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Review

Environmental Accounting and Sustainability: A Meta-Synthesis

Sheela Sundarasen [1,*], Usha Rajagopalan [1] and Ahnaf Ali Alsmady [2]

[1] Department of Accounting, Prince Sultan University, Riyadh 11586, Saudi Arabia; urajagopalan@psu.edu.sa
[2] Department of Accounting, University of Tabuk, Al-Qadisiyah, Tabuk 47334, Saudi Arabia; aalsmadi@ut.edu.sa
* Correspondence: ssundarasen@psu.edu.sa

Abstract: This study conducts a comprehensive *meta-synthesis* of review-based research on environmental accounting, spanning from 1995 to 2024. Environmental accounting, also known as green accounting, has evolved as a critical tool for integrating sustainability into corporate financial practices. Using bibliometric methods via Bibliometrix R-package (Biblioshiny—Version 4.2.0) and VOSviewer (Version 1.6.20), the research mainly examines scholarly discussion in review-based studies and identifies dominant themes. The main clusters identified are (1) environmental audits and management, (2) green accounting, financial reporting and sustainable development, (3) CSR, stakeholder engagement, and accountability, and (4) environmental accounting and protection. On the descriptive end, publication trends, prominent authors, articles, and sources are identified. The findings highlight a significant increase in review-based studies since 2022, coinciding with the growing global awareness and importance of sustainability. This study contributes to the field by consolidating fragmented research on environmental accounting, offering a framework for future academic exploration. Practically, it informs policymakers and business leaders on the importance of unified reporting standards across regions; integrating environmental considerations into financial decision-making; promoting transparency, accountability, and sustainability accounting; and disclosure across industries and regions.

Keywords: environmental accounting; green accounting; sustainability; financial reporting and disclosure; environmental management; environmental audit; CSR; bibliometric study; meta-synthesis

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1. Introduction

Environmental accounting refers to an approach that organizations take to track the effects of their actions on the environment [1–3]. It incorporates environmental conservation and management principles into cost–benefit analyses and reporting practices [4]. More than ever, environmental accounting (also known as green accounting) plays a central role in organizations, in addition to financial performance and stockholders' maximization. There is a surge in awareness and pressure from all stakeholders [5] to consider environmental matters in their business dealings due to environmental challenges such as pollution, climate change, and resource depletion [6–9]. Thus, non-financial reporting is on the rise, and organizations are expected to report the environmental effects arising from their day-to-day business activities. Environmental expenses can be measured, reported, and managed through environmental accounting [10–12]. It integrates environmental data into regular accounting systems to help companies make better decisions that consider both financial and environmental impacts. The integration of environmental data supports firms in adopting eco-friendly practices and promoting sustainability.

Extant literature on environmental accounting has explored different aspects such as conceptual frameworks [13,14], real-world applications [15–18], and policy implications [19–21]. There are also some studies on water accounting [22,23], space accounting [24], etc. The current study is prompted by the necessity of gathering, evaluating, and synthesizing the substantial amount of environmental accounting literature currently published. Despite an

abundance of individual and review studies that have made contributions to the understanding of this topic, thorough assessments highlight the need to consolidate fragmented findings and effectively contribute towards several practical implications.

Integrating environmental accounting into corporate governance frameworks, especially in emerging markets, could enhance firms' transparency and accountability by ensuring companies report their environmental impacts clearly. This fosters trust among stakeholders, including investors, consumers, and regulators, since regulatory oversight and environmental scrutiny are on the rise. Second, environmental accounting could support improved risk management by recognizing and mitigating environmental risks like resource depletion and pollution, and at the same time help firms maintain compliance with both local and international environmental standards. Third, incorporating environmental accounting into long-term business strategies aligns corporate practices with sustainable development goals (SDGs), thus balancing firms' financial performance with environmental protection. This also aids in strategic decision-making by providing data that can guide investments in green technologies and resource efficiency, driving both sustainability and competitiveness. Companies that embrace these practices are more likely to attract foreign investments, as sustainability is becoming a key focus for investors globally.

In this context, this research aims to present a meta-synthesis of existing review-based studies using a bibliometric approach, contribute towards bridging the gaps between theory and practice, and provide a more all-inclusive view of the subject matter. Subsequently, it could promote and support policymakers in designing effective policies and regulations. It is also envisioned that this study could create awareness amongst business leaders in terms of understanding the financial and non-financial implications of environmental performance.

The following research questions (RQs) will be addressed:

RQ1: What are the publication trends in review-based studies on environmental accounting in terms of the number of publications, prominent journals, authors, and articles?

RQ2: What are the major themes in review-based studies on environmental accounting?

RQ3: What are the practical implications and potential future research directions of environmental accounting?

The study is organized in the following manner. Section 2 outlines the methodology used in the study, while Section 3 includes a descriptive analysis, bibliometric assessment, content evaluation, and suggestions for future research. Section 4 presents the conclusions.

2. Methodology

This study uses the Scopus database due to its broad multidisciplinary coverage. Web of Science has a more limited scope, focusing more on established journals with higher impact factors, which can result in an incomplete representation of research from regional and emerging fields [25]. As the first step of the data extraction, a systematic search was performed of titles, abstracts, and keyword lists, utilizing the specified terms "Environmental Accounting", "Green Accounting", and "Sustainability Accounting". Thereafter, the scope was restricted to articles published in the English language within the realms of economics, business, business finance, and management. The search results were further filtered by selecting the document type "Review Articles", published between 1995 and 2024, resulting in 115 review articles. A meticulous manual reading of the abstracts of the review studies was undertaken to ensure the suitability of the review articles for the current study. Finally, a total of 62 review articles were identified post application of all the above-mentioned inclusion and exclusion criteria. The application of the inclusion and exclusion criteria is depicted in the PRISMA table in Figure 1.

Following the methodologies of other bibliometric studies [26–30], this study utilized the Bibliometrix R-package (Biblioshiny—Version 4.2.0) [31] to generate textual and graphical representations of publication trends, prominent articles, authors, and significant publishing sources. Additionally, VOSviewer software (Version 1.6.20) [32] was employed

to visualize the keyword networks and identify clusters or groups of keywords with high connectivity. The resulting visualization was analyzed to further understand the structure of the literature, identify key clusters and thematic relationships, and provide comprehensive suggestions for practical implications and future research based on the associations between different keywords.

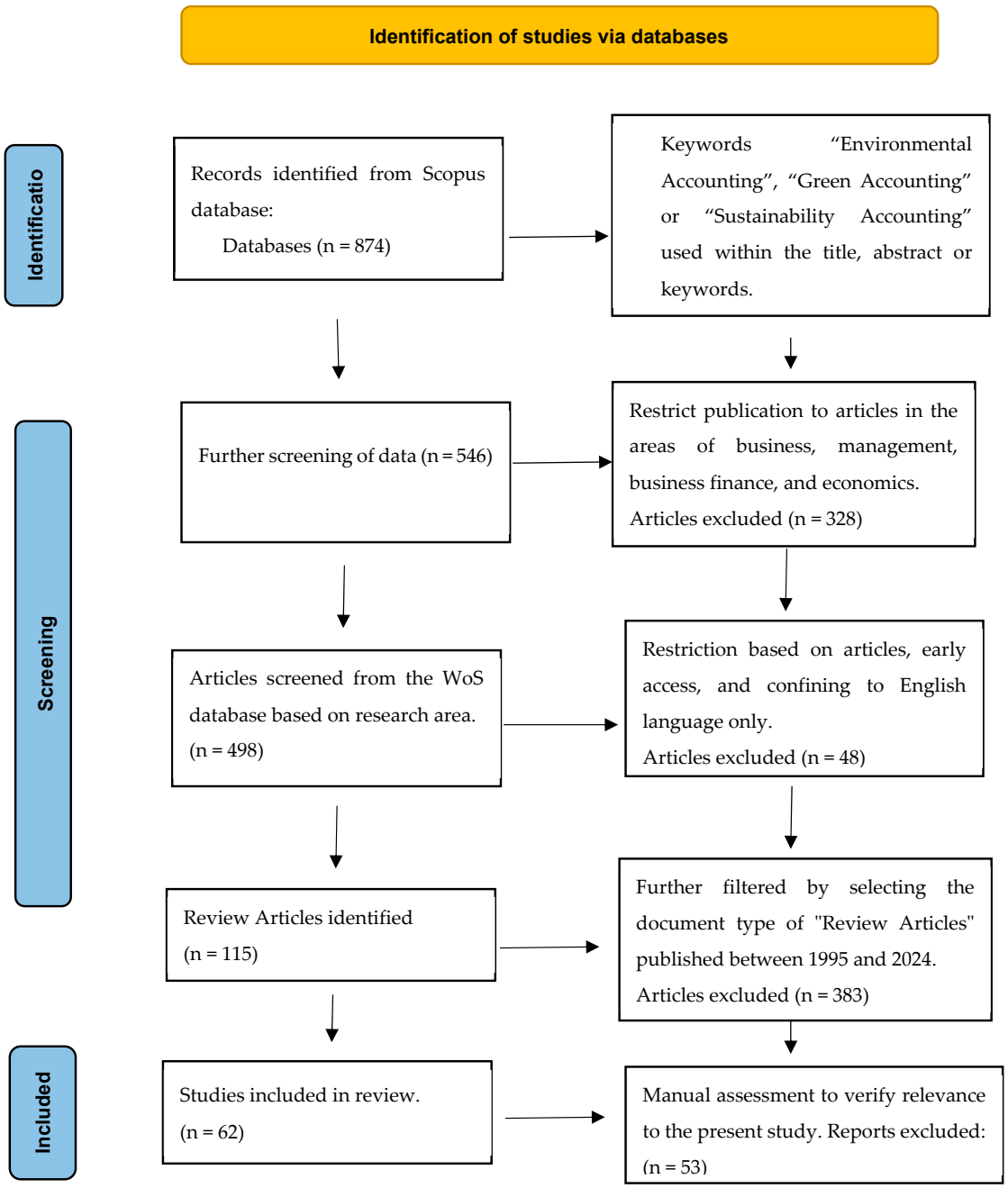

Figure 1. PRISMA table.

3. Findings

This section discusses both the quantitative and qualitative findings obtained from Bibliometrix R-package (Biblioshiny—Version 4.2.0) [31] and Vosviewer [32].

3.1. Publication Trends

Figure 2 displays the publication trends of review-based studies in the 'Environmental Accounting' field between 1995 and 2024. The years 1995 to 2016 can be considered as the early development period in this domain, as there were minimal review-based studies (between 1 and 4) on environmental accounting during this period. This could be due to the scarcity of individual publications on environmental accounting since there was a lack of awareness of environmental sustainability and businesses were focusing more on financial performance and shareholder maximization. Nevertheless, research in this domain gained more importance and traction in the following years, as seen in 2005, with a slight increase to five review-based publications. This suggests a nascent interest in consolidating existing individual research work on the subject matter. From the year 2017 onwards, an increase in the publication of review-based studies on environmental accounting is noted. This could be due to the increased universal focus on sustainability, as shown by the Paris Agreement and the global emphasis on climate change, and the integration of environmental considerations into business practices. The trend continued with ten publications, respectively, in 2018 and 2019, though a dip was noticed in 2021. This temporary interruption could be due to the COVID-19 pandemic. The perpetual output of seven to eight publications between 2022 and 2024 indicates an endured interest and importance in synthesizing existing research on environmental accounting.

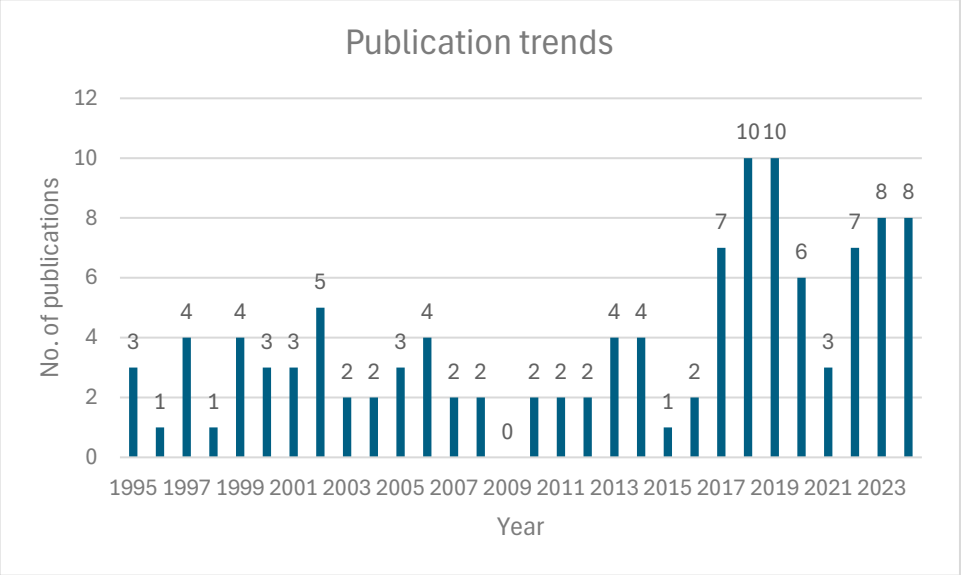

Figure 2. Publication trends of review-based studies on environmental accounting between 1995 and 2024. Source: Bibliometrix R-package (Biblioshiny).

3.2. Prominent Review-Based Publications on Environmental Accounting (Based on Citations)

Table 1 depicts four prominent review-based articles on environmental accounting. The research on social and environmental accounting (SEA) and corporate social responsibility (CSR) has made a significant impact on how the field has developed. To begin with, Ref. [33] reviewed 25 years of SEA research across three sub-periods and observed a shift from social to environmental accounting from the late 1980s. The author advocated that the future of environmental accounting is very much dependent on appropriate educational programs to prepare the future generation of qualified professionals. This is further supported by [34], who placed emphasis on environmental accounting's engagement with practice to foster socially and environmentally sound practices. To attain this objective, knowledge of environmental accounting should be included in the curricula, effectively promoting sustainable development. Both scholars emphasize the relevance of educational programs and practical engagement for the advancement of environmental accounting.

Ref. [35] discusses social and environmental reporting (SAR) and organizational legitimacy, observing the research trends and factors affecting environmental disclosure in the Special Issue of the *Accounting, Auditing & Accountability Journal*. The author reviewed articles highlighting the importance of knowing why organizations are willing to disclose their social and environmental initiatives—mainly from the perspective of legitimization. The author also discussed reviews that suggest the potential of use of legitimacy theory to further examine managerial behavior within the context of SAR. Ref. [36] encouraged more research collaboration with organizations that use sustainability accounting. This finding demonstrates that the collective studies on 'engagement research' have the potential to advance sustainability accounting and performance and shape both practice and policy. Reflecting on current times, the four key review-based articles (based on citations) discussed above on environmental accounting unveil momentous understandings of the development of social and environmental accounting (SEA). These studies indicate several key points: a shift from social to environmental accounting; the importance of incorporating social and environmental issues into the curricula to prepare future accountants with the awareness and knowledge of the matter; the need to legitimize environmental disclosures; and the need for enhanced partnership with establishments to improve sustainability accounting and performance. This is important as engagement research has the potential to effectively impact both practice and policy. Moving forward, it is envisioned that more environmental accounting studies could be undertaken on specific areas of environmental issues (aligning with sustainable development goals—SDGs), such as water accounting, carbon accounting, space accounting, etc.

Table 1. Prominent and relevant review-based articles on environmental accounting based on citations.

Prolific Articles (Based on Citations)	Title	Summary of the Paper	Citation
[33]	Twenty-five years of social and environmental accounting research: Is there a silver jubilee to celebrate?	This study reviewed the social and environmental accounting literature (SEAL), identifying trends, strengths, and weaknesses. It notes the shift from social to environmental accounting since the late 1980s and the lack of integration into undergraduate curricula. The paper calls for the broadening of accounting educational programs to include social and environmental factors, contributing to qualified professionals.	444
[34]	Engagement, education and sustainability: A review essay on environmental accounting	This study explored the enabling potential of environmental accounting (EA) through three areas: its engagement with practice to foster socially and environmentally sound practices, the role of EA education in empowering future accountants, and EA's contribution to sustainable development. It also examined critical perspectives on EA's effectiveness and challenges.	141
[35]	Introduction: The legitimizing effect of social and environmental disclosures—a theoretical foundation	This study introduces the Special Issue of the *Accounting, Auditing & Accountability Journal* on social and environmental reporting (SAR) and organizational legitimacy. It reviews SAR research trends, motivations for disclosure, and the role of legitimacy theory, highlighting contributions from other papers in the issue.	2127
[36]	Engaging with organizations in pursuit of improved sustainability accounting and performance	This study advocates for research on sustainability accounting and accountability, focusing on engagement with organizations reporting on their sustainability performance. It highlights the gap in the current literature, which often ignores practical applications within organizations, and calls for more research to improve accounting systems and reduce sustainability impacts.	319

Source: Authors' own elaboration from Bibliometrix R-package (Biblioshiny).

3.3. Most Relevant Authors

Table 2 documents a short overview of prominent authors and their contributions to the existing literature on environmental accounting research. These authors have played

a prominent role in shaping the field of environmental accounting research with their synthesis and scholarly discussion on the matter. The authors have covered a wide range of topics, from how to report on environmental issues to challenges faced, governance on environmental accounting, and sustainability in business developments. The studies by [37,38] predominantly focus on how environmental issues can be incorporated into accounting practices and ultimately promote global reporting standards that could have positive social and environmental impacts. Refs. [39,40] discussed the real-life challenges faced by organizations in sustainability reporting and highlighted methodological problems and concerns in terms of measuring these environmental impacts. Refs. [36,41] studies focused on a very important domain of environmental accounting, i.e., how accounting could play a role in environmental governance and sustainability reporting. The authors highlight the importance of and the need to integrate ESG factors into corporate reporting and frameworks. Refs. [34,40], on the other hand, discussed the technical challenges of environmental accounting and how it could contribute towards sustainable development. Their work features how social and environmental accounting has evolved—moving from social and environmental issues to broader perspectives of global sustainability. Ultimately, these studies have highlighted the importance of thorough environmental oversight and accountability in business operations within traditional accounting. An important point to highlight is that most of the prominent authors in the field of environmental accounting are from Australia and Europe, highlighting the need for increased research contributions from other regions, as this area of study is crucial for global sustainability efforts.

Table 2. Prominent authors based on the number of publications of review-based studies between 1995 and 2024.

Authors	Affiliation	Country	Summary of Research Expertise
[37]	The Australian National University	Australia	Integration of environmental and sustainability considerations into accounting practices, emphasizing sustainable business practices and environmental stewardship.
[39]	University of South Australia	Australia	Sustainability accounting and reporting, addressing practical challenges in implementing sustainable practices and analyzing the effectiveness of different reporting mechanisms.
[38]	Macquarie University	Australia	Focused on the intersection of accounting and sustainability, critically examining how accounting practices can reflect environmental and social impacts and advocates for comprehensive reporting standards.
[41]	Universidad de Burgos	Spain	Examined the role of accounting in environmental governance and policy. His work involves case studies and empirical research on the use of accounting tools in environmental decision-making.
[36]	Durham University	United Kingdom	Investigated issues related to sustainability reporting and integrated reporting, advocating for the integration of environmental, social, and governance (ESG) factors into corporate reporting frameworks.
[40]	University of Alabama in Huntsville	United States	Explored the technical and practical aspects of environmental accounting, addressed the methodological challenges in measuring and reporting environmental impacts, and offered solutions for improved data accuracy.
[34]	University of St Andrews, Scotland	United Kingdom	Focused on the strategic role of accounting in promoting sustainable development and long-term environmental sustainability.

Source: Authors' own elaboration from Bibliometrix R-package (Biblioshiny).

3.4. Prominent Sources of Review-Based Studies on Environmental Accounting Between 1995 and 2024

Identifying prominent sources (journals) is important in bibliometric studies because it boosts the credibility and trustworthiness of current studies by linking them to reputable work published in reputable and established journals, ensuring that new research is based on a strong academic foundation. Table 3 shows the top sources in review-based envi-

ronmental accounting research, highlighting their significance based on the number of published documents. The *Accounting, Auditing & Accountability Journal* (ABDC—A*) is at the top with 16 publications, showing its importance in studying the association between accounting, auditing, and accountability with a strong focus on environmental accounting and sustainability. The *Sustainability* journal comes next with 10 publications; this journal is known for its approach to environmental, economic, and social sustainability from different multi-disciplinary perspectives. *Asian Review of Accounting*, *Journal of Accounting and Organizational Change*, *Journal of Cleaner Production*, and the *Sustainability Accounting, Management and Policy Journal* all have five publications, respectively. They offer important information via studies about how organizations adapt to and practice sustainability. These journals link accounting, management, and policies and demonstrate the consequences of sustainable practices and policy implications to all stakeholders. In contrast, *Corporate Social Responsibility and Environmental Management* and *Renewable and Sustainable Energy Reviews* each have four publications. These journals investigate and review articles published on social responsibility, corporate strategies, and renewable energy practices within the realm of accounting. The *Journal of Environmental Management*, with three publications, includes reviews discussing the importance of integrating environmental management into accounting systems. In conclusion, these journals demonstrate that environmental accounting is a complex and interdisciplinary field; it has great potential for rigorous studies from multiple perspectives and offers a strong foundation for further research and practical application.

Table 3. Prominent sources based on the number of publications of review-based studies between 1995 and 2023.

Sources	Articles	Publisher	ABDC	ABS
Accounting, Auditing & Accountability Journal	16	Emerald Publishing	A*	3
Sustainability (Switzerland)	10	MDPI	-	-
Asian Review of Accounting	5	Emerald Publishing	B	1
Journal Of Accounting and Organizational Change	5	Emerald Publishing	B	1
Journal Of Cleaner Production	5	Elsevier	A	2
Sustainability Accounting, Management and Policy Journal	5	Emerald Publishing	A	2
Corporate Social Responsibility and Environmental Management	4	Wiley	A	2
Renewable and Sustainable Energy Reviews	4	Elsevier	A*	3
Journal of Environmental Management	3	Elsevier	A*	3

Source: Authors' own elaboration from Bibliometrix R-package (Biblioshiny).

3.5. Trends Topics

The "Trends Topic" in Biblioshiny reveals the progression of key research areas over time within a specific research domain, thus assisting researchers in determining important trends and opportunities for further research. Figure 3 shows how review-based studies on environmental accounting have evolved (between 1998 and 2024), highlighting the dominant themes in specific periods.

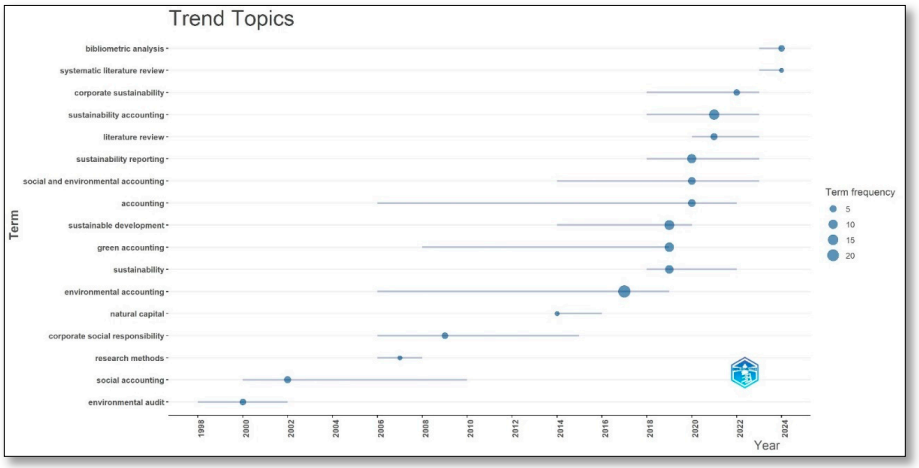

Figure 3. Trending topics of review-based studies on environmental accounting between 1995 and 2023. Source: Bibliometrix R-package (Biblioshiny).

From 1998 to 2004, most of the review-based studies on environmental accounting are related to research domains such as 'Environmental Audit' and 'Social Accounting'. Environmental audit was one of the initial topics, concentrating on how organizations performed environmentally, followed rules, and found ways to enhance environmental performance. Social accounting also became more popular during this time, blending social impacts with regular accounting practices. These themes started a new era of accounting, showing that people are beginning to see the importance of considering environmental and social aspects when making financial decisions. Thereafter, between 2005 and 2016, most of the review-based studies were focused on 'Corporate Social Responsibility (CSR)'. This era highlighted review studies on CSR and the importance of organizations taking responsibility for their impact on society and the environment. Terms like 'environmental accounting', 'social and environmental accounting', and 'green accounting' became widespread and continued to be prominent through 2022, reflecting increased global awareness of climate change, environmental degradation, and resource scarcity. Within this period, governments, businesses, and other stakeholders began to realize the importance of incorporating sustainability into economic systems to ensure that the environment and finances work hand in hand and stay solid in the long run.

The idea of 'Sustainability', including corporate sustainability, sustainability accounting, and sustainability reporting, became most important and prevalent between 2018 and 2022, during which time studies were focused on the long-term health of the environment, society, and economy. Another important area of review-based study was 'Sustainable Development', which strongly advocates that organizations incorporate sustainability principles into their operations. Reviews in this area indicate that there is a growing acknowledgment of the importance for companies to embrace thorough sustainability practices and openly disclose their environmental effects. This mirrors the wider societal trend towards sustainability and responsibility. Bringing together academic conversations on 'Social and Environmental Accounting' and 'Sustainability Reporting' has become more crucial, showing the importance of companies sharing their sustainability efforts and effects completely. Sustainability accounting and corporate sustainability are important topics that emphasize incorporating sustainability into key business plans. The growing use of terms like 'literature review' and 'systematic literature review' shows the field's dedication to combining current knowledge, recognizing research trends, highlighting research areas that need more exploration, and the influence of academic studies on environmental accounting.

3.6. Keyword Analysis

Figure 4 showcases keywords from the review-based articles on environmental accounting, with different colors representing distinct clusters or themes. Each color-coded cluster highlights a thematic focus within the broader field of environmental accounting.

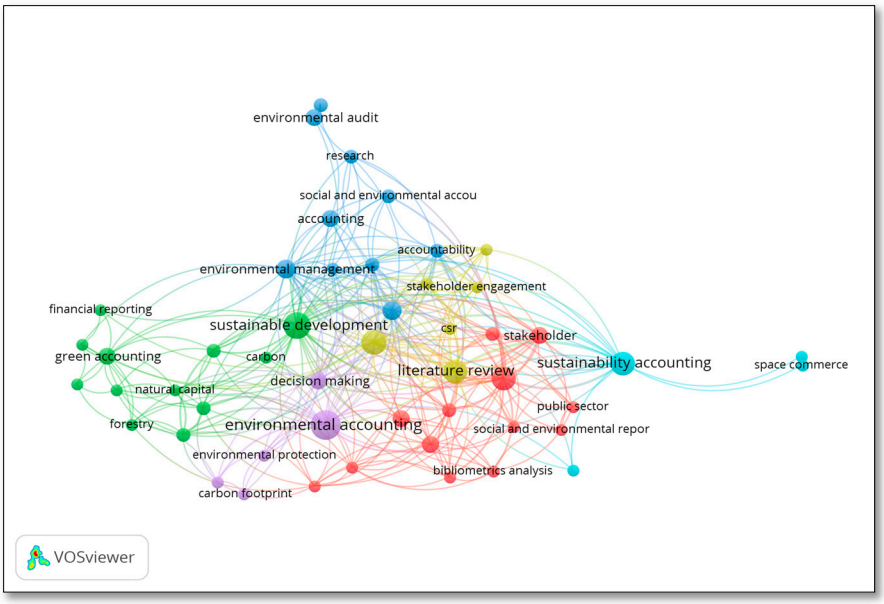

Figure 4. Keyword network of review-based studies on environmental accounting between 1995 and 2024. Source: Vosviewer.

3.6.1. Blue Cluster: Environmental Audits and Management

The interconnected keywords in the blue cluster suggest that this cluster seems to predominantly relate to review studies on the managerial aspects of environmental accounting: "environmental audit", "environmental management", "accountability", "social and environmental accounting", and "research". Environmental audits—systematic, independent evaluations of firms' compliance with environmental regulations and practices—act as a powerful and effective platform for environmental accounting governance [42], while environmental management relates to the integration of environmental matters into strategic planning and the eco-friendly management of resources. These operational initiatives are expected to minimize the destructive and harmful effects of business activities on the environment. The scholarly discussion under this cluster also includes the extent to which environmental audit processes and management practices co-exist and work together for these said purposes. This cluster also examines the effectiveness of environmental audits in assessing and ensuring corporations comply with environmental principles and sustainability objectives, acting with responsibility and transparency in all undertakings [43]. In addition to environmental audits, the cluster shows a strong link between environmental management and social and environmental accounting, indicating the prominence of integrating social aspects into regular environmental management [44]. This link could eventually contribute towards proper corporate reporting and sustainability. This integration is vital as it contributes towards holistic strategies affecting both environmental effects and social duties [36,45]. Thus, the integration of environmental audits, management, and social accounting into corporate governance enhances corporate accountability, fosters holistic sustainability strategies, and improves corporate reporting and compliance with environmental regulations. Policymakers should enforce mandatory environmental audits, particularly for high-impact industries, to ensure compliance with environmental regulations and promote transparent sustainability reporting. Additionally, they should incentivize businesses to adopt integrated reporting frameworks that combine financial, environmental, and social accounting through tax incentives or subsidies. Business lead-

ers can further enhance sustainability efforts by fostering cross-sector collaboration with environmental experts, regulators, and stakeholders, with policymakers facilitating such partnerships by creating platforms for knowledge sharing and cooperation.

Potential research directions include the following:

1. Investigating how environmental audits help companies improve their corporate governance and how this affects management practices across multiple industries and regions.
2. Examining the challenges and benefits of incorporating social and environmental accounting in developing countries, with a focus on environmental audits.
3. Examining the possibilities and effectiveness of using technology-based digital auditing and blockchain technology in environmental audits and environmental management.

3.6.2. Green Cluster: Green Accounting, Financial Reporting, and Sustainable Development

The keywords in the green cluster include "green accounting", "financial reporting", "sustainable development", "natural capital", "carbon", "forestry", and "decision making". Based on these keywords, this cluster seems to focus on the association between green accounting, financial reporting, and sustainable development. Natural capital is an important keyword in this cluster, encompassing the Earth's natural resources, such as geology, soil, air, water, and living organisms [46,47]. The associated keywords in this cluster suggest the importance of using green accounting, i.e., the efficient utilization of natural capital, carbon, and forestry resources, and ensuring proper financial reporting and sustainable development [48,49]. Authors have also discussed the importance of environmental costs in addition to traditional financial metrics through green accounting [33,35]. This could ensure corporate practices are in line with sustainable development goals [50–52] and that all environmental processes are disclosed [53]. It also involves reviews on how companies could measure and report their carbon footprints so that they can better manage and lessen their environmental impacts to meet global climate goals [54]. Determinants of environmental disclosures are also reviewed, including regulatory requirements, societal pressure, firm characteristics, and culture [55].

The implication of integrating green accounting into financial reporting is that businesses can enhance transparency regarding their environmental impact, improve resource efficiency, reduce carbon emissions, and align their operations with global sustainability goals. This also positions companies to meet regulatory requirements, build trust with stakeholders, and drive long-term sustainability by making informed, environmentally conscious decisions. Policymakers should implement regulations requiring businesses to integrate green accounting into their financial reporting to ensure transparency in natural resource utilization and carbon emissions. They should also promote incentives, such as tax reductions or subsidies, for companies that actively manage and report their environmental impacts. Business leaders should focus on embedding sustainability into their decision-making processes by adopting comprehensive green accounting practices that track natural capital usage, carbon footprints, and environmental costs, while working with policymakers to develop sector-specific sustainability guidelines.

Possible areas for future research include the following:

1. Examining how corporate culture, tone from the top, and stakeholder engagement can affect the adoption of green accounting in emerging markets.
2. A comparative study between developed and emerging markets on how green accounting techniques can improve the overall financial and non-financial efforts of businesses operating in different sectors (especially with high environmental impacts).
3. Examining how new technologies such as blockchain, AI, and big data analytics can improve the accuracy and transparency of environmental reports and carbon footprint tracking.

3.6.3. Yellow Cluster: CSR, Stakeholder Engagement, and Accountability

Keywords in the yellow cluster include "CSR" (corporate social responsibility), "stakeholder engagement", and "accountability". Accounting journals have focused broadly on sustainability themes like CSR and stakeholder theory [56]. Review articles in this cluster also highlight the importance of stakeholders' engagement in influencing a company's CSR efforts, especially when it comes to being accountable for environment-related concerns [52,57,58]. Studies indicate that stakeholders—such as consumers, investors, employees, and communities—are increasingly demanding greater transparency from organizations about their environmental and social practices. Therefore, companies are using CSR initiatives to meet stakeholder expectations and integrate sustainability strategies [37,59]. This means that businesses are not only focusing on environmental impacts, but also on building trust and improving their social license to operate by engaging with stakeholders and being accountable for their actions [36,60] Thus, policymakers should establish clear guidelines for CSR reporting and stakeholder engagement, ensuring that businesses are held accountable for both social and environmental impacts, while providing incentives for those that demonstrate meaningful CSR efforts. Business leaders should prioritize transparent communication with stakeholders by integrating CSR into their core strategies, regularly reporting on social and environmental performance, and actively engaging stakeholders to foster trust and align business practices with societal and environmental expectations.

Potential research directions include the following:

1. Investigating how technology, digital platforms, and social media could reform stakeholder engagement in CSR initiatives, mainly in terms of improving transparency and accountability for environmental practices.
2. A comparative study across industries on the effectiveness of stakeholder engagement and CSR, its environmental impact, challenges, and adaptation strategies.
3. Examining the long-term influence of stakeholder pressure on the evolution of corporate environmental strategies, assessing whether responsive CSR practices lead to more sustainable outcomes and resilience.

3.6.4. Purple Cluster: Environmental Accounting and Protection

The main interconnected keywords in this cluster include "environmental accounting", "carbon footprint", and "environmental protection". This cluster emphasizes "environmental accounting" as a central theme and an emerging area of research [61,62], with closely related topics like carbon footprint, climate change, and environmental protection also mentioned. Studies document that environmental accounting can be viewed based on three perspectives: pollution and environmental protection cost [33,63], natural resource asset tracing, and environmentally adapted macroeconomic markers [64]. This cluster highlights the technical side of environmental accounting, including measuring and reporting environmental impacts (such as carbon footprints), factors contributing to carbon emissions (such as economic growth patterns, energy consumption trends, and environmental regulations) [65], and climate change [66]. The reviews discuss ways to measure greenhouse gas emissions and how they affect a company's sustainability. It is believed that accounting can help protect the environment and promote sustainability in both the public and private sectors. Specifically, in the public sector, reviews report that research within this domain is still emerging, as most studies are concentrating mainly on the purpose or motivation of reporting and reporting frameworks. This cluster's attention to carbon footprint-related reviews shows a continued interest in creating better ways to measure greenhouse gas emissions and their impact on a company's sustainability [63,67,68]. Furthermore, combining environmental protection with accounting practices highlights the importance of accounting in promoting environmental sustainability. Sustainability accounting in general terms and reporting corporate effects are also reviewed under this cluster [69]. Thus, the implication of integrating environmental accounting with carbon footprint tracking and sustainability reporting is that businesses can now measure their environmental impact

more accurately, comply with regulations, and contribute to long-term environmental protection while fostering greater transparency and accountability in both the public and private sectors. Policymakers should establish standardized frameworks for environmental accounting to ensure the consistent measurement and reporting of carbon emissions and other environmental impacts across industries, while offering incentives for businesses that implement robust sustainability practices. Business leaders should integrate environmental accounting into their decision-making processes to better track their carbon footprints, comply with environmental regulations, and enhance their sustainability initiatives, while collaborating with regulators to develop sector-specific sustainability strategies that align with national and global climate goals.

Potential research directions include the following:

1. Examining how carbon accounting could assist companies to make eco-friendly strategies and lower their carbon footprints.
2. Investigating how environmental accounting practices influence corporate compliance with environmental regulations across industries and regions.
3. Examining the possibilities of how environmental accounting could enhance environmental protection efforts, particularly in environmentally unfriendly industries. A comparison could be initiated between developed and developing countries.

Finally, the red cluster is not discussed in detail as its main keywords are stakeholders and social and environmental reporting. These two keywords have been discussed in detail under the yellow and blue clusters, respectively. Additionally, keywords such as literature review and bibliometric analysis are too generic and are found in all other clusters as well.

In general, all these clusters prove the extent of the complexity and inter-connectedness of research within the domain of environmental accounting. Though each cluster seems to be relatively specific within the domain of environmental accounting, the ultimate conclusion that can be derived is the fact that environmental accounting research is evolving and covering broader aspects of accounting in general. Also, there appears to be an integration of several other inter-connected issues, such as social, environmental, financial, legitimacy, regulation, cultural, and institutional aspects. This is mainly because comprehensive frameworks are needed to tackle the global sustainability issues currently faced. The ideas for possible research in each cluster pave ways to further develop the field of environmental accounting and identify new solutions for sustainability problems. To surmise, the clusters show important topics in environmental accounting: the blue cluster looks at environmental audits and management for accountability; the green cluster focuses on green accounting, financial reporting, and sustainable development; the yellow cluster highlights CSR and stakeholder engagements within the realm of environmental accounting; and the purple cluster emphasizes the technical side of accounting in terms of environmental protection and carbon impact.

4. Conclusions

In summary, this meta-synthesis on environmental accounting uses a bibliometric analysis to combine the current review-based literature and highlight the evolution of environmental accounting and emerging related topics. The research shows that environmental accounting and its related issues are now crucial and at the forefront of the sector because of the increasing concerns about environmental sustainability and stakeholders' expectations. By following the PRISMA guidelines and using the appropriate tools [Bibliometrix R-package (Biblioshiny) and VOSviewer], the researchers were able to analyze publication trends, prominent authors, research articles, sources, and emerging themes for the meta-synthesis of environmental accounting review-based studies. The study found that there has been a surge in review-based studies on environmental accounting since 2022, mainly because of global sustainability efforts and the fact that environmental accounting covers broader aspects within the realm of accounting.

This study also highlights the significant contributions from leading journals, such as the *Accounting, Auditing & Accountability Journal*, *Asian Review of Accounting*, *Journal of*

Accounting and Organizational Change, *Journal of Cleaner Production*, *Sustainability Accounting*, *Management and Policy Journal*, and the *Sustainability* journal. The findings also recognize the influential work of prominent authors like [37,39] The main clusters or themes identified are as follows:

- The blue cluster focuses on environmental audits and management, highlighting the role of audits in ensuring governance, accountability, and compliance with sustainability goals. It also considers integrating social dimensions into environmental management frameworks.
- The green cluster centers on green accounting, financial reporting, and sustainable development, emphasizing the valuation of natural capital, carbon footprints, and the role of accounting in supporting sustainability initiatives.
- The yellow cluster highlights CSR (corporate social responsibility) and stakeholder engagement, focusing on how stakeholder demands drive corporate accountability and influence sustainability practices.
- The purple cluster emphasizes environmental accounting and protection, with a focus on carbon accounting, environmental protection efforts, and the incorporation of environmental costs into financial decision-making.

In summary, this research gives important information about how environmental accounting has evolved, where it stands now, and its future directions. It shows the importance of comprehensive reviews in synthesizing existing research, identifying trends, and addressing research gaps. The outcome of the meta-synthesis is envisioned to provide valuable insights and guidelines to all stakeholders on sustainable accounting across industries and regions. It could also help organizations follow global sustainability objectives and make better decisions by including sustainability in their business plans, supporting eco-friendly actions, and making better use of resources. It could encourage businesses to measure and report on environmental costs and impacts. The findings of the study could also benefit regulators in terms of designing unified and comprehensive reporting standards, incorporating and ensuring companies' compliance with environmental laws. As for investors and consumers, the adoption of environmental accounting by organizations provides transparency, allowing them to make informed decisions about a company's corporate responsibility and sustainability efforts. This encourages businesses to be more accountable and align with global sustainability goals. With the current surge in sustainability awareness and initiatives worldwide, environmental accounting is set to advance and make bigger impacts, driven by ongoing innovation and interdisciplinary collaboration. A more concerted effort by all stakeholders to adopt environmental accounting procedures and integrate them into decision-making processes will enable organizations to not only track and report their environmental impact more transparently, but also drive sustainable business practices, reduce ecological footprints, and foster long-term economic and environmental resilience.

To conclude, the findings from the meta-synthesis of environmental accounting justify the research questions posed in the study. RQ1, regarding publication trends, was validated by identifying a notable rise in review-based studies on environmental accounting, particularly since 2022, with key contributions from prominent journals, authors, and articles. RQ2 was answered with the exploration of major themes, highlighting crucial clusters such as environmental audits, green accounting, and corporate social responsibility. Lastly, RQ3, focused on practical implications and potential future research; we identified emerging areas like carbon accounting and the integration of technology, confirming promising avenues for further exploration in the field. These findings validate the study's objectives and emphasize the importance of continued research in this field.

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