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Nature Finance and Ecosystem Valuation: A Bibliometric Mapping of Financialization of Biodiversity

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ABSTRACT

This study investigates the evolving landscape of scholarly research on nature finance and the financialization of biodiversity through a comprehensive bibliometric analysis of literature indexed in Scopus from 2000 to 2025. Using VOSviewer, we mapped co-occurring keywords, author networks, temporal trends, and country collaborations to identify dominant themes, emerging topics, and influential contributors. The findings reveal a conceptual transition from traditional ecosystem service valuation toward market-based conservation instruments, including conservation finance, carbon markets, and blockchain-based solutions. The thematic clusters emphasize the increasing intersection between finance, sustainability, and biodiversity policy, with recent trends showing a surge in decentralized finance applications for environmental assets. Notably, the United Kingdom and United States dominate collaborative networks, while Asia-Pacific regions exhibit growing engagement in the field. This study contributes to the theoretical understanding of biodiversity financialization and offers practical insights for policymakers, financial institutions, and environmental stakeholders aiming to design inclusive and effective biodiversity finance strategies. It also identifies gaps for future interdisciplinary research that bridges ecological science with financial innovation.

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1. INTRODUCTION

In the past two decades, the financial sector has increasingly turned its attention toward environmental assets, integrating nature and biodiversity into frameworks of valuation and investment. This phenomenon, often referred to as "nature finance," reflects a shift in how ecosystems are conceptualized—not merely as public goods, but as financial assets with market value. Governments, development banks, and private investors are increasingly engaging in ecosystem service markets, green bonds, and biodiversity credits, all aiming to attach financial metrics to nature conservation goals [1]. The underlying narrative of this trend is the assumption that financial mechanisms can protect biodiversity by aligning conservation with capital accumulation. However, this assumption is not without critique, particularly regarding the commodification of life systems and its broader implications [2].

The valuation of ecosystems has become a pivotal strategy in environmental policy and sustainable finance. Tools such as the System of Environmental Economic Accounting (SEEA), The Economics of Ecosystems and Biodiversity (TEEB), and Natural Capital Accounting are increasingly institutionalized by governments and multilateral organizations [3]. These tools aim to integrate nature into national accounts and corporate financial statements, framing environmental degradation as a measurable economic externality. The appeal of ecosystem valuation lies in its promise to "make nature count" in decision-making processes traditionally dominated by economic metrics [4]. However, this monetization strategy also raises concerns about reducing ecological complexity into simplified financial abstractions.

Alongside ecosystem valuation, the broader process of "financialization of biodiversity" has gained prominence in academic and policy discourse. This term refers to the ways in which financial logics, instruments, and actors reshape environmental governance. Financialization extends beyond mere funding mechanisms; it entails a fundamental transformation in how environmental problems are conceptualized and managed [5]. Biodiversity offsets, conservation finance instruments, and environmental derivatives are examples of how financial technologies attempt to manage biodiversity loss through pricing and market-based regulation. These instruments reframe conservation as an investment opportunity rather than a public or moral obligation. Yet, such mechanisms are deeply contested, especially by scholars and activists who question their effectiveness and ethical underpinnings [4].

Given the growing scholarly attention to these dynamics, it becomes essential to map the intellectual landscape surrounding nature finance and ecosystem valuation. Bibliometric analysis provides a robust method to visualize and interpret the evolution of this field, identifying key themes, influential works, collaboration networks, and research trends. Past studies have used bibliometrics to analyze adjacent domains, such as environmental accounting, green finance, and sustainability transitions. However, there remains a notable gap in systematic mapping focused specifically on the financialization of biodiversity. Understanding the contours of this emerging research frontier is crucial for academics, practitioners, and policymakers aiming to engage critically with the promises and pitfalls of market-oriented conservation.

The increasing convergence between finance and ecology is not merely a technical or academic issue—it signals a profound socio-political transformation. Financialization of biodiversity raises questions about who owns nature, who profits from its preservation, and who bears the costs of ecological degradation. As conservation becomes embedded in financial markets, there is a risk of excluding local communities, marginalizing alternative value systems, and reinforcing global inequalities [6]. At the same time, supporters of nature finance argue that without economic valuation, ecosystems remain invisible to market actors, leading to continued exploitation. Thus, the current moment presents both a challenge and an opportunity to examine how biodiversity is being reimagined, traded, and governed through financial lenses.

Despite the burgeoning literature on nature finance and ecosystem valuation, several challenges persist in understanding the trajectory and structure of this field. First, the terminology used across studies is highly heterogeneous—ranging from "green finance" to "natural capital markets," which often leads to conceptual ambiguity. Second, the literature is scattered across disciplines, including economics, environmental science, political ecology, and finance, making it difficult to consolidate a coherent knowledge base. Third, there is limited insight into which countries, institutions, or authors are driving the research agenda, and how their contributions are shaping dominant narratives. Without a systematic mapping, it is challenging to assess whether this field is dominated by policy-driven advocacy or critical academic inquiry.

To address these gaps, this study aims to conduct a comprehensive bibliometric mapping of the literature on nature finance and ecosystem valuation, with a specific focus on the financialization of biodiversity. Using the Scopus database and the VOSviewer tool, we examine the evolution of key concepts, author networks, country collaborations, and thematic clusters from 2000 to 2025. The objective is not only to trace the intellectual development of this research area but also to identify emerging debates, knowledge silos, and future research directions.

2. METHODS

This study employs a bibliometric analysis approach to map and analyze the scientific literature related to nature finance, ecosystem valuation, and the financialization of biodiversity. Bibliometric analysis allows for the quantitative assessment of academic publications, helping to identify research trends, co-authorship networks, keyword co-occurrences, and influential publications. By using this method, we aim to uncover the intellectual structure and thematic evolution of the field, offering a comprehensive overview of how financial and ecological discourses have converged in the scholarly domain. This approach has been widely used in sustainability research and finance, proving effective in synthesizing fragmented knowledge across interdisciplinary fields.

The data for this study were retrieved from the Scopus database, one of the largest and most comprehensive repositories of peer-reviewed literature. A structured search strategy was developed using a combination of keywords including: "nature finance", "ecosystem valuation", "biodiversity finance", "financialization of biodiversity", "natural capital", and "environmental asset pricing". The search was conducted in July 2025, covering publications between 2000 and 2025, reflecting the growing scholarly engagement with this topic over the past two and a half decades. Only journal articles and review papers written in English were included to maintain consistency and ensure quality. After initial screening, a total of 642 documents were selected for analysis.

To analyze the bibliometric data, we used VOSviewer (version 1.6.20), a widely recognized tool for constructing and visualizing bibliometric maps. VOSviewer was utilized to generate co-authorship networks and keyword co-occurrence maps.

3. RESULTS AND DISCUSSION

3.1 Keyword Co-Occurrence Network

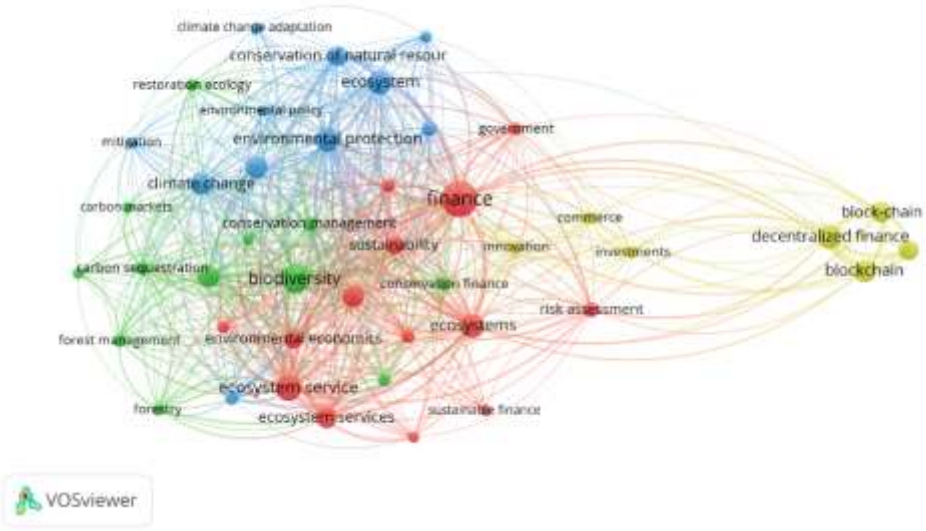

Figure 1. Network Visualization
Source: Data Analysis Result, 2025

Figure 1 reveals a multi-cluster network of keywords associated with the financialization of biodiversity and nature finance. Each color represents a thematic cluster based on keyword co-occurrences. The red cluster is dominated by terms like *finance*, *ecosystems*, *conservation finance*, *risk assessment*, and *sustainable finance*. This cluster reflects the heart of the nature finance discourse, where financial instruments and risk-based approaches intersect with ecosystem valuation and sustainable development frameworks. The centrality of "finance" in this cluster suggests that financial concepts are structurally integrated across diverse ecological themes, reinforcing the trend of embedding biodiversity conservation within market-based models.

The green cluster centers on *biodiversity*, *ecosystem services*, *environmental economics*, and *carbon markets*. This indicates a strong orientation toward the economic valuation of nature. The proximity of keywords such as *carbon sequestration*, *forest management*, and *environmental economics* signals an emphasis on quantifying ecological functions for carbon credit schemes or payments for ecosystem services (PES). The tight interconnections in this cluster reflect the growing scholarly engagement with how natural assets are being priced, traded, and governed through market mechanisms.

The blue cluster introduces a distinct policy and governance dimension. Keywords like *environmental protection*, *climate change adaptation*, *conservation of natural resources*, and *government* point to institutional and regulatory considerations in biodiversity finance. This cluster represents the public sector's role in shaping environmental policy frameworks and national strategies, such as natural capital accounting and climate-related regulations. Its links to both red (finance) and green (biodiversity) clusters highlight the integrative and often mediating function of environmental governance between ecological value and financial logic.

Interestingly, the yellow cluster on the right is relatively isolated and centers on *blockchain*, *decentralized finance*, and *innovation*. This emerging thematic area suggests that digital technologies are gaining ground in the context of nature finance. Although currently less connected than the core finance-biodiversity-policy triad, the presence of blockchain indicates early-stage research into decentralized mechanisms for ecosystem valuation, possibly through tokenized biodiversity credits or smart contracts for conservation funding. This signals a potential frontier for future exploration.

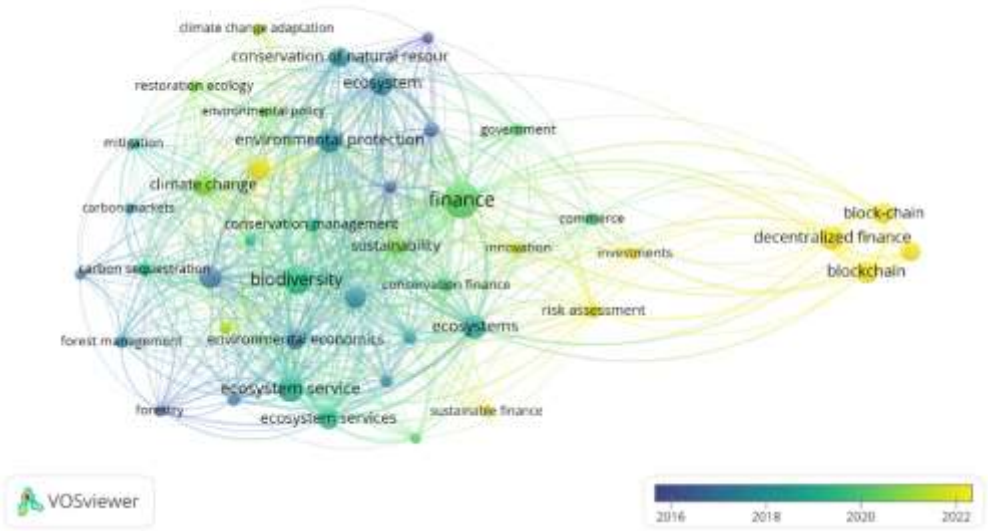

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

Figure 2 illustrates the temporal evolution of research themes related to nature finance and ecosystem valuation between 2016 and 2022. Keywords are color-coded by the average year of their occurrence in the literature: dark blue and purple nodes indicate earlier focus (pre-2018), while yellow nodes represent more recent emphasis (2021–2022). The core of the map—comprising terms like *biodiversity*, *ecosystem services*, *environmental protection*, and *climate change*—is predominantly greenish-blue, reflecting that these foundational concepts have been consistently studied over the past 5–7 years and remain central in the literature. This suggests a stable academic foundation built on environmental science and ecological economics.

More recent research frontiers are clearly visible on the right side of the map, where bright yellow nodes such as *blockchain*, *decentralized finance*, and *digital innovation* appear relatively disconnected from the older thematic clusters. These keywords represent an emerging scholarly interest in applying web3 technologies and fintech solutions to conservation finance and ecosystem valuation. The spatial and temporal distance from traditional biodiversity terms implies that these newer approaches are still developing their theoretical connections with the core environmental discourse. This indicates a shift in research priorities, where the integration of decentralized digital infrastructure into nature-based finance is gaining scholarly traction, particularly after 2020.

Furthermore, the visualization reveals a temporal layering effect, where earlier research focused on ecosystem management, environmental policy, and valuation strategies has gradually expanded to include risk assessment, sustainable finance, and investment mechanisms. Terms like *finance*, *sustainability*, and *innovation* occupy a central and transitional position in both time and connectivity—serving as a bridge between ecological concepts and newer financial technologies. This evolution reflects a broader paradigm shift from descriptive ecological valuation toward instrumental financialization models, underscoring the growing complexity and interdisciplinarity of this research field. The map thus not only tracks what is being studied but when these themes gain prominence—offering critical insight into the trajectory of biodiversity finance research.

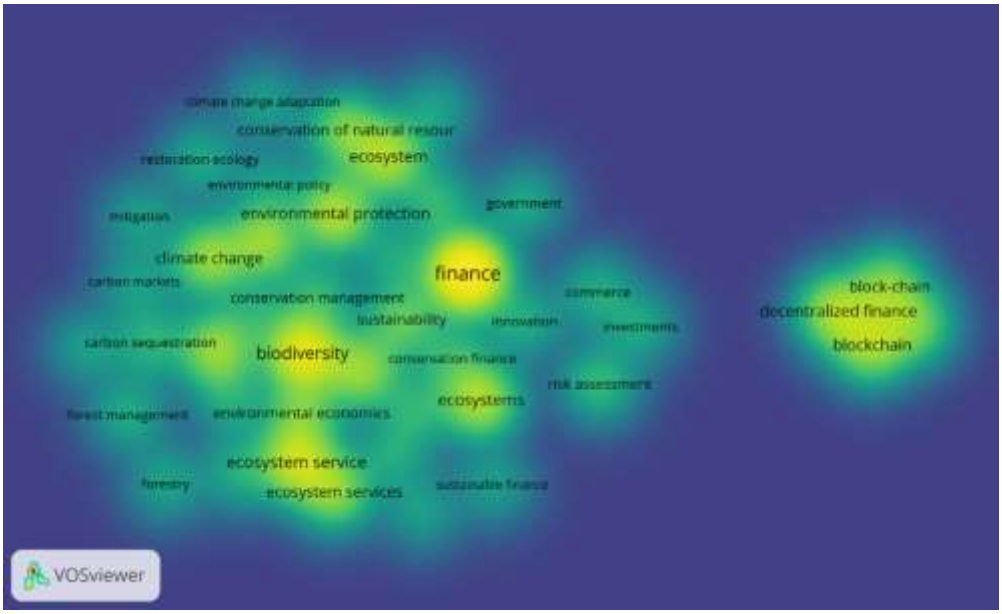

Figure 3. Density Visualization

Source: Data Analysis, 2025

Figure 3 highlights the most frequently co-occurring keywords in the literature, using color intensity to indicate their prominence. Bright yellow areas, such as around the keywords *finance*, *biodiversity*, *ecosystem service*, and *blockchain*, represent high-density zones—indicating these terms appear most often and are central to recent research discussions. The cluster surrounding *finance* overlaps significantly with *ecosystems*, *sustainability*, *conservation finance*, and *risk assessment*, signaling the core focus on integrating environmental and financial frameworks. The density around *biodiversity* and *ecosystem service* reflects longstanding ecological concerns, while the continued visibility of *climate change* and *environmental protection* suggests that foundational environmental issues remain actively linked to finance-related narratives. Interestingly, a secondary high-density cluster appears distinctly on the right side of the map around *blockchain* and *decentralized finance*. Despite being somewhat disconnected spatially, this bright node signifies a growing interest in innovative digital solutions for financing nature. The presence of this cluster highlights a new frontier in biodiversity finance where decentralized technologies may offer alternative, transparent mechanisms for conservation funding, tracking carbon credits, or tokenizing ecosystem services. Though still emerging, its intensity suggests that this niche is becoming a hotbed of scholarly attention, and may redefine how nature and finance intersect in the digital era.

3.2 Co-Authorship Network

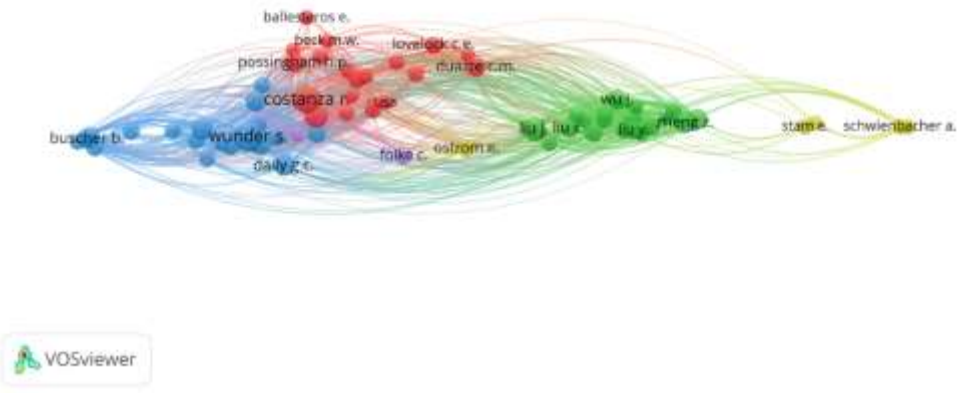

Figure 4. Author Collaboration Visualization
Source: Data Analysis, 2025

Figure 4 highlights the key scholarly contributors and collaboration patterns in the field of nature finance, ecosystem valuation, and biodiversity financialization. The nodes represent authors, with the size indicating publication volume or centrality, while the connecting lines show co-authorship links. Distinct color clusters indicate tightly connected research communities. The blue cluster on the left, featuring authors like *Buscher B.* and *Wunder S.*, appears grounded in environmental governance and political ecology. The red cluster at the center, with highly central figures like *Costanza R.*, *Possingham H.P.*, and *Beck M.W.*, represents foundational contributors to ecological economics and ecosystem service valuation. The green cluster on the right, dominated by authors such as *Liu J.*, *Wu J.*, and *Zheng Z.*, reflects a more recent and possibly Asian-

centric cohort engaging in biodiversity finance, often with a technical or modeling orientation. Notably, the yellow cluster at the far right, with emerging names like *Schwienbacher A.* and *Stame E.*, is loosely connected but points to growing work in digital finance and innovation, such as decentralized finance (DeFi) applied to conservation.

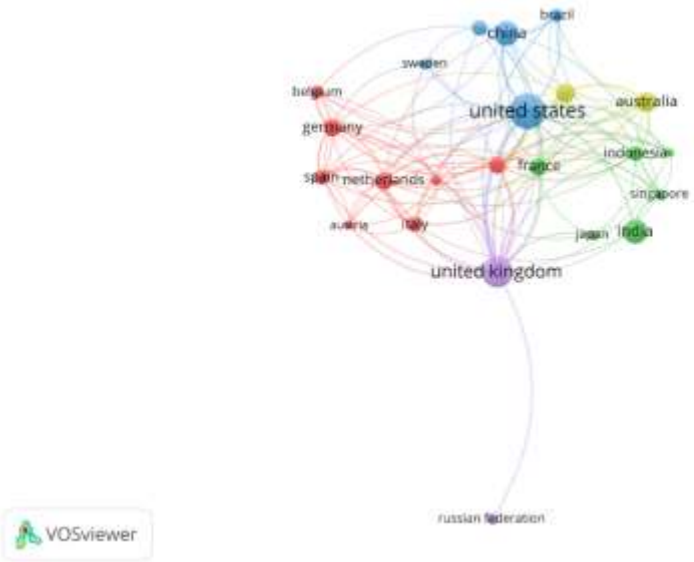

Figure 5. Country Collaboration Visualization
Source: Data Analysis, 2025

Figure 5 reveals the geopolitical structure of international research collaborations in the field of nature finance and ecosystem valuation. The United Kingdom appears as the most central and well-connected hub, acting as a bridging country among various global clusters, including Western Europe (e.g., Germany, Netherlands, Spain), North America (United States), and emerging economies (India, China, Indonesia). The United States also plays a dominant role, connected to nearly all major publishing countries and forming a cluster with Australia, China, and Brazil, reflecting its influence in both environmental economics and innovation-driven finance. The European cluster (red), including Germany, Belgium, and the Netherlands, shows strong internal cohesion, suggesting tight academic networks often based on EU funding frameworks or shared regional priorities. Meanwhile, the green cluster represents the growing contribution of Asia-Pacific countries like India, Singapore, Japan, and Indonesia, which, although slightly peripheral, indicate expanding interest in biodiversity finance in the Global South. A notable outlier is the Russian Federation, which appears largely isolated with minimal international co-authorship, highlighting regional disparities in engagement with global research on financialization of biodiversity.

3.3 Citation Analysis

Table 1. Top Cited Research

Citations	Authors and year	Title
1613	[7]	Ecosystem services in decision making: Time to deliver
613	[8]	Complex systems: Ecology for bankers
165	[9]	Arrested development? The promises and paradoxes of "selling nature to save it"

Citations	Authors and year	Title
160	[10]	Protected areas, conservation and tourism - financing the sustainable dream
150	[11]	Measure Twice, Cut Once: Entrepreneurial Ecosystem Metrics
130	[12]	Grabbing "Green": Markets, Environmental Governance and the Materialization of Natural Capital
122	[13]	Blue carbon: Knowledge gaps, critical issues, and novel approaches
109	[14]	Socioeconomic influences on biodiversity, ecosystem services and human well-being: A quantitative application of the DPSIR model in Jiangsu, China
100	[15]	Integrating local ecological services into intergovernmental fiscal transfers: The case of the ecological ICMS in Brazil
93	[16]	Marine protected dramas: The flaws of the Brazilian national system of marine protected areas

Source: Scopus, 2025

Practical Implication

This study provides valuable insights for policymakers, investors, environmental NGOs, and international development institutions involved in biodiversity finance and ecosystem service valuation. By mapping the intellectual structure of the field, the study enables decision-makers to identify which financial mechanisms (e.g., conservation finance, carbon markets, decentralized finance) are most actively discussed and which regions or institutions lead the conversation. For governments seeking to integrate biodiversity into national economic planning, the bibliometric mapping helps in aligning policies with prevailing research priorities. Moreover, the identification of emerging technologies like blockchain in biodiversity finance offers practitioners early signals for piloting innovative, transparent, and scalable conservation funding models. Financial institutions can also leverage the clustering insights to align ESG (Environmental, Social, and Governance) investment portfolios with biodiversity-related goals in accordance with scientifically grounded frameworks.

Theoretical Contribution

Theoretically, this study contributes to the interdisciplinary nexus between **ecological economics**, **financialization theory**, and **environmental governance**. It reveals how biodiversity is increasingly being framed within financial paradigms and offers empirical evidence of the intellectual shift from ecosystem valuation toward more sophisticated market-based and risk-driven frameworks. The bibliometric mapping demonstrates the evolution of academic thinking from traditional ecological value systems (e.g., ecosystem services, environmental economics) to contemporary innovations (e.g., decentralized finance, blockchain tokenization). It extends the theory of financialization by documenting how environmental assets are commodified and integrated into financial circuits. Furthermore, it offers a critical lens to understand the spatial and temporal diffusion of these ideas—highlighting which authors, countries, and collaborations are shaping the dominant discourses. This study, thus, bridges gaps between environmental science, finance, and political economy, offering a macro-level synthesis that grounds future theoretical explorations.

Limitation of the Study

While this study offers a comprehensive overview, it is not without limitations. First, the analysis is restricted to publications indexed in the **Scopus database**, which, although extensive, may exclude relevant works published in non-indexed journals, grey literature, or local-language sources—particularly from regions in the Global South. Second, the **bibliometric method** is quantitative in nature and does not capture the full richness of theoretical debates, discursive tensions, or normative critiques

that may be embedded in the texts. Third, keyword-based searches are inherently sensitive to terminology variations and may overlook synonymous or emergent terms not explicitly included in the search string. Lastly, while the study identifies trends and patterns, it does not evaluate the *impact* or *effectiveness* of the financial mechanisms discussed, which would require complementary qualitative methods or case study analysis. These limitations open avenues for further research using mixed methods to deepen the understanding of the political and ethical implications of biodiversity financialization.

4. CONCLUSION

This study offers a comprehensive bibliometric mapping of the scholarly landscape on nature finance and the financialization of biodiversity, revealing how ecological valuation has evolved into a sophisticated, interdisciplinary field intersecting economics, environmental science, and financial innovation. The analysis highlights key thematic clusters such as biodiversity conservation, ecosystem services, climate change, and blockchain-based decentralized finance while also identifying influential authors, countries, and collaboration networks that drive the research frontier. The results indicate a clear shift from traditional ecosystem valuation toward market-based conservation mechanisms, risk management approaches, and emerging digital technologies. As biodiversity continues to be reframed within financial logics, it is essential for scholars, practitioners, and policymakers to critically engage with both the promises and pitfalls of this transformation. By offering a structured synthesis of research patterns, this study not only informs academic discourse but also supports the development of more inclusive, effective, and accountable biodiversity finance strategies in the era of environmental urgency and economic complexity.

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