

Biodiversity Accounting Research Mapping: Bibliometric Analysis to Identify Thematic Trends and Research Gaps

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ABSTRACT

Biodiversity accounting research has accelerated significantly since 2020, but comprehensive mapping of the intellectual structure of this field is still limited. This research aims to map the intellectual landscape, thematic evolution, and collaboration patterns in biodiversity accounting research. Bibliometric analysis was conducted on 102 documents from Scopus for the period 2013-2025 using VOSviewer. The results of the study identified three main thematic clusters: corporate disclosure practices, theoretical-methodological foundations, and ecosystem services-ecology perspectives. Temporal evolution shows a shift from conceptual development to practical application. The dominance of developed countries in knowledge production indicates geographical inequalities that require more inclusive international collaboration. This research provides a roadmap for the development of future biodiversity accounting research.

INTRODUCTION

Global biodiversity is facing a sixth mass extinction crisis triggered by anthropogenic activity, with the rate of species loss reaching 1,000 times faster than natural rates (Ceballos et al., 2015). The Convention on Biological Diversity (CBD) reports that one million species are threatened with extinction in the coming decades (IPBES, 2019). In the business context, the Dasgupta Review (2021) revealed that more than half of global GDP depends on ecosystem services that are currently degraded. Pressure from investors, regulators, and civil society encourages companies to disclose their impact and dependence on biodiversity (Atkins & Maroun, 2018; Jones & Solomon, 2013).

The academic response to this crisis gave birth to the field of biodiversity accounting and disclosure, which aims to develop a reporting framework to encourage corporate accountability (Boiral, 2016; Rimmel & Jonäll, 2013). The literature shows that biodiversity reporting is still dominated by impression management and symbolic disclosure rather than substantive action (Maroun & Usher, 2018). Frameworks such as the Global Reporting Initiative (GRI), the Natural Capital Protocol, and the Taskforce on Nature-related Financial Disclosures (TNFD) have been developed for standardization, but adoption and the quality of implementation still vary (van Liempd & Busch, 2013; Haque & Jones, 2020).

Although biodiversity accounting research shows a significant growth in publications since 2020, there has been no comprehensive mapping of the intellectual structure of this field. Fundamental unanswered questions include: (1) How have the intellectual landscape and patterns of knowledge production in this field evolved? (2) What topics and themes dominate academic discourse, and which ones are overlooked? (3) Who are the key researchers and institutions that shape the development of this field? (4) Are there geographical biases in knowledge production that could affect the global applicability of the developed framework?

Several previous studies have identified the need to conduct systematic studies in the field of biodiversity accounting. Samkin et al. (2014) emphasized the need for a comprehensive review to understand the development of biodiversity reporting practices, while Roberts et al. (2021) identified the need for a systematic review in the context of broader ecological accounting. However, there have been no bibliometric studies that use science mapping to comprehensively uncover hidden patterns and research gaps.

Jones and Solomon (2013) call for a more critical approach to biodiversity accounting research, but systematic mapping of the evolution of knowledge themes and structures has not been done. Adler et al. (2018) identified geographic concentration in biodiversity reporting studies, but a thorough analysis of international collaboration patterns and the implications of developed country dominance on the relevance of the developed global framework has not been empirically explored.

This research fills the gap through a comprehensive bibliometric analysis that maps the intellectual structure of biodiversity accounting research using multiple analytical techniques. We argue that understanding the structure of

knowledge production is a prerequisite for advancing this field effectively. Science mapping can reveal patterns of research collaboration, thematic concentration, and research gaps that are not seen through traditional literature review (Donthu et al., 2021; Zupic & Čater, 2015). By analyzing 102 documents from the Scopus database for the period 2013-2025, this study used VOSviewer to produce informative network visualizations and comprehensive analysis (Van Eck & Waltman, 2010).

The specific objectives of this study are: (1) Identify trends in publications, researcher productivity, and major journals in the field of biodiversity accounting; (2) Analyzing the temporal pattern of publication growth and conceptual evolution through keyword novelty analysis; (3) Mapping the main thematic clusters through keyword co-occurrence analysis to identify the intellectual structure of the field; (4) Analyze patterns of geographical collaboration and identify the dominance of certain countries in knowledge production; (5) Identify critical research gaps and formulate a future research agenda based on bibliometric findings.

THEORETICAL REVIEW

Biodiversity accounting emerged as an academic field responding to accelerating species loss and the recognition that conventional accounting systems fail to capture organizational environmental impacts (Gray, 2010; Boiral, 2016). Jones and Solomon (2013) problematized traditional approaches, highlighting how biodiversity disclosures are often characterized by symbolic rather than substantive action. The field has evolved from conceptual development toward practical application, with frameworks such as GRI Standard 304, the Natural Capital Protocol, and the Taskforce on Nature-related Financial Disclosures (TNFD) driving standardization efforts (GRI, 2016; TNFD, 2023).

Atkins and Maroun (2018) introduced "extinction accounting," proposing more radical approaches to quantifying biodiversity loss as organizational impact. However, implementation remains inconsistent across organizations and jurisdictions. Haque and Jones (2020) and Adler et al. (2018, 2023) documented that biodiversity disclosure quality remains limited despite growing regulatory pressure, particularly among multinational corporations. Methodologically, the field integrates ecological science with accounting theory. Costanza et al. (2014) and the Millennium Ecosystem Assessment (2005) established ecosystem services as central to valuing biodiversity, though operationalizing these concepts in corporate settings faces persistent challenges (Houdet et al., 2012).

A significant research gap exists regarding geographical disparities: developed countries, particularly the United Kingdom and Commonwealth nations, dominate knowledge production while megadiverse regions remain underrepresented (Mittermeier et al., 1997; Myers et al., 2000). Siddiqui (2013) called for context-sensitive methodologies adapted to developing economies. Adams and Abhayawansa (2022) and Mansoor and Maroun (2016) confirmed limited research in African and Asian contexts. Current gaps include insufficient understanding of governance mechanisms driving disclosure in emerging

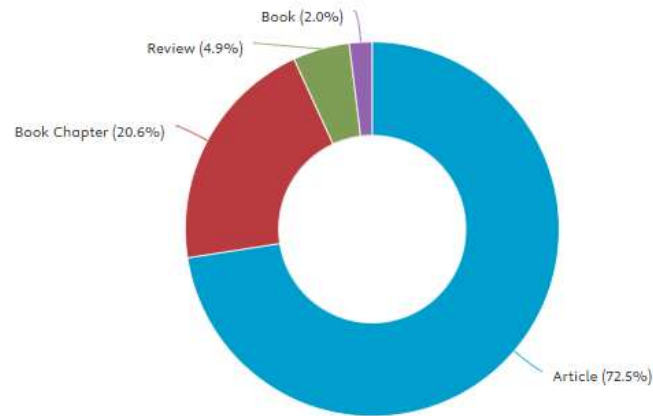
markets, inadequate analysis of implementation barriers in developing countries, and limited examination of disclosure quality beyond mere presence. Comprehensive bibliometric mapping of this field remains underdeveloped, necessitating systematic analysis of intellectual structure, thematic evolution, and collaborative patterns to advance future research directions.

METHODOLOGY

The bibliometric analysis in this study is based on a clear and systematic methodological approach (Donthu et al., 2021; Zupic & Čater, 2015). Scopus is the primary database choice due to its position as a globally recognized repository (Baas et al., 2020; Mongeon & Paul-Hus, 2016), which offers access to metadata from thousands of publishers spanning a diverse range of publication sources such as journals, books, and other literature (Burnham, 2006; Prancutė, 2021) through a structured document search procedure. The research steps include: First, keyword determination and literature search will be carried out on September 2, 2025, using the keywords Biodiversity Accounting, Biodiversity Disclosure, Extinction Accounting, Biodiversity Reporting, and Biodiversity Corporate Disclosure in an all-year time span. This initial search result yielded 184 documents. Second, by entering the query Article title, Abstract, Keywords ("Biodiversity Accounting" OR "Biodiversity Disclosure" OR "Extinction Accounting" OR "Biodiversity Reporting" OR "Biodiversity Corporate Disclosure") AND (LIMIT-TO (SUBJAREA, "BUSI")), the number of documents shrinks to 102. The documents that have been selected in the second stage are stored in Comma Separated Values (CSV) format from the Scopus database. Finally, the third stage includes the data analysis process, where documents that have been converted into CSV format are processed using VOSviewer software to produce an informative visual representation along with comprehensive analysis (Van Eck & Waltman, 2010).

RESULTS AND DISCUSSION

Based on the search of the Scopus database related to biodiversity accounting research, a total of 102 documents were obtained, distributed in four types of publications (See Figure 1) (Scopus, 2025). Journal articles dominated with 74 papers (72.5%), indicating that biodiversity accounting research was more widely published through scientific journals, indicating that this topic has become an active research subject in the academic community. The book chapter occupies the second position with 21 papers (20.6%), reflecting efforts to integrate the concept of biodiversity accounting into broader theoretical discussions. Article review recorded 5 documents (4.9%), showing that efforts to synthesize literature are still limited. While the complete book is only 2 documents (2.0%), it indicates that the publication of a special monograph is still very rare.

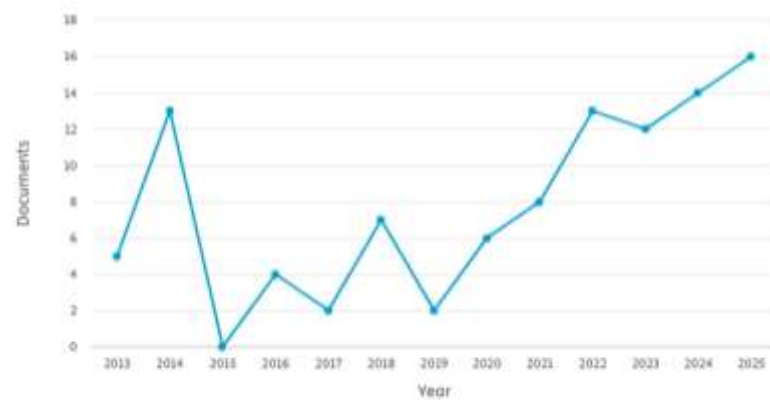


Source: Scopus, 2025

Figure 1. Document Type Distribution

The number of scientific publications is a key parameter in analyzing the dynamics of the development of a certain area of study (Chen et al., 2015). The pattern of time distribution of research literature on biodiversity accounting can be interpreted in Figure 2. It is clear that the number of publications on biodiversity accounting grew in 2014, 2022, and 2024, then increased again in 2025 with the emergence of new articles. This trend suggests that biodiversity accounting has become the focus of more intensive attention and has become the object of extensive study in academia.

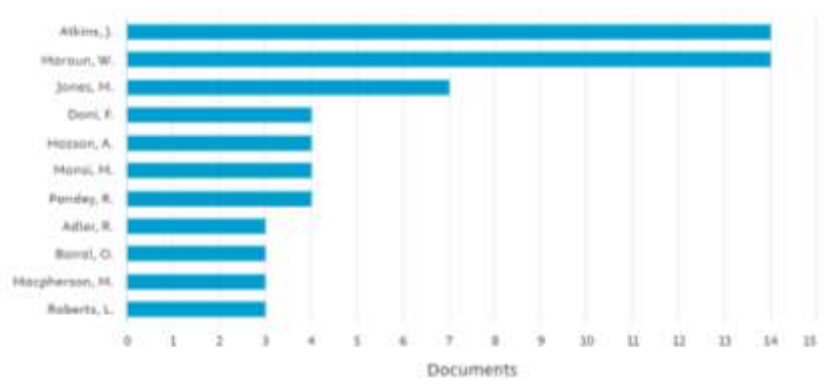
Figure 2 presents publication trends that show the dynamic development of biodiversity accounting research during the period 2013-2025. Publication began with 5 documents in 2013, then experienced a significant surge, reaching the first peak of about 13 documents in 2014, indicating a high initial interest in this topic. However, there was a drastic decrease to around 1 document in 2015, followed by fluctuations in 2016-2019 with a range of 2-7 documents, reflecting a period of conceptual consolidation. A positive trend began to be seen since 2020, with consistent growth from 6 documents to around 8 in 2021 and reaching a second peak of around 13 documents in 2022. Although it decreased slightly in 2023 (about 12 documents), publications again increased sharply to around 14 documents in 2024 and reached 16 documents in 2025. The acceleration trend since 2020 is likely triggered by increasing global awareness of the biodiversity crisis (IPBES, 2019; Dasgupta, 2021), regulatory pressures (European Commission, 2023), and the corporate sustainability agenda (TNFD, 2023), indicating that biodiversity accounting has become an increasingly important and relevant area of research.



Source: Scopus, 2025

Figure 2. Publication Distribution

Based on the analysis of the productivity of authors in biodiversity accounting research (Figure 3), there are two most prolific authors with significant contributions, namely Atkins and Maroun, who each produced 14 documents. These two authors demonstrate consistent dedication to developing the field of biodiversity accounting and can be considered key researchers in this domain. Jones ranks third with 7 documents, showing substantial contributions but at a considerable distance from the top two authors. Furthermore, there is a group of writers with medium productivity, namely Doni, Hassan, Mansi, and Pandey, who each contribute 4 documents. While Adler, Boiral, Macpherson, and Roberts each had 3 documents. This distribution pattern indicates a concentration of research in some core researchers, who may have deep specialties in biodiversity accounting and have the potential to form research collaborations or networks in this area.



Source: Scopus, 2025

Figure 3. Author Productivity

In Table 1, there are journals that contribute the most articles to biodiversity accounting research. Of the total 102 research articles, 18 were published in the Accounting Auditing and Accountability Journal, 10 articles were published in the Journal of Business Strategy and the Environment, and 7 articles were published in the Journal of Sustainability Accounting Management and Policy. These findings reflect the high activity of publishing articles related to biodiversity accounting in these journals. However, it should be noted that the

theme of biodiversity accounting also emerged in other journals, although it dominated the journals that have been mentioned.

Table 1. Five Journals with the Highest Number of Articles

Sources	Articles
Accounting, Auditing and Accountability Journal	18
Business Strategy and the Environment	10
Sustainability Accounting Management and Policy Journal	7
Social and Environmental Accountability Journal	6
Corporate Social Responsibility and Environmental Management	5

Source: Scopus, 2025

Table 2 shows the five highest-cited articles in the Biodiversity Accounting study, reflecting the most influential contributions in the literature. The most cited article is Boiral's (2016) work with 221 citations, indicating a significant influence in discussing biodiversity reporting practices and corporate impression management. The second article by Jones and Jill Solomon et al. (2013) has 193 citations. Haque and Jones (2020) examined the disclosure of European corporate biodiversity and board gender diversity with 161 citations. Rimmel and Jonäll (2013) discuss biodiversity reporting in Sweden with 137 citations, while Atkins and Maroun (2018) explore integrated extinction accounting with 117 citations. These five articles are important theoretical and empirical foundations in the development of biodiversity accounting research.

Table 2. The Five Most Cited Articles

No	Document title	Authors	Year	Source	Cited by
1	Accounting for the Unaccountable: Biodiversity Reporting and Impression Management	Boiral, O.	2016	Journal of Business Ethics, 135(4), pp. 751-768	221
2	Problematising accounting for biodiversity	Jones and Jill Solomon, M., John Jones, M., Frances Solomon, J.	2013	Accounting Auditing and Accountability Journal, 26(5), pp. 668-687	193
3	European firms' corporate biodiversity disclosures and board gender diversity from 2002 to 2016	Haque, F., Jones, M.J.	2020	British Accounting Review, 52(2), 100893	161
4	Biodiversity reporting in Sweden: Corporate disclosure and preparers' views	Rimmel, G., Jonäll, K.	2013	Accounting Auditing and Accountability Journal, 26(5), pp. 746-778	137
5	Integrated extinction accounting and accountability: building an ark	Atkins, J., Maroun, W.	2018	Accounting Auditing and Accountability Journal, 31(3), pp. 750-786	117

Source: Scopus, 2025

Keyword Analysis

The green cluster emphasizes corporate sustainability disclosure and reporting practices. The main keywords include "sustainability", "biodiversity disclosure", "integrated reporting", "environment", "environmental performance", and "GRI" (Global Reporting Initiative). The cluster reflects a focus on how companies communicate their biodiversity performance to stakeholders through various reporting frameworks (Atkins & Maroun, 2018; Boiral, 2016). The presence of "integrated reporting" shows a trend towards holistic reporting that integrates financial and non-financial information, including biodiversity aspects (IIRC, 2021). The terms "biodiversity disclosures" and "public sector biodiversity disclosures" indicate research on the transparency and quality of disclosure in both the private and public sectors (Jones & Solomon, 2013; Rimmel & Jonäll, 2013). The connection with "environmental performance" suggests that biodiversity disclosure is seen as an integral part of an organization's overall environmental performance (Haque & Jones, 2020). References to GRI indicate the use of international reporting standards as a framework for biodiversity disclosure (GRI, 2016). This green cluster represents a practical dimension of biodiversity accounting, focusing on reporting mechanisms and standards that facilitate the communication of biodiversity information to external stakeholders in the context of corporate governance and corporate accountability (Gray et al., 2014).

The red cluster represents a core theme of the research that focuses on the accounting and reporting aspects of biodiversity. The dominant keywords include "biodiversity accounting", "biodiversity reporting", "extinction accounting", "accountability", and "sustainability accounting". These clusters reflect fundamental discussions on how organizations measure, report, and account for their impact on biodiversity (Jones & Solomon, 2013). The emerging concept of "extinction accounting" indicates the evolution of a more radical accounting approach to acknowledging the loss of species and ecosystems (Atkins & Maroun, 2018). The presence of the term "emancipatory" indicates the existence of a critical perspective that seeks to liberate accounting from the conventional paradigm towards a more transformative approach (Gallhofer & Haslam, 2019). The cluster is also closely linked to "accounting for biodiversity" and "biodiversity management", demonstrating the integration between biodiversity measurement and management practices (Rimmel & Jonäll, 2013; Siddiqui, 2013). The themes of "sustainable development" and "climate change" in this cluster emphasize how biodiversity accounting plays a role in the broader sustainable development agenda (Atkins et al., 2015; Boiral, 2016). Overall, the red cluster represents a theoretical and methodological foundation in the development of accounting systems capable of capturing the complexity of biodiversity values and the impact of organizations on life on the planet (Gray, 2010; Lamberton, 2005).

Blue clusters represent the ecological dimension and ecosystem services in the context of biodiversity accounting. The dominant keywords include

"ecosystem", "ecosystem services", "sustainability reporting", "environmental disclosures", and "climate change" represent the current themes (2022-2024), indicating a shift towards the integration of ecosystem perspectives, ecosystem services, and linkages with climate change (Russell et al., 2022; Adler et al., 2023). This pattern shows the evolution of research from the construction of theoretical and methodological foundations to practical application and integration with the broader global sustainability agenda (van Liempd & Busch, 2013; Cuckston, 2018). The novelty of current research emphasizes a holistic approach that connects biodiversity accounting with business risks, ecosystem services, and comprehensive environmental disclosures, reflecting the urgency and complexity of biodiversity challenges in contemporary business contexts (TNFD, 2023; Atkins et al., 2024).

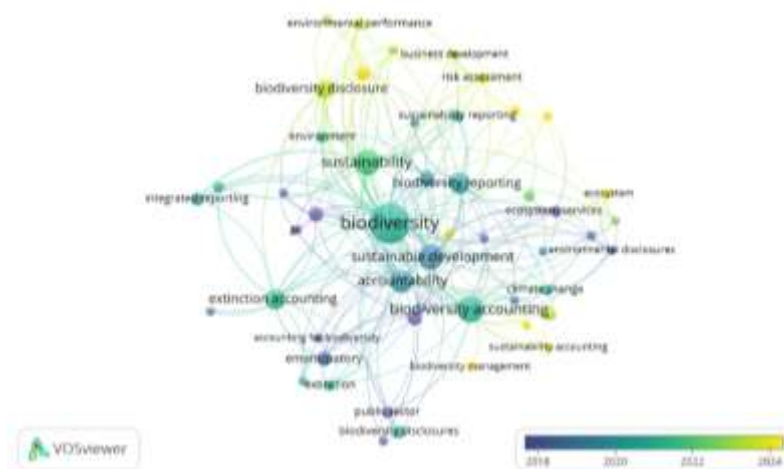
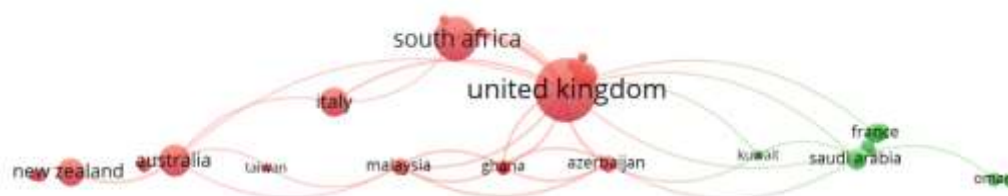


Figure 5. Keyword Temporal Evolution

Collaboration

The analysis of collaborative networks provides insight into the capacity of academic research in the field of biodiversity accounting across countries (Zupic & Čater, 2015). This study examines the spread of countries involved in biodiversity accounting research. Visualization of the collaboration network shows the United Kingdom (UK) as the dominant hub in biodiversity accounting research with 42 documents, 1,366 citations, and the highest total link strength (32), indicating the central role of UK researchers in shaping global discourse and facilitating international collaboration. South Africa ranks second with 21 documents and 494 citations (link strength 14), reflecting a strong collaboration with the UK that is likely triggered by the similarity of the regulatory context and the importance of African biodiversity conservation (Maroun & Atkins, 2018). The red pattern in the UK-South Africa-Australia-New Zealand-Italy cluster indicates an active Commonwealth collaboration network. Interestingly, Azerbaijan emerged with a high link strength (11) despite having only 3 documents, indicating intensive collaboration with certain countries. Asian countries such as Malaysia, Saudi Arabia, and Kuwait (marked in green) form separate clusters with more limited collaboration, indicating emerging research in the region. Australia and New Zealand showed significant productivity with high citations (214 and 409), reflecting the strong quality of the research. This

pattern reveals a geographic gap in biodiversity accounting research, where the dominance of Western countries contrasts with the limited participation of megadiverse countries in Asia, Africa, and Latin America (Mittermeier et al., 1997; Myers et al., 2000), even though the region has the highest biodiversity and faces the most serious threat of degradation (IPBES, 2019).



Source: VOSviewer, 2025

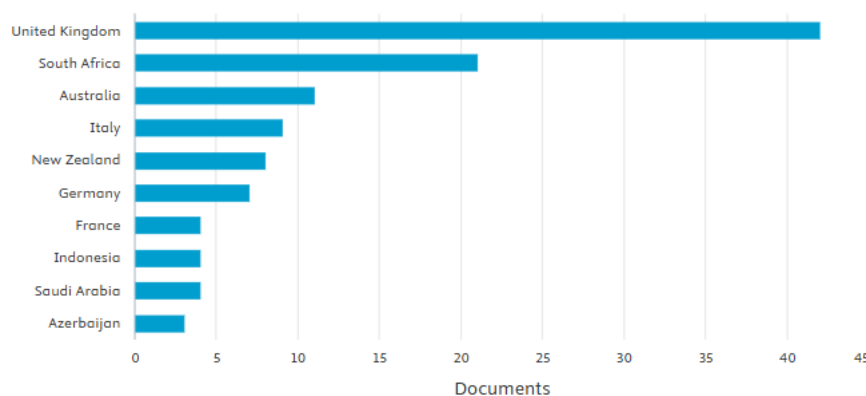
Figure 6. Collaboration Map

Table 3. Country Collaboration Network

No	Country	Docs	citations	total link strength	No	Country	Docs	citations	total link strength
1	United Kingdom	42	1366	32	18	Jordan	1	1	2
2	South Africa	21	494	14	19	Norway	1	0	2
3	Azerbaijan	3	14	11	20	Pakistan	1	36	2
4	Malaysia	3	32	10	21	Portugal	2	1	2
5	Australia	11	214	9	22	Spain	2	86	2
6	Ghana	2	12	8	23	Taiwan	1	20	2
7	Kazakhstan	2	12	8	24	Austria	1	0	1
8	Saudi Arabia	4	11	6	25	Brazil	1	0	1
9	Italy	9	69	4	26	Canada	3	245	1
10	United States	2	8	4	27	China	1	11	1
11	France	4	61	3	28	Finland	2	10	1
12	Kuwait	1	2	3	29	Sweden	2	144	1
13	New Zealand	8	409	3	30	United Arab Emirates	1	161	1
14	Oman	2	36	3	31	Denmark	1	113	0
15	Thailand	2	16	3	32	India	1	0	0
16	Germany	7	82	2	33	Indonesia	4	26	0
17	Ireland	1	8	2	34	Macao	2	7	0

Source: VOSviewer, 2025

Figure 7 presents documents by country showing the dominance of the United Kingdom with 42 documents, far surpassing that of other countries and confirming its position as a leader in global biodiversity accounting research (Scopus, 2025). South Africa ranks second with 21 documents, reflecting serious attention to biodiversity issues in the African region (Maroun & Atkins, 2018). Australia, Italy, and New Zealand showed moderate contributions with 11, 9, and 8 documents, respectively, indicating consistent research activity. Germany and France contributed 7 and 4 documents, respectively, while Indonesia and Saudi Arabia each had 4 documents, showing that the participation of developing countries is still limited. Azerbaijan has a smaller contribution with 3 documents. This distribution pattern reveals significant geographical inequalities, where developed countries, particularly from the European and Commonwealth regions, dominate knowledge production in biodiversity accounting (Adams & Abhayawansa, 2022). This is paradoxical considering that many megadiverse countries with the highest biodiversity are actually underrepresented in research (Mittermeier et al., 1997; Conservation International, 2023), indicating the need for capacity building for more inclusive international research and collaboration (Siddiqui, 2013; Mansoor & Maroun, 2016).



Source: Scopus, 2025

Figure 7. Documents by Country

The findings from the above analysis of document distribution, publication trends, author productivity, keyword mapping, and international collaboration networks provide a comprehensive overview of the contemporary biodiversity accounting research landscape. The patterns identified in terms of publication growth, thematic evolution, and collaborative structure offer important insights into the current state of the field and the future direction of the field's development.

CONCLUSIONS AND RECOMMENDATIONS

This bibliometric analysis reveals that biodiversity accounting research has developed into an increasingly mature research field, characterized by a significant acceleration of publications since 2020 and the emergence of new themes that connect biodiversity with a broader global sustainability agenda. The intellectual

structure of this field shows three main interrelated dimensions: corporate disclosure and reporting practices, the theoretical and methodological foundations of biodiversity accounting, and the integration of ecological perspectives and ecosystem services. Temporal evolution indicates a shift in focus from conceptual development towards practical application and integration with business risks and climate change, reflecting the urgency of the biodiversity crisis in contemporary business contexts.

However, the analysis also reveals significant geographical inequalities, where knowledge production is dominated by developed countries even though megadiverse countries face the most serious biodiversity challenges. This inequality raises critical questions about the relevance and applicability of frameworks developed for diverse global contexts. Going forward, this field requires more inclusive international collaboration, the development of context-sensitive methodologies, and more attention to the perspectives of developing countries. Future research needs to explore the practical implementation of biodiversity reporting frameworks, develop more robust metrics to measure organizational impact on biodiversity, and strengthen integration between accounting research and ecological science to produce more effective solutions to the global biodiversity crisis.

FURTHER STUDY

This bibliometric study has several limitations worthy of consideration. First, analysis is restricted to Scopus database; inclusion of Web of Science, Google Scholar, or grey literature might reveal additional research patterns and perspectives overlooked in this mapping. Second, the study covers 2013-2025; earlier periods or extended timeframes could provide deeper historical context of biodiversity accounting development. Third, language bias exists as non-English publications may be underrepresented in Scopus, potentially affecting representation of developing countries' contributions. Fourth, citation counts reflect visibility rather than research quality; highly cited papers may not represent the most methodologically sound research.

Future investigations should expand database coverage, analyze qualitative content of publications for deeper thematic understanding, conduct systematic reviews of regional research traditions, and examine why megadiverse countries remain underrepresented despite facing the most critical biodiversity challenges. Longitudinal tracking of research gaps identified in this study would help assess whether future research adequately addresses emerging needs in biodiversity accounting.

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