A BIBLIOMETRIC ANALYSIS OF GREEN ACCOUNTING RESEARCH

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ABSTRACT

The primary goal of green accounting is to address social issues impacting global sustainable development and to influence corporate actions towards social and environmental concerns. This research aims to map the concept of green accounting and describe its impact on science. This research is a literature review using bibliometrics. Bibliometrics helps map research related to developing green accounting research trends published by leading journals from 1992 to 2023, which have been indexed by Scopus as many as 233 articles, using VosViewer software. The analysis is focused on keyword trends, authors, and institutions. The results show that the number of articles discussing the theme of green accounting has been increasing yearly, which aligns with the development of economics and the environment. The most popular keywords are sustainable development, environmental management, and environmental economics. The most published writer is Markandya. Meanwhile, the most popular organization is Fondazione Eni Enrico Mattei (FEEM). This study provides valuable insights for researchers focusing on green accounting. Therefore, this theme has the potential to be further developed in the future.

Keywords: green accounting, bibliometric, systematic review.

INTRODUCTION

Agriculture, environment, and economy are complementary issues in developing countries, with environmental issues affecting human health, productivity, and the future of natural resource bases (Gürlük and Karaer 2003). This complex interplay underscores the critical role of green accounting in promoting sustainable development. As stated in the word of Allah, surah an-Naml verses 61: *"Or, who made the earth habitable, and made rivers flow through it, and set mountains on it, and placed a partition between the two seas? Is there another god with God? But most of them do not know"*. This verse highlights Allah's role in establishing a balanced and habitable human environment. It emphasizes the importance of utilizing natural resources responsibly and sustainably, aligning with the goals of green accounting (Wiredu, Osei Agyemang, and Agbadzidah 2023).

Green accounting offers a framework for integrating environmental considerations into economic decision-making. Quantifying environmental costs and benefits associated with agricultural practices provides valuable insights for optimizing resource use, minimizing waste, and reducing ecological impact (Sudarminto and Harto 2023). Increased energy efficiency can reduce environmental impact by reducing energy losses and waste energy emissions, with potential applications in addressing and solving environmental problems (Rosen and Dincer 1997). This benefits the environment and translates into cost savings and resource optimization for agricultural businesses.

Furthermore, green accounting fosters organizational transparency and accountability regarding environmental performance. This aligns with individual concerns and values often present in developing countries, as highlighted by Bansal (2003). With access to transparent environmental data, stakeholders like investors, consumers, and regulators can make informed decisions prioritizing economic profitability and environmental responsibility (Matakanye, van der Poll, and Muchara 2021). This shift in decision-making driven by green accounting ultimately paves the way for a more sustainable future where agricultural practices, environmental well-being, and economic prosperity coexist (Bansal 2003).

Green accounting, also known as environmental accounting or sustainable accounting, is a framework for integrating environmental considerations into traditional financial practices (Indarto and Ani 2023). It recognizes the environmental impact of businesses and organizations and aims to measure and manage it alongside financial performance (Ariyani, Astuti, and Candraningtyas 2023). This includes accounting for environmental costs like pollution, resource depletion, and emissions and valuing environmental assets like clean air, water, biodiversity, and natural resources (Pirmana et al. 2021).

Green accounting practices include reducing carbon emissions, using natural resources efficiently, and managing industrial waste effectively (Syamlan and Mukhlisin 2020; Sudarminto and Harto 2023). Companies adopting these practices often benefit from improved reputation, operational efficiency, and competitive advantage (Dunakhir 2022). Green accounting also provides transparency into which companies contribute positively or negatively to the environment (Sulistiyana, Sari, and Pandin 2023). With technological advancements, stricter regulations, and growing public awareness of environmental issues, green accounting practices are expected to remain essential to sustainable business strategies (Sudarminto and Harto 2023).

Green national accounting offers methods for measuring welfare equivalent income, sustainable income, and gross social profit. In this context, Green NNP equals wealth equivalent income under constant interest rates or consumption (Asheim 2000). Implementing green accounting in mining can improve resource and environmental accounting, with defensive expenditures contributing to green NNP and resource depreciation being a charge against GNP (Cairns 2004). While environmental accounts play a crucial role in supporting organizations' environmental agendas and shaping how we understand the natural environment, conventional accounting practices offer limited positive influence in this process (Gray et al. 1995). Green national accounting initiatives require a comprehensive set of indicators, including both economic and biophysical measures, to effectively convey a nation's sustainable development performance (Lawn 2007). Extended national accounts that assess the environmental sustainability of economic activity by calculating the cost of natural capital consumption can potentially lead to more prudent and sustainable economic policies (Bartelmus 2009).

Green accounting research, environmental awareness, and climate change are increasingly important in the modern era. This research helps companies measure and manage their environmental impact, promote sustainable business practices, and contribute to climate change mitigation efforts. Eck and Waltman

(2007) define bibliometrics as the study of the production and dissemination of information, and this method has been used to map Green Accounting research trends. Some examples of previous green accounting bibliometric research include Nidhi and Anand (2022), who analyzed long-term trends using Scopus, focusing on information disclosure practices. Dermawan, Kusmayadi, and Firmansyah (2023) mapped future research using dimension.ai, focusing on popular research topics, clusters, and implications. Dwianika et al. (2024) analyzed recent Scopus research, focusing on leading journals and authors, research trends, and research themes. This research has differences in research period, data sources, and analysis focus. The relevance of the green accounting phenomenon prompted us to conduct research in bibliometric analysis. This research aims to map published trends in green accounting using the VosViewer, and mapping will focus on authors, institutions, and countries.

Understanding these green accounting research trends is essential to identify areas requiring further research and to inform the development of future green accounting practices. Mukhlisin et al. (2020) suggest that future studies should emphasize the significance of key themes such as "access to clean water and sanitation, affordable and clean energy, sustainable urban development, responsible consumption and production, climate action, preservation of marine life, and conservation of terrestrial ecosystems" in advancing sustainable development goals (SDGs). This aligns with the principles of Islam (Maqashid Sharia), which include promoting environmental protection as one of its objectives. Environmental protection, included in the green accounting studies, is a part of *hifdzul bi'ah* or *hifdzul' alam* (Al-Qardhawi 2001). The results of this research will help researchers, practitioners, and other stakeholders contribute to a more sustainable future.

LITERATURE REVIEW

Green accounting focuses on identifying, measuring, assessing, and disclosing costs associated with a company's environmental activities (Rounaghi 2019). It is also known as environmental accounting or sustainable accounting. Green accounting is an accounting system that considers the environmental costs of a company's activities and reflects them in financial statements (Tu and Huang 2019). Green accounting is an integrated process of recognizing, valuing, recording, summarizing, reporting, and disclosing financial, social, and environmental objects, transactions, or events in the accounting process to produce financial, social, and environmental accounting information that is complete, integrated, and relevant to users for decision-making and management of economic and non-economic (Lako 2018). Green accounting expands and refines the accounting system related to the use of natural resources in the production process and final demand, as well as the impact of changes in environmental quality due to pollution and other effects associated with production, consumption, and natural events (Ferieka, Meutia, and Taqi 2022).

It is important to emphasize that green accounting is intended to implement the company's environmental and social responsibility to meet the welfare of the stakeholders and parties involved (Albastiah and Sisdianto 2022). Welfare is guided by the values of faith in Maqashid Sharia (Alwi et al. 2022).

Maqashid Sharia theory suggests that green accounting safeguards property, religion, the soul, the mind, and future generations. These goals are similar to those of Maqashid Sharia (Erianto, Hasibuan, and Nurlaila 2023). In addition, with the industry's technology development, green accounting has become an essential thing for institutions to implement. This supports the sustainable development program or SDGs (Sari et al. 2023).

Green accounting is a growing field of accounting that is becoming increasingly important as businesses and governments seek to address the challenges of climate change and environmental sustainability (Singh et al. 2019). By incorporating environmental costs into their financial reporting, companies can provide a more accurate picture of their environmental impact (Bernardi and Stark 2018). This information can be used to make more informed decisions about environmental management and to improve the company's environmental performance (Hartmann and Vachon 2018).

Green accounting can be applied to large and small companies in various industries and the manufacturing or service sectors (Byzzanthi and Ermawati 2021). Green accounting can be systematically applied on a large or smaller scale for the required basis. It is undeniable that to build an optimal environmental accounting system in a country, accountants have the potential to be a powerful tool for governments in controlling economic and financial aspects (Le, Nguyen, and Phan 2019). To achieve this goal, it is important to carefully identify and define the goals and tasks of environmental accounting and to conceptualize and codify standards, rules, and criteria based on reasonable and practical principles (Rounaghi 2019).

To improve environmental accounting practices, companies apply the concept of Triple Bottom Line Accounting (TBLA). TBLA has three main aspects, namely social sustainability (people), profitability (profit), and environmental impact (environment), which have become the company's focus (Arowoshegbe and Emmanuel 2016) . The "people" aspect emphasizes the human aspect that the company manages, "profit" reflects the company's ability to achieve profits, and "environment" reflects the company's relationship with its surrounding environment, including air quality, water, and biodiversity (Taqi et al. 2021).

METHOD

Bibliometrics is a well-established method for examining large sets of scientific data. This technique helps understand how a field develops over time, including the emergence of new research areas. While bibliometrics is a staple in scientific research, its application in business studies is still novel and often needs full development (Donthu et al. 2021). This research is a literature review using bibliometrics, specifically focusing on how it can be used to analyze the concept of green accounting. Bibliometric analysis to explore how green accounting research has evolved involved searching Scopus, a central academic database, for articles containing the term "green accounting" published between 1992 and 2023. This search yielded 233 publications. To visualize trends in research topics, authorship, and institutional affiliation, used specialized software called VosViewer.

VOSviewer is freely available software designed explicitly for bibliometric analysis (https://www.vosviewer.com/). VOSviewer excels at creating visual maps depicting connections between research elements. Can generate maps based on citations (linking authors or journals) or co-occurrences (linking keywords) to see how different research topics, authors, and institutions are interrelated within green accounting. VosViewer uses VOS mapping (where VOS stands for Visualization of Similarities) to create informative research maps. It can display maps built using this technique or other well-established methods like multidimensional scaling. The key takeaway is that VOSviewer offers researchers flexibility in visualizing connections within data.

RESULTS AND DISCUSSIONS

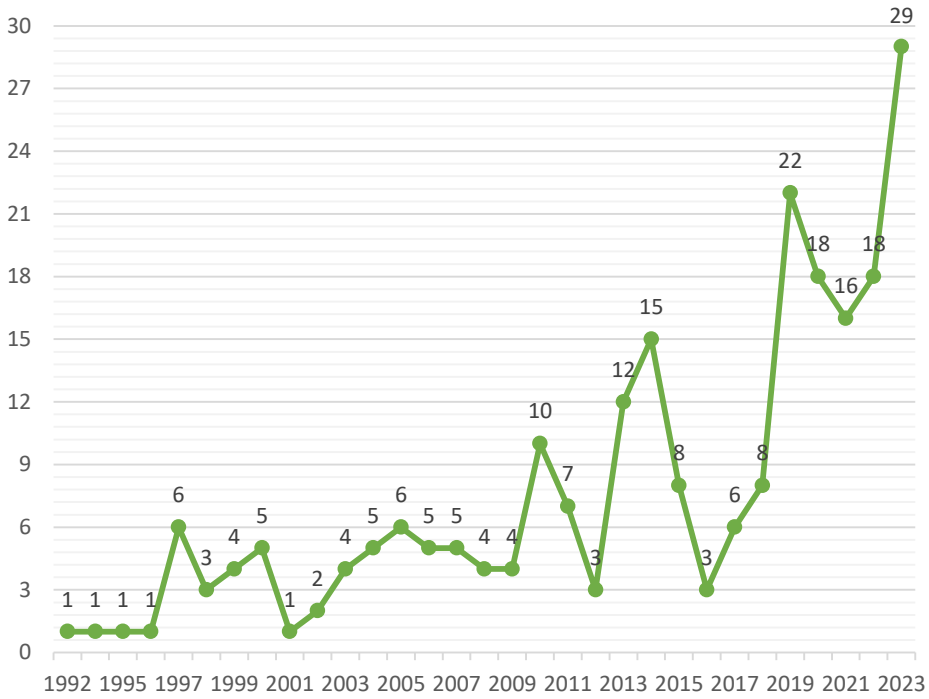

Figure 1 Quantity of Publications
Source: secondary data (processed, 2023)

This section explores the volume of research on green accounting. As shown in Figure 1, Scopus data reveals a growing trend in publications on this theme. Over the 31 years (1992-2023), 233 articles were published. The annual distribution of papers varied significantly, ranging from 1 to 29. Notably, 2023 and 2019 witnessed the highest publication output, with 29 and 22 articles, respectively. It is interesting to note that Scopus didn't show any indexed publications for green accounting in 1993.

Bibliometrics is a powerful approach that analyzes scientific output like articles, publications, citations, and patents. This analysis involves calculations and statistics to assess research activity. It is valuable for evaluating researchers, labs, scientific fields, and a country's overall research performance. This report will first explore the history of bibliometrics and then delve into the critical databases and indicators used in this field. This section details the key findings

from our 233 green accounting articles analysis and a visual map to represent the keyword analysis results. This map identifies and connects important or unique terms frequently appearing in these articles. Visualizing these connections can help gain valuable insights into the knowledge structure of green accounting research. The map is used to see the key themes, how they relate, and how they evolve. Science mapping is a technique for visualizing the scientific domain associated with bibliometrics. The process of doing this visualization involves making a landscape map that may show scientific subjects.

Co-authorship analysis is a technique used to analyze the relationship between two or more authors based on the number of co-authored documents. In this analysis, the results of VosViewer software processing display bibliometric mapping in Figure 2.

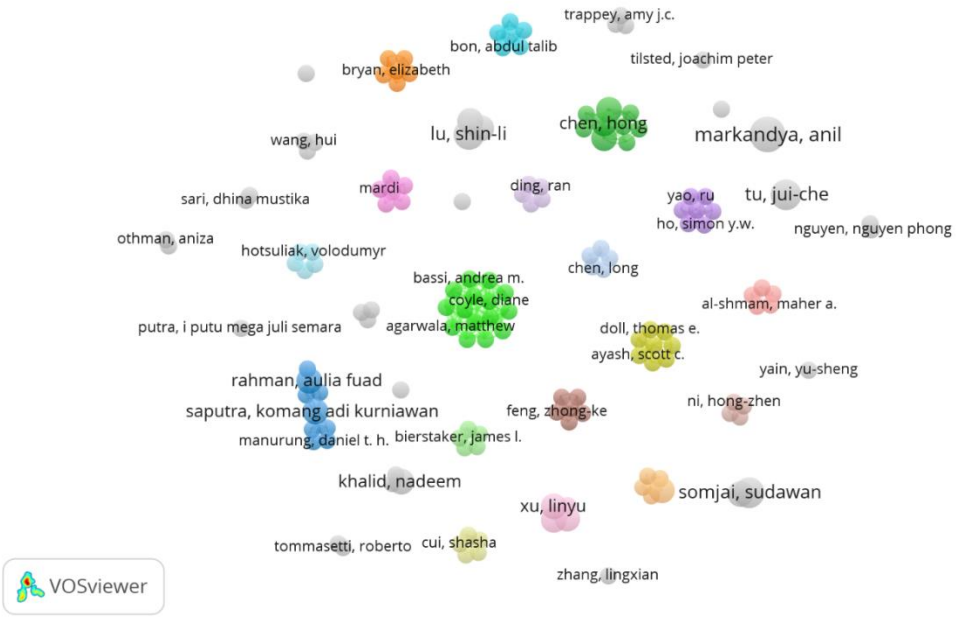

Figure 2 Co-Authorship Authors
Source: secondary data (processed, 2023)

Figure 2 shows the author's name in a coloured circle according to the co-author type or more, usually referred to as a network visualization. Authors who collaborate are indicated by the same colour and separated by a line. The circle size also indicates the number of articles the author has written. The author's number of publications increases with the size of the circle. The above data indicate that authors with more prominent names have published more articles. Based on the bibliometric mapping, it is evident that Markandya, who titled his work "Green Accounting in Europe", has produced the most significant number of publications on green accounting, Lu and Somjai, with 38 clusters and 150 interconnected author items. The authors carried out individual research, as indicated by grey-circled writers not connected to other circles. It is also known from these results that the largest cluster is the green-coloured cluster with 15 authors.

Table 1 List of Top 10 Citations

No	Authors	Title	Citations
1	Owen, Gray, and Bebbington (1997)	Green Accounting: Cosmetic Irrelevance or Radical Agenda for Change?	137
2	Burritt (2004)	Environmental management accounting: Roadblocks on the way to the green and pleasant land	121
3	Ng (2018)	From sustainability accounting to a green financing system: Institutional legitimacy and market heterogeneity in a global financial centre	108
4	Halberg, Verschuur, and Goodlass (2005)	Farm level environmental indicators; are they useful? An overview of green accounting systems for European farms	105
5	Gray and Laughlin (2012)	It was 20 years ago today: Sgt Pepper, Accounting, Auditing &Accountability Journal, green accounting and the Blue Meanies	97
6	Rodrigues, Gupta, and Mendiondo (2014)	A blue/green water-based accounting framework for assessment of water security	96
7	Vaio and Varriale (2018)	Management innovation for environmental sustainability in seaports: Managerial accounting instruments and training for competitive green ports beyond the regulations	91
8	Rubenstein (1992)	Bridging the gap between green accounting and black ink	90
9	Li and Fang (2014)	Global mapping and estimation of ecosystem services values and gross domestic product: A spatially explicit integration of national 'green GDP' accounting	74
10	Aronsson, Johansson, and Löfgren (1997)	Welfare measurement, sustainability and green national accounting: a growth theoretical approach	73

Source: secondary data (processed, 2023)

Table 1 shows the ranking of the top 10 papers by total citations from publication to the current study. The highest ranked, with a total of 137 citations, is the article by Owen, Gray, and Bebbington (1997) entitled “Green Accounting: Cosmetic Irrelevance or Radical Agenda for Change?”. Then, in the second position, with 121 citations written by Burritt (2004) in an article entitled “Environmental Management Accounting: Roadblocks on the Way to the Green and Pleasant Land”. Third, with 108 citations, is a paper written by Ng (2018)

titled “From Sustainability Accounting to a Green Financing System: Institutional Legitimacy and Market Heterogeneity in a Global Financial Center”. This analysis of green accounting research reveals a compelling field worthy of further exploration. The high number of citations to previous works in recent studies suggests a strong foundation and ongoing development in this area. In other words, green accounting is a dynamic field with a rich history that continues to be actively built upon.

The co-authorship organization is a type of analysis determined by the number of documents co-authored by the author, which provides an overview of the institution that acts as a platform for the author in his research. The co-authorship results show the organization that wrote the most publications.

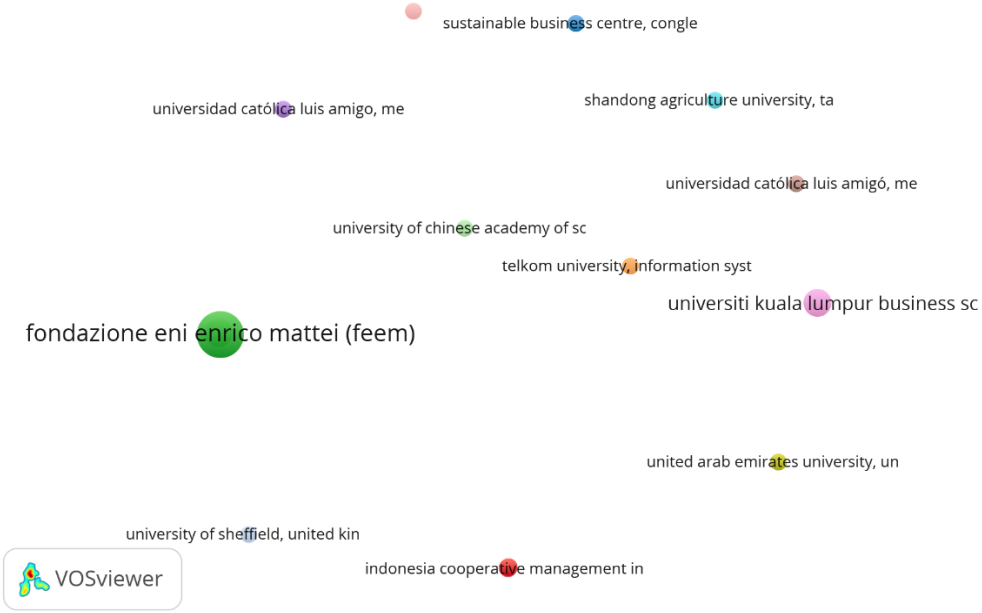

Figure 3 Co-Authorship Organization
Source: secondary data (processed, 2023)

To see how productive an institution is in contributing to a journal, one can see from the bright and large circles. Meanwhile, to see the most prominent institution, we can count the number of publications and the number of links to other institutions, where an author can write many papers in different journals. The most famous institution category can be seen based on the most popular institution and the largest institution. The results of VosViewer mapping show that the ranking of the most famous institutions or organizations is the Fondazione Eni Enrico Mattei (FEEM).

Based on the 381 existing organizations grouped into 200 existing clusters, five organizations, including Fondazione Eni Enrico Mattei (FEEM), the University Of Bath, the University Kuala Lumpur Business School, Basque Centre For Climate Change, and the University Of Sheffield, are the organizations that collaborate with the most in writing papers with the theme of green accounting. This shows that authors from various institutions in various countries publish green accounting studies. Hence, green accounting is quite popular among researchers and experts in various parts of the world.

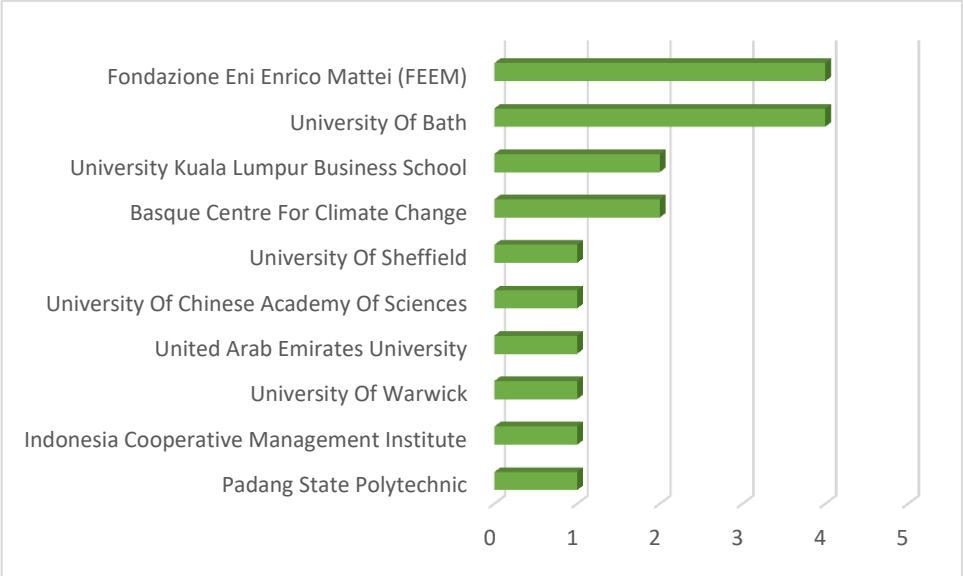

Figure 4 Top 10 Author's Affiliation of Green Accounting Publications
Source: secondary data (processed, 2023)

Furthermore, the visualization of journal publisher mapping is depicted in Figure 5, bibliometrics of journal sources. Based on this figure, we can see several country clusters that appear to publish the most articles with the theme of green accounting.

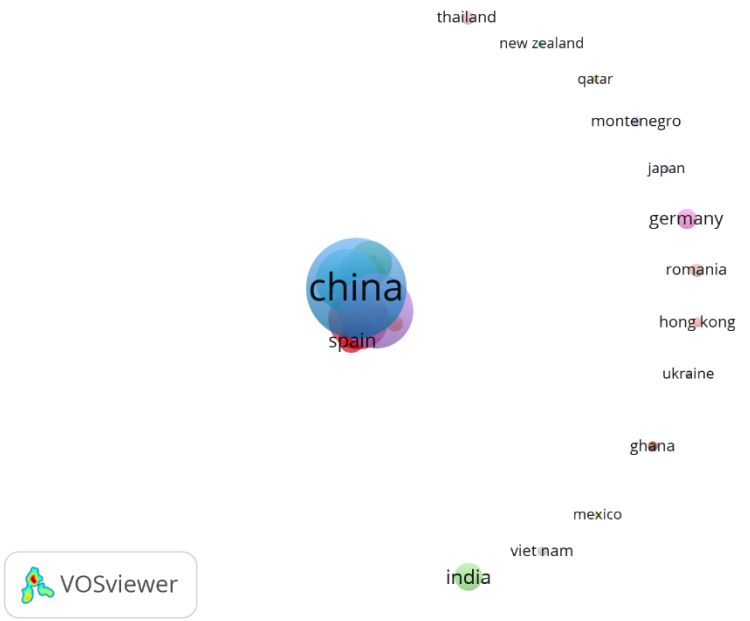

Figure 5 Co-Authorship Countries
Source: secondary data (processed, 2023)

Based on Figure 5, the larger the circle of the publishing country, the more papers the country publishes. It can be seen that China has the brightest light. This means that China publishes the most-green accounting-themed papers compared to other countries.

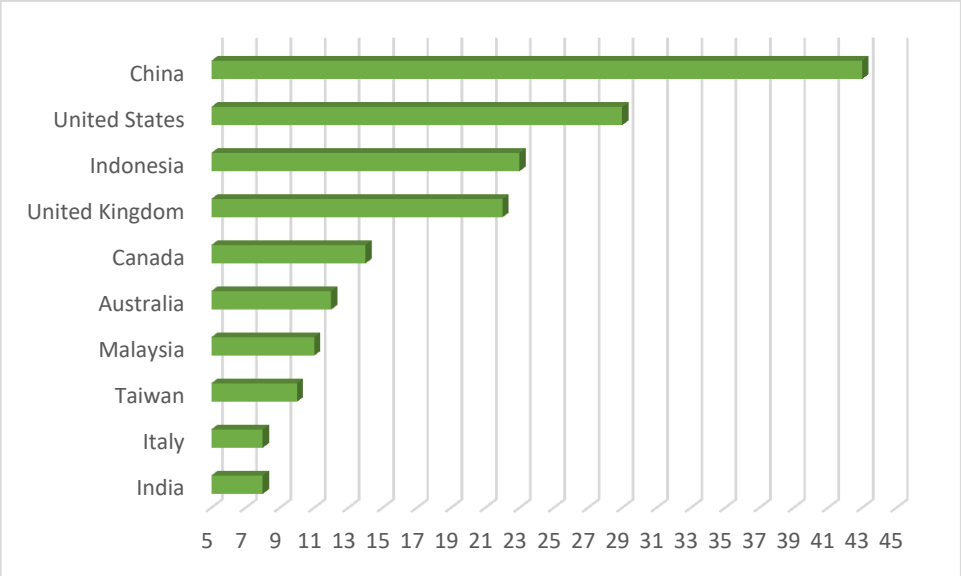

Figure 6 Top 10 Countries of Green Accounting Publications
Source: secondary data (processed, 2023)

Figure 5 and Figure 6 show that out of 45 countries, 20 clusters are the most extensive set of interconnected items. This means that these countries collaborate in publishing papers. One of the most popular countries is China, in the middle position among 45 countries. The results show that authors from China collaborate extensively in producing green accounting-themed papers with authors from other listed countries, namely Australia, Indonesia, Malaysia, and Taiwan. It can also be concluded that China (43) and the United States (29) are classified as active in journalism but do not collaborate. Countries such as Germany, Hong Kong, India, and others are not interconnected.

This study also employed VosViewer to identify the most frequently used keywords within green accounting research. These keywords are visualized in a map (see Figure 7). The size of each keyword corresponds to its prevalence; more prominent keywords appear more often in green accounting articles. This map provides a snapshot of the key themes and concepts that dominate current research in this field. This data allows us to track keyword trends used for green accounting research. The bibliometric analysis reveals keywords that are currently popular within the field. The prevalence of a keyword is reflected by the size of its circle on the map. Larger circles indicate more frequent use. Additionally, the lines connecting keywords show how related they are to each other, providing insight into the overall structure and emerging research areas within green accounting.

Based on Figure 7, the analysis results using VosViewer on green accounting-themed keywords show that there are many clusters that are interrelated with other keywords. Keywords that have the same color indicate a very close relationship. The most widely used keywords in green accounting-themed journals are *sustainable development*, *environmental management* and *environmental economics*.

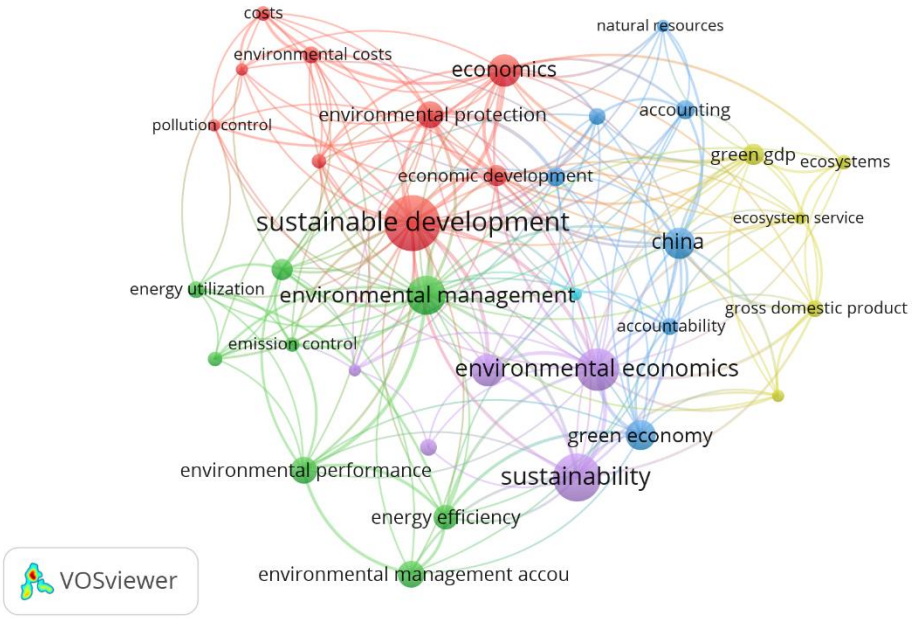

Figure 7 Co-Occurrences All Keywords
Source: secondary data (processed, 2023)

Sorted from the 50 keywords retrieved, the following keywords that frequently appear in green accounting-themed papers published on November 2, 2023, are displayed and their relationship with other keywords in 3 clusters, namely: Red cluster 1 consists of 9 keywords namely: cost-benefit analysis, cost, economic development, economics, environmental accounting, environmental cost, environmental protection, pollution control, sustainable development. All these words are closely interrelated in achieving sustainable development. Benefit-cost analysis, environmental accounting, pollution control, and environmental protection are tools that can help achieve a balance between the economy and the environment.

Green cluster 2 consists of 8 keywords: emission control, energy efficiency, energy utilization, environmental impact, environmental management, environmental management accounting, environmental performance, and renewable energy resources. The interrelationship between these words shows that effective environmental management requires emission control, energy efficiency, renewable energy utilization, environmental management accounting, and renewable energy resources. By implementing this comprehensive strategy, companies and individuals can reduce their environmental impact and build a more sustainable future.

Blue cluster 3 consists of 7 keywords: accountability, accounting, accounting system, China, environmental policy, green economy, and natural resources. The interrelationship between these words shows that environmental accounting plays a vital role in promoting accountability, providing information in policy-making, and encouraging the transition to a more environmentally friendly economy in a country.

Based on Figure 7, the most frequently used word is sustainable development. An example of a related article that uses this term is by Nguyen, Ha,

and Tran (2023) titled "Determinants Influencing The Application Of Green Accounting: The Case Of Emerging Market Construction Firms". This study investigates green accounting, a tool that measures environmental impact, in Vietnamese construction firms. The researchers surveyed managers and accountants in 243 firms to identify factors influencing the application of green accounting. The analysis revealed five key determinants: staff and resources, legal and regulatory structure, customer demand, educational and legal systems, stakeholder pressure, managerial perceptions, and internal resources. The findings of this study aim to provide information to businesses and government agencies on how to address these factors and promote the use of green accounting in Vietnam's construction industry.

Green accounting has recently gained significant attention as a tool to address environmental and social issues and promote sustainable development. This study uses bibliometrics to analyze the concept of green accounting and its impact on scientific research. The findings reveal an increasing trend of green accounting publications, with “Sustainable Development”, “Environmental Management”, and “Environmental Economics” being the most common keywords. Markandya emerged as the most prolific author, while Fondazione Eni Enrico Mattei (FEEM) stood out as the leading institution. These findings underscore the growing importance of green accounting in the economic and environmental fields.

Research on green accounting has provided valuable insights, but gaps still need to be explored further. More in-depth investigations are needed to thoroughly understand the application of green accounting and its challenges in various contexts. Company-specific case studies can be a valuable lens through which to examine green accounting practices in detail. Researchers can identify unique barriers and opportunities by studying companies' first-hand experiences in implementing these accounting systems. A deeper understanding of companies' challenges will help develop more effective and practical solutions.

In addition, future research could examine the implications of green accounting findings on government policy. By understanding how green accounting can affect firms' financial and environmental performance, governments can design policies that encourage adopting sustainable practices. This can contribute to achieving broader sustainable development goals. Further research on green accounting in developing countries such as Indonesia is also fundamental. Given their different economic and social contexts, these countries face unique challenges and opportunities in implementing green accounting. By studying the Indonesian experience, researchers can develop a more adaptive and inclusive green accounting framework.

Finally, incorporating social aspects into green accounting research will provide a holistic understanding of its impact. Green accounting focuses not only on environmental and social impacts for workers, communities, and society. By considering social aspects, researchers can ensure that green accounting is implemented responsibly and ethically. By addressing these research gaps, future research can enrich our understanding of green accounting and its role in achieving holistic, sustainable development. Green accounting has the potential to be a powerful tool to drive positive change and create a more sustainable future for all.

CONCLUSIONS

This study thoroughly analyzed the research trends in green accounting through bibliometric mapping of 233 Scopus-indexed publications from 1992 to 2023. The findings suggest that while there is a substantial body of literature on green accounting, there remains ample room for further exploration and development within the field. Promising areas for future research were identified, including popular topics and keywords such as "green accounting," "sustainable development," and "environmental economics," which could serve as focal points for deeper investigation in subsequent studies. Additionally, the study sheds light on top authors and institutions, such as Markandya, Lu, Somjai, and Fondazione Eni Enrico Mattei, offering valuable references for future researchers seeking to delve into green accounting.

This research serves as a valuable reference for comprehending the evolving landscape of green accounting research, providing visual insights into its development over the years. By pinpointing promising keywords and highlighting influential authors and institutions, it offers guidance to future researchers navigating this complex domain. There are concerns regarding the promotion and implementation of green accounting, which could potentially undermine its credibility. This might stem from the narrow focus of green accounting solely on afforestation and carbon emissions. In contrast, zero waste accounting emphasises transforming waste into practical resources for human benefit. Therefore, this can be a recommendation for future studies where other researchers should examine the benefits and challenges of zero waste accounting.

It is important to note that the results of this study are dynamic and subject to change as new trends emerge in green accounting research. Furthermore, the study's focus on a specific timeframe and dataset suggests the potential for broader analyses incorporating different timeframes and data sources. Moreover, future research could benefit from employing alternative software tools and incorporating additional elements to explore green accounting trends comprehensively. Overall, this study contributes valuable insights into the trajectory of Green Accounting research and provides a roadmap for future scholars to delve deeper into this critical study area.

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