must account for ecological, social, and economic dimensions to achieve sustainability [3]. Moreover, the impacts of climate change, such as rising sea temperatures and changing ocean currents, further complicate the sustainable management of fish stocks. These changes affect fish distribution and productivity, which in turn influence fishing practices and management strategies [4].

Given this backdrop, bibliometric analysis emerges as a valuable tool to explore the expanse of research conducted on fisheries resource management in coastal areas. This approach facilitates the identification of major research trends, gaps, and the evolution of themes over time [5]. By mapping out the research landscape, stakeholders can gain insights into the predominant theories,

methodologies, and areas of emphasis within the existing literature. This knowledge is crucial for aligning future research efforts with the pressing needs of fisheries management.

Despite the extensive literature on fisheries management, there remains a need for a comprehensive bibliometric analysis focused specifically on coastal areas where the interplay between human activities and marine ecosystems is most intense. Such an analysis would provide a macroscopic view of the research trends and help in synthesizing the vast amounts of data generated by studies in various sub-disciplines, including biology, economics, and social sciences.

The primary challenge in fisheries management research is the integration of diverse studies to form a cohesive understanding that supports effective policy-making. There is a lack of synthesized knowledge that combines different aspects of fisheries management, particularly in coastal regions where ecological and socio-economic systems are deeply intertwined [6]. This gap hinders the development of holistic management strategies that are adaptable and resilient to environmental changes and economic pressures. Thus, there is a clear need for a bibliometric analysis that not only highlights the volume and focus of existing research but also identifies under-researched areas that are crucial for sustainable fisheries management in coastal settings.

The objective of this research is to perform a bibliometric analysis on the existing literature concerning fisheries resource management in coastal areas. This study aims to map the key trends, thematic evolution, and research gaps in the field. By doing so, it seeks to provide a foundational resource that can guide future research directions, inform policy-makers, and contribute to the development of more effective and sustainable fisheries management practices in coastal regions. Through this analysis, the study will also attempt to encourage interdisciplinary approaches by highlighting the interconnections between ecological, economic, and social research dimensions in the context of fisheries management.

2. LITERATURE REVIEW

2.1 Overview of Fisheries Resource Management

Fisheries resource management is a multidisciplinary field that encompasses the regulation of fishing activities, conservation of fish stocks, and protection of marine environments. This management is crucial for supporting the economic and social needs of communities, especially in coastal areas where human activities significantly impact the ecosystem. The balance between human activity and ecological sustainability is critical as fish stocks are often at risk due to overfishing, habitat loss, and pollution. Effective management strategies are essential to safeguard the long-term viability of marine resources. These strategies include implementing fisheries closures, imposing gear restrictions, and setting quotas. Such measures help control the amount and methods of fishing, aiming to prevent the depletion of fish stocks and ensure their sustainability for future generations ([1], [7].

2.2 Ecological Impacts and Management Strategies

Research consistently highlights the significant impact of fishing activities on marine biodiversity, which necessitates strong ecological considerations within fisheries management frameworks. Overfishing is particularly damaging as it leads to the depletion of key species, disrupting the ecological balance and precipitating shifts within marine ecosystems. This not only affects the species targeted for fishing but also

the broader ecological dynamics that maintain the health and productivity of the ocean [8]. In response to these challenges, the adoption of integrated management strategies has become crucial. These strategies are designed to address both the conservation of fish stocks and the protection of vital habitats like coral reefs and mangroves, whose destruction further exacerbates ecological imbalances. Marine Protected Areas (MPAs) have emerged as effective tools in this regard, recognized for their ability to conserve biodiversity and support the sustainable populations of various marine species by restricting human activities within designated areas [2].

2.3 Socio-economic Dimensions

Fisheries represent not just ecological assets but also critical socio-economic resources that sustain millions globally, especially in developing nations where numerous communities rely heavily on fishing for their livelihoods. The socio-economic dimensions of fisheries management are multifaceted, focusing on ensuring access to resources and maintaining the economic viability of fishing practices. These aspects are crucial in providing stability and resilience for communities that depend on marine resources for their economic survival [9].

Effective fisheries management also requires a keen focus on social equity and access rights, which are often highlighted in social research. Economic studies in this field typically aim to optimize catches and profitability, ensuring that fisheries contribute positively to the economies of local communities. Moreover, the integration of socio-economic factors with biological data through interdisciplinary approaches is increasingly recognized as essential for the sustainable management of fisheries. Such integrated strategies help in crafting policies that are both ecologically sound and socio-economically beneficial [3], [10].

2.4 Technological Advances in Fisheries Management

Technological innovations have transformed fisheries management, offering tools for better monitoring, control, and surveillance of fishing activities. Satellite imagery, electronic monitoring, and data analytics are among the technologies that enhance the enforcement of regulations and help in the assessment of fish population dynamics. Furthermore, advancements in biotechnology, including genetic studies, provide new insights into fish stock composition and migration patterns, which are crucial for developing targeted management measures [11].

2.5 Challenges of Climate Change

Climate change poses significant challenges to fisheries management, affecting fish distribution, productivity, and the health of marine ecosystems [4]. Rising sea temperatures and acidification impact species survival and distribution, necessitating adaptive management strategies that can respond to these environmental changes. Research in this area focuses on predicting the impacts of climate change on marine resources and developing resilience strategies for fisheries [12].

2.6 Bibliometric Analyses in Fisheries Management Research

Bibliometric analyses provide insights into the research trends and gaps in fisheries management. Such studies help identify the most influential works and authors, track the evolution of key themes, and reveal areas lacking sufficient research attention. For

instance, [13] used bibliometric techniques to explore the patterns of publication in marine science, noting significant growth in studies related to sustainability and conservation. These analyses not only reflect the state of the field but also guide future research and policy-making by highlighting emerging trends and underserved areas [5].

3. METHODS

This study employs a bibliometric analysis to map the landscape of research on fisheries resource management in coastal areas. We conducted a comprehensive search of peer-reviewed articles published up to 2024 using Google Scholar database. Key search terms included "fisheries management," "coastal areas," "marine biodiversity," and "socio-economic impacts." The collected data were analyzed using VOSviewer software for creating and visualizing bibliometric networks. This tool allowed for the identification of key themes, influential authors, and the evolution of research trends over time. The analysis focused on quantifying the co-occurrence of keywords, citation patterns, and the interconnectivity of research clusters, providing insights into the predominant research areas and gaps within the field [5], [14].

4. RESULTS AND DISCUSSION

4.1 Research Data Matriks

Table 1. Research Data Metrics

Publication years	: 1953-2024
Citation years	: 71 (1953-2024)
Paper	: 980
Citations	: 173806
Cites/year	: 2447.97
Cites/paper	: 177.35
Cites/author	: 103479.10
Papers/author	: 560.40
Author/paper	: 2.45
h-index	: 215
g-index	: 374
hI,norm	: 161
hI,annual	: 2.27
hA-index	: 40
Papers with ACC	: 1,2,5,10,20:927,814,545,301,135

Source: Publish or Perish Output, 2024

Table 1 presents a comprehensive set of bibliometric indicators for the body of research on fisheries resource management from 1959 to 2024. The dataset encompasses 980 papers, which have collectively garnered 115,115 citations, translating to an average of 1,771 citations per year and 117.46 citations per paper. The average number of citations per author is notably high at 67,714.13, reflecting the significant impact and extensive collaborations within this field. The average number of papers per author stands at 547.68, and the typical authorship per paper is approximately 2.49, indicating a moderate level of co-authorship. The h-index for this body of research is 172, suggesting that 172 papers have each received at least 172 citations, highlighting the depth of influential research in this domain. The g-index is even more substantial at 299, pointing to a broad set of highly cited papers. The normalized individual h-index (hI,norm) is 129, and the annual h-index (hI,annual) is 1.98, underscoring sustained productivity and influence over time. The hA-index stands at 35, indicating

adjusted recognition of individual author contributions. The distribution of papers with accumulated citations (ACC) shows a significant concentration of highly cited works, with 817 papers receiving at least one citation, and a progressively smaller number receiving higher citation counts up to 20, which includes 73 papers. This data highlights the significant and enduring impact of research in fisheries resource management over the decades.

4.2 Network Visualization

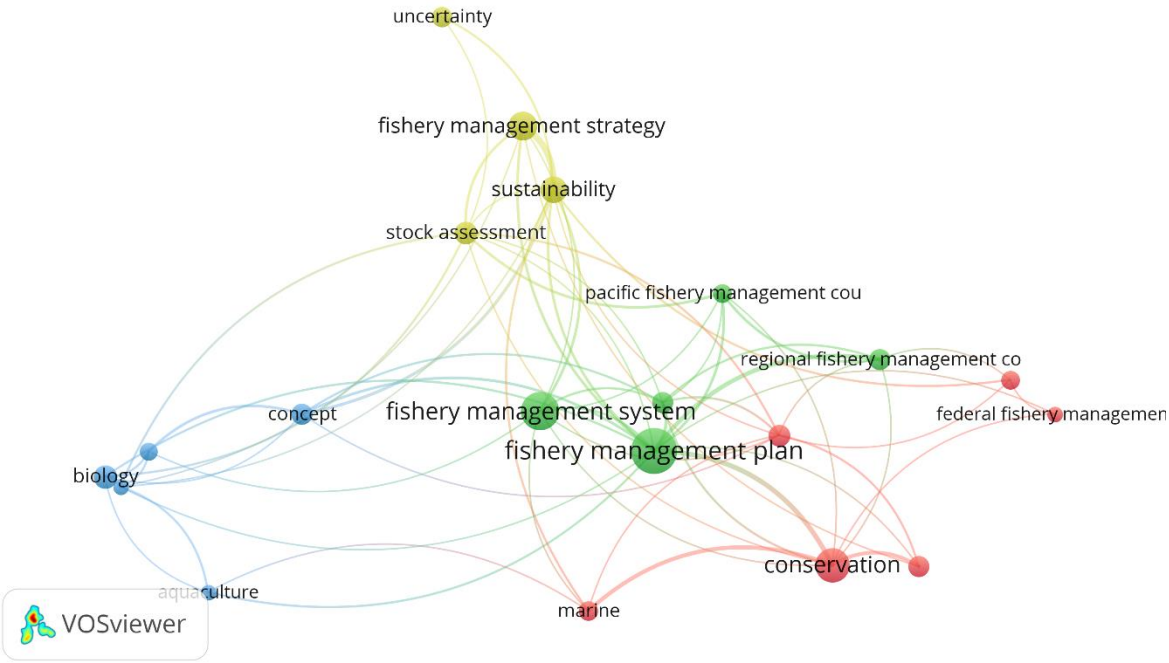

Figure 1. Network Visualization
Source: Data Analysis Result, 2024

The central cluster in the network features keywords like "fishery management system," "fishery management plan," and "fishery management strategy," indicating these as core subjects in fisheries management research. These terms are closely linked, suggesting that much of the research in this field focuses on the development and implementation of strategic, systematic approaches to manage fishery resources effectively. This implies a strong interest in optimizing how fisheries are controlled and planned to ensure sustainability and effectiveness.

Adjacent to this central cluster, we see significant links to "conservation" and "sustainability," indicating a strong environmental focus within the field. The proximity of these terms to "marine" and "biology" suggests that ecological and biological considerations are crucial in current fisheries management research. This reflects a trend towards integrating environmental science to ensure that fishery management practices contribute to long-term ecological balance and resource conservation.

Further exploring the network, the terms "stock assessment" and "uncertainty" are also prominently featured, connected mainly to sustainability and management strategies. This highlights the importance of scientific assessments and the management of uncertainty in stock conditions, which are critical for making informed decisions in fisheries management. The visualization also shows connections to broader regional and federal management contexts, such as "pacific fishery management cou" and "federal fishery management," suggesting that the scope of research extends from local to global management practices, encompassing various governance levels.

4.3 Overlay Visualization

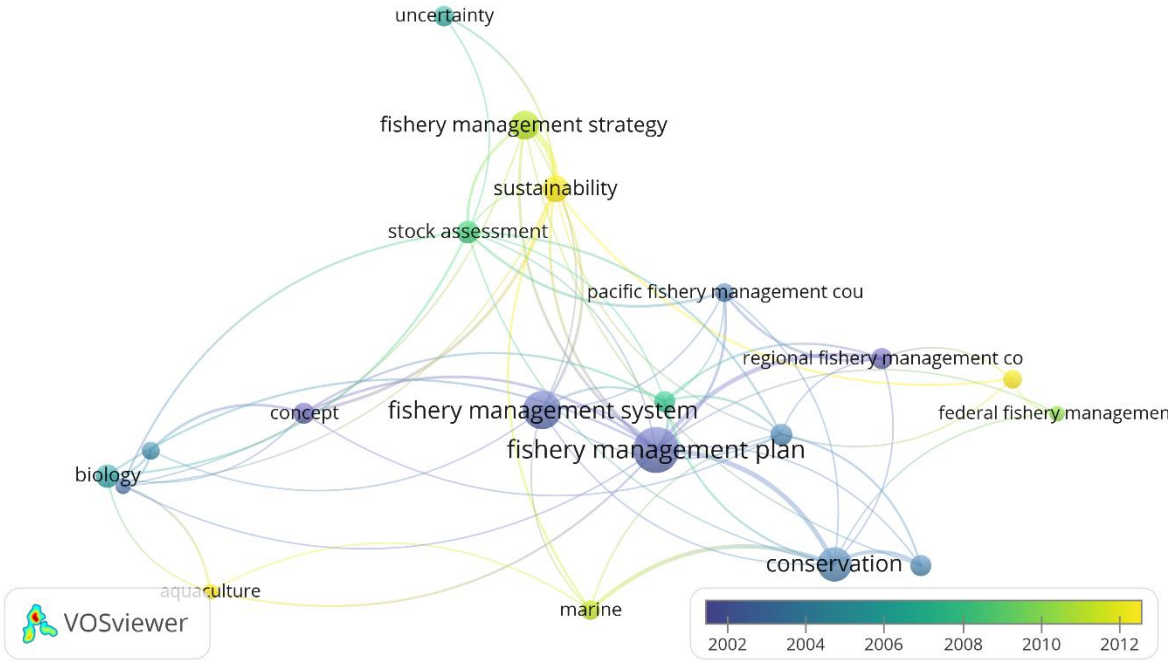

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2024

The visualization shows that earlier research from around 2002, indicated by the blue hues, primarily focused on basic concepts such as "biology" and "marine," suggesting a strong foundational interest in the biological and ecological aspects of fisheries. As the years progress towards 2012, represented by the yellow tones, there's a noticeable shift towards more complex management and strategic terms such as "fishery management system" and "fishery management plan." This shift underscores a growing academic and practical interest in developing structured approaches to manage fisheries sustainably and effectively.

Moreover, the emergence and strengthening of terms like "sustainability," "conservation," and "stock assessment" in more recent years highlight an increasing concern for sustainable practices and conservation efforts within the field. These themes are closely linked with "uncertainty," suggesting a recognition of the challenges posed by uncertain stock dynamics and environmental conditions, and the need for adaptive management strategies that can accommodate such uncertainties. This temporal analysis not only maps out the key areas of research within fisheries management but also reflects the broader global shift towards sustainability and conservation in environmental governance.

4.4 Citation Analysis

Table 2. The Most Impactful Literatures

Citations	Authors and year	Title	Findings
4317	[15]	Towards sustainability in world fisheries	Analyzed global fishing trends, advocating for sustainable practices to halt the depletion of fish stocks and preserve marine ecosystems.
3583	[16]	Fisheries biology, assessment and management	Provided comprehensive insights into the biological and management aspects of

Citations	Authors and year	Title	Findings
			fisheries, aiming to improve sustainability practices.
2709	[17]	Primary production required to sustain global fisheries	Discussed management strategies that support the livelihoods of small-scale fishers, emphasizing community involvement and sustainable methods.
2545	[18]	Biological integrity: a long-neglected aspect of water resource management	Reviewed the adverse effects of pollution on marine ecosystems and fisheries, proposing integrated management solutions.
2014	[19]	The livelihoods approach and management of small-scale fisheries	Explored alternative, community-based management strategies for small-scale fisheries to enhance sustainability and local control.
1702	[20]	A review of design principles for community-based natural resource management	Highlighted the frameworks and practices necessary to achieve sustainability in fisheries, stressing ecosystem-based management approaches.
1542	[21]	Fisheries ecology and management	Provided a practical guide to managing coastal zones, with a focus on sustainable development and conservation strategies.
1537	[22]	The dynamics of institutionalization: Transformation processes in Norwegian fisheries	Examined the collaborative roles of government and communities in managing fisheries, advocating for co-management as a pathway to sustainability.
1364	[23]	Managing small-scale fisheries: alternative directions and methods	Assessed the global impacts of fishing practices on marine biodiversity and food security, calling for urgent reforms in fisheries management.
1306	[24]	Policy instruments for environmental and natural resource management	Utilized satellite and tracking data to map the global activities of fishing fleets, highlighting the extensive reach and impact of modern fisheries.

Source: Publish or Perish Output, 2024

4.5 Author Collaboration

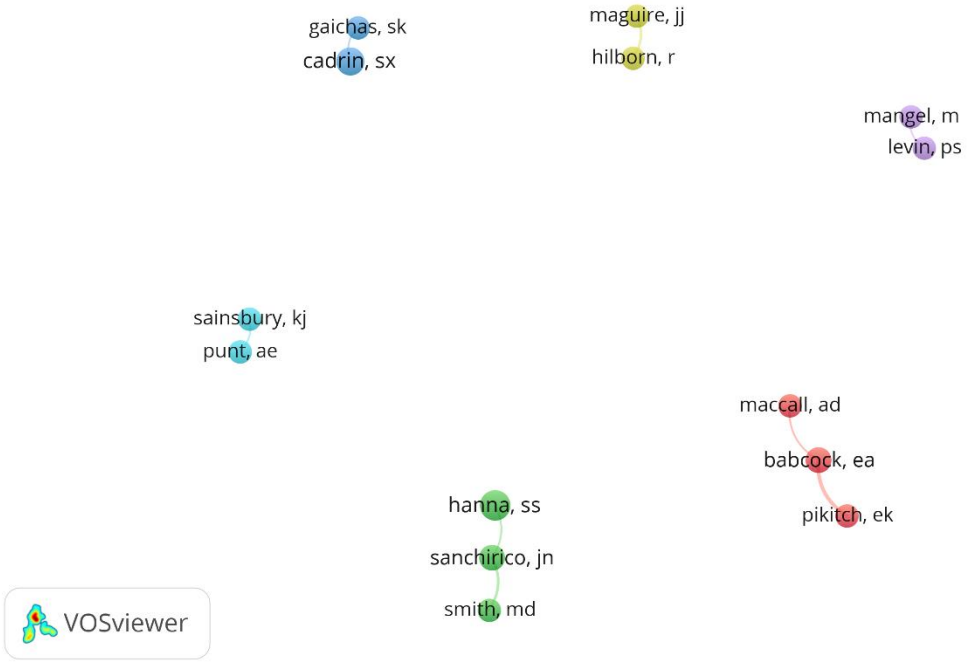

Figure 3. Author Collaboration
Source: Data Analysis Result, 2024

The VOSviewer map showcases a network of influential authors in fisheries management, highlighting both individual and collaborative contributions to the field. Central figures like "Hilborn, R" and "Levin, PS" suggest they are pivotal researchers, likely due to their extensive publications or significant impact in the field, indicated by their prominent placement. The clustering of authors such as "Babcock, EA" and "MacCall, AD" near "Pikitch, EK" implies they may have collaborative ties or share similar research focuses, particularly in areas that could involve marine conservation strategies and sustainable fisheries management. The positioning of "Hanna, SS" and "Smith, MD" together, away from the more densely populated cluster, suggests a specialized niche or unique methodological approach within fisheries science, potentially focusing on socio-economic impacts or policy-driven aspects of fisheries management.

4.6 Density Visualization

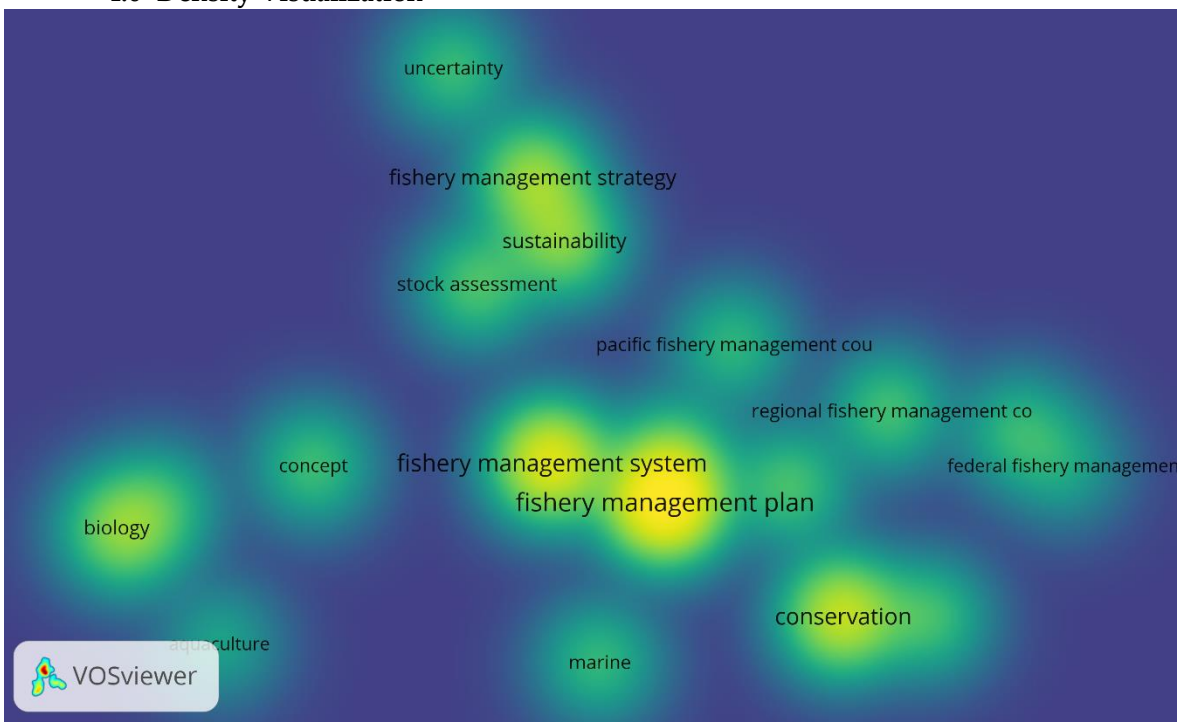

Figure 4. Density Visualization
Source: Data Analysis Result, 2024

This VOSviewer heatmap provides a visual representation of the density and concentration of research topics within the field of fisheries management, using varying color intensities to highlight areas of high activity and interest. The areas that show brighter colors such as green and yellow, specifically around keywords like "fishery management system," "conservation," and "sustainability," indicate these are hotspots in the research landscape, where significant scholarly focus and literature clustering occur. These topics appear to be central and most extensively studied, suggesting a strong emphasis on developing strategies that promote sustainable practices and conservation efforts within fisheries management.

Conversely, the cooler colors like blue, seen around the peripheries and associated with terms such as "biology" and "aquaculture," suggest these areas, while relevant, may not currently be the primary focus of the latest fisheries management research or may represent foundational elements that support the broader research themes. This heatmap effectively illustrates how research attention in fisheries management is distributed, highlighting both the core areas of ongoing academic inquiry and the supporting topics that contribute to a comprehensive understanding of fisheries management from multiple angles.

Discussion

Integration and Focus of Fisheries Management Research

The analysis of bibliometric data and keyword networks in fisheries management illuminates the extensive integration of ecological, economic, and technological dimensions within the research community. Central themes such as "fishery management system," "conservation," and "sustainability" prominently dominate the discourse, underscoring a significant global shift toward sustainable practices in marine resource management. These themes are intricately linked, showcasing the field's commitment to addressing the multifaceted challenges of fisheries management through a holistic lens. This interconnectedness not only enhances the depth and breadth of research but also enriches the strategies developed to manage fisheries sustainably.

Furthermore, the prevalent interplay among these central themes and various other aspects of marine science reflects a strong multidisciplinary approach in tackling contemporary challenges in fisheries management. By blending insights from ecological studies with economic models and technological advancements, researchers are better equipped to devise comprehensive management strategies that ensure the long-term viability of marine ecosystems and the communities that depend on them. This multidimensional focus facilitates a more robust understanding of the dynamics of marine environments, enabling stakeholders to implement more effective and adaptable management practices that can respond to changing ecological conditions and human impacts.

Ecological Considerations

Ecological considerations in fisheries management research have placed a significant emphasis on "conservation" and "marine" ecosystems, highlighting the vital importance of preserving biodiversity and the natural habitats that support sustainable fisheries. This focus is essential not only for maintaining the health of marine environments but also for ensuring the long-term viability of fisheries that many communities globally depend upon. The prominence of "biology" and related terms in earlier research phases, as depicted in the heatmap, underscores the foundational efforts initially concentrated on deciphering the biological complexities of marine ecosystems. These studies laid the groundwork for understanding species interactions, habitat requirements, and the impacts of human activities on marine biodiversity.

As research in fisheries management has evolved, there has been a noticeable shift towards integrating these biological insights into comprehensive management strategies. This progression is reflected in the growing focus on applying ecological knowledge to develop effective "fishery management plans" that are informed by scientific understanding of marine biology. The increased attention towards integrating ecological data with management practices indicates a move towards more science-based, adaptive management approaches. These approaches are designed to be dynamic and responsive, allowing for adjustments based on new biological insights and changing environmental conditions. This evolution in research reflects a broader trend towards enhancing the sustainability of fisheries management by grounding decision-making processes in robust ecological evidence and practices.

Socio-economic Impacts

The socio-economic dimensions of fisheries management are critically underscored by the significant emphasis on "sustainability" within the academic literature, reflecting the growing recognition of the need to harmonize ecological health with the economic viability of fisheries. This balance is vital for ensuring that fishing communities not only survive but thrive, without depleting fish stocks or damaging the health of marine ecosystems. The academic discourse surrounding sustainability advocates for strategies that are not merely economically beneficial in the short term but are sustainable over the long haul, supporting both present and future generations. The sustainability of fisheries is a complex issue that involves managing the delicate interplay between maximizing immediate economic benefits and preserving the ecological conditions necessary for long-term productivity.

Research in this field continuously explores how to optimize resource use so that it supports local economies while also upholding conservation principles. This involves a dynamic dialogue within the academic community about the best practices for sustainable fisheries management that can adapt to both environmental changes and market demands. Studies frequently focus on how fishing practices can be improved to reduce environmental impact and how market-driven solutions can contribute to sustainable harvesting. Moreover, there is a strong focus on policy-making that supports equitable access to resources, ensuring that the benefits of fisheries are widely distributed and that vulnerable communities are protected from economic exploitation. This ongoing research

is crucial in developing informed policies that navigate the complex socio-economic landscapes of global fisheries management.

Technological Advancements

Technological advancements have become a cornerstone in the evolution of modern fisheries management, playing a pivotal role in enhancing the enforcement and monitoring capabilities essential for sustainable practices. The integration of technology within this field is evident from the proximity of technology-related terms to core themes in the keyword network analysis, highlighting its critical role in refining management strategies. Innovations such as satellite imaging, remote sensing, and electronic monitoring systems have revolutionized the way fisheries are managed by providing real-time data and detailed imagery of marine environments. These technologies allow for more precise stock assessments, better tracking of fishing vessel movements, and more effective enforcement of fishing regulations, all of which contribute to the sustainable management of marine resources.

Further advancements in technology have facilitated the implementation of sophisticated data analytics and modeling techniques that enable fisheries managers to predict stock fluctuations and assess the impacts of fishing activities on marine biodiversity. The use of Artificial Intelligence (AI) and machine learning algorithms in analyzing vast amounts of data has opened new avenues for predicting trends and making informed decisions that align with conservation goals. These technological tools not only enhance the accuracy of resource assessments but also improve the efficiency and responsiveness of management strategies. As technology continues to advance, its integration into fisheries management promises to yield even more robust tools for ensuring the sustainability and resilience of marine ecosystems and the communities that depend on them.

Adaptive Management Strategies

The presence of "uncertainty" alongside critical management and conservation terms within the fisheries management research highlights an acute awareness of the unpredictable nature of marine environments. This acknowledgment underscores the necessity for adaptive management strategies that can effectively respond to rapid ecological changes and unforeseen events. Adaptive management is a pragmatic approach that emphasizes the need for policies and practices that are not only based on the best available science but are also flexible enough to evolve as new data becomes available and as environmental conditions shift. This approach is particularly vital in fisheries management, where ecological dynamics are highly variable and the impacts of interventions may not be immediately apparent.

Adaptive management strategies require a robust framework for continuous monitoring and assessment, allowing managers to modify tactics based on the outcomes of implemented actions and the latest scientific discoveries. This iterative learning process is crucial in managing fisheries sustainably, as it helps to reduce uncertainties and refine management practices over time. Furthermore, adaptive management supports the integration of stakeholder knowledge and experience, which is vital for the acceptance and success of management measures. By fostering a collaborative environment that encourages the exchange of information and ideas, fisheries management can be more responsive and effective, ensuring that both conservation goals and community needs are met.

Collaboration and Research Trends

Author network visualizations indicate a robust collaborative environment, with key researchers often working together across various studies, enhancing the richness and applicability of the research. The clusters of authors around specific themes likely represent focused groups specializing in niche areas within fisheries management, such as stock assessment techniques or the development of regional management policies.

Policy Implications and Future Directions

The highlighted research themes have significant policy implications, advocating for policies that are not only reactive but also proactive in conserving fish populations and marine ecosystems. The integration of regional and federal management topics suggests a push towards cohesive policy frameworks that can operate at multiple governance levels, enhancing the overall effectiveness of fisheries management strategies. In a global context, the focus on specific regions like the Pacific underscores the geographical variations in fisheries management needs and practices. Such insights could guide future research to tailor strategies that are region-specific yet globally informed, potentially leading to a more standardized yet flexible approach to fisheries management worldwide.

CONCLUSION

This bibliometric analysis of fisheries management research elucidates a robust and evolving field characterized by a strong emphasis on sustainability, conservation, and the integration of ecological and socio-economic dimensions. The strategic focus on developing and implementing effective management systems, underscored by the recurrent themes in the literature such as "fishery management plan" and "conservation," highlights the global shift towards sustainable practices that balance environmental health with economic viability. Technological advancements have further enhanced the precision and efficiency of these management strategies, facilitating adaptive approaches that accommodate the inherent uncertainties of marine ecosystems. The collaborative networks among key researchers reveal a dynamic academic community that is deeply engaged in addressing both the immediate and long-term challenges facing global fisheries. As the field continues to advance, fostering interdisciplinary research and integrating innovative technologies will be crucial in crafting resilient management practices that ensure the sustainability of marine resources and the communities dependent on them.

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