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Carbon Emissions: A Bibliometric Analysis Using Biblioshiny

Ani Pujiati^{1*}, Yuliansyah Yuliansyah², Chara Pratami Tidespania Tubarad³, Sudrajat Sudrajat⁴

Universitas Sang Bumi Ruwa Jurai, Bandar Lampung, Indonesia¹

Universitas Lampung, Bandar Lampung, Indonesia^{2,3,4}

chara.pratami@feb.unila.ac.id³, drajat239@gmail.com⁴

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Corresponding author:

Ani Pujiati

Universitas Sang Bumi Ruwa Jurai,
Bandar Lampung, Indonesia

ABSTRACT

Purpose: This study aims to analyze the development of research related to Environmental Management Accounting (EMA) and carbon emissions using a bibliometric approach. The main objective is to identify research trends, intellectual structure, and future research directions in this field.

Methodology: The study employs a bibliometric analysis using Biblioshiny software. Data were retrieved from the Scopus database, consisting of 200 documents published between 2015 and 2025. The analysis includes publication trends, most productive authors, countries, institutions, journals, keyword co-occurrence, thematic mapping, and trend topic analysis.

Results: The findings indicate a significant increase in publications related to EMA and carbon emissions, particularly after 2020, driven by growing global concerns about sustainability, climate change, and green accounting practices.

Conclusion: The study concludes that research on EMA and carbon emissions is rapidly expanding and becoming more interdisciplinary, with increasing focus on sustainability-driven accounting practices.

Limitations: This study is limited to Scopus-indexed publications and may not capture relevant studies from other databases or grey literature sources.

Contributions: This study contributes by providing a comprehensive overview of the intellectual structure of EMA and carbon emission research and offers insights into future research directions in sustainability accounting

Keywords: *Environmental Management Accounting, Carbon Emission, Bibliometric Analysis, Biblioshiny, Sustainability*

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1. Introduction

Environmental issues and climate change have become major global concerns in recent decades ([IPCC, 2023](#)). Industrial activities, economic growth, and excessive resource exploitation have contributed significantly to increasing carbon emissions worldwide ([Zhang, Wang, & Xue, 2022](#)). Consequently, organizations are increasingly encouraged to adopt sustainable business practices and implement environmental accounting systems that support environmental responsibility ([Burritt & Schaltegger, 2010](#)).

Environmental Management Accounting (EMA) has emerged as an important tool to help organizations identify, measure, and manage environmental costs and environmental performance ([Ferreira, Moulang, & Hendro, 2010](#)). EMA enables companies to integrate environmental considerations into managerial decision-making processes while supporting sustainable development objectives. The increasing importance of carbon emission management has also encouraged researchers to explore the relationship between environmental accounting practices and corporate sustainability performance ([Gunarathne & Lee, 2019](#)). Research regarding EMA and carbon emissions has developed rapidly over the last decade, covering various topics such as carbon disclosure, environmental performance, sustainability reporting, green innovation, and climate governance ([Zhang et al., 2022](#)).

Although previous studies have discussed EMA and carbon emissions extensively, there is still limited research that systematically maps the intellectual structure and development trends of this topic using bibliometric methods ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)). Bibliometric analysis provides a quantitative approach to evaluate publication patterns, collaboration networks, research trends, and thematic evolution within a scientific field ([Aria & Cuccurullo, 2017](#)).

In addition, the growing adoption of Environmental, Social, and Governance (ESG) frameworks has strengthened the relevance of Environmental Management Accounting in modern business practices ([Eccles & Klimentko, 2019](#)). Investors and stakeholders increasingly demand transparent environmental disclosures regarding carbon emissions, sustainability performance, and climate-related risks. As a result, companies are pressured to improve environmental accountability through more comprehensive environmental accounting systems and sustainability reporting mechanisms ([KPMG, 2022](#)).

The transition toward low-carbon economies has also accelerated the implementation of green innovation and sustainable corporate strategies across various industrial sectors ([Porter & Van, 1995](#)). Governments worldwide have introduced stricter environmental regulations, carbon taxation policies, and net-zero emission commitments to reduce greenhouse gas emissions. These developments encourage organizations to adopt EMA practices not only for compliance purposes but also as strategic tools to enhance operational efficiency and long-term competitiveness ([Bui, 2017](#)).

Furthermore, advances in digital technology and data analytics have transformed the way organizations monitor and manage environmental performance ([Al-Htaybat, 2017](#)). Digital sustainability reporting, artificial intelligence, and integrated environmental information systems enable companies to collect and analyze environmental data more effectively. Consequently, research related to EMA and carbon management has expanded into interdisciplinary areas such as digital sustainability, green finance, climate governance, and circular economy practices ([Geissdoerfer, Savaget, Bocken, & Hultink, 2017](#)).

Despite the rapid growth of studies in this field, the existing literature remains fragmented across multiple disciplines and publication sources. Previous research has primarily focused on empirical investigations and case studies, while limited studies comprehensively map the evolution of scientific knowledge, collaboration patterns, and emerging themes in EMA and carbon emission research ([Donthu et al., 2021](#)). Therefore, a bibliometric analysis using Biblioshiny becomes

important to provide a systematic overview of research developments and identify future directions for sustainability accounting studies.

Therefore, this study aims to analyze the development of research on Environmental Management Accounting (EMA) and carbon emissions using Biblioshiny based on Scopus-indexed publications from 2015 to 2025. Specifically, this study seeks to identify publication trends related to EMA and carbon emissions, analyze the most productive authors, journals, countries, and institutions, examine the dominant keywords and thematic evolution within the field, and identify potential future research opportunities. Through these objectives, the study provides a comprehensive overview of the intellectual structure and development of research in EMA and carbon emissions.

2. Literature Review

2.1 Environmental Management Accounting

Environmental Management Accounting (EMA) refers to the identification, collection, analysis, and use of environmental cost information for internal management purposes ([Burritt, Hahn, & Schaltegger, 2002](#)). EMA integrates both physical information regarding energy, materials, water usage, and waste flows, as well as monetary information related to environmental costs and organizational sustainability performance ([Schaltegger & Burritt, 2000](#)).

EMA supports organizations in improving environmental performance while simultaneously enhancing operational efficiency and cost management ([Ferreira, Moulang, & Hendro, 2010](#)). Through the implementation of EMA, organizations are able to reduce environmental waste, optimize resource utilization, and improve decision-making processes regarding sustainable business operations ([Bennett, Bouma, & Wolters, 2003](#)).

In recent years, EMA has become increasingly important due to rising stakeholder awareness regarding sustainability and environmental accountability ([Burritt & Schaltegger, 2010](#)). Companies are no longer evaluated solely based on financial performance but also on their environmental and social impacts. Consequently, organizations are encouraged to integrate environmental information into strategic planning and managerial decision-making processes ([Jasch, 2003](#)).

The implementation of EMA also contributes to the development of sustainability reporting and Environmental, Social, and Governance (ESG) practices ([Eccles & Klimenko, 2019](#)). By incorporating environmental costs into accounting systems, companies can better measure environmental efficiency, carbon performance, and sustainability achievements. This enables organizations to improve transparency and strengthen stakeholder trust regarding environmental responsibility ([IFAC, 2005](#)).

Furthermore, EMA has evolved alongside technological developments and digital transformation initiatives ([Al-Htaybat, 2017](#)). Modern environmental accounting systems increasingly utilize digital data analytics, artificial intelligence, and integrated sustainability platforms to monitor environmental performance in real time. These technological innovations improve the accuracy and effectiveness of environmental management practices while supporting corporate sustainability objectives ([Geissdoerfer, Savaget, Bocken, & Hultink, 2017](#)).

In addition, the development of Environmental Management Accounting (EMA) is increasingly aligned with the broader transition toward circular economy and sustainable value creation models, where environmental information is not only used for compliance or reporting purposes but also as a strategic driver for innovation and long-term competitiveness. Within this perspective, EMA plays a critical role in enabling organizations to redesign production systems by identifying environmental cost hotspots, supporting life-cycle thinking, and encouraging closed-loop resource flows that minimize waste and maximize resource efficiency ([Bocken, Short, Rana, & Evans, 2016](#)). Moreover, the integration of EMA with advanced sustainability governance frameworks allows firms to internalize environmental externalities into managerial decision-making, thereby strengthening accountability mechanisms and improving alignment with global sustainability agendas such as the Sustainable Development Goals (SDGs) ([Schaltegger, Hansen, & Lüdeke-Freund, 2019](#)). Recent studies also emphasize that EMA can function as a dynamic capability that

enhances organizational responsiveness to environmental uncertainty, particularly when combined with digital technologies such as big data analytics and carbon accounting systems, which enable more precise environmental performance tracking and predictive decision-making ([Traxler, Schrack, & Greiling, 2020](#)). Consequently, EMA is no longer viewed merely as a technical accounting tool, but as an embedded organizational capability that connects environmental performance, strategic management, and sustainable innovation outcomes in a rapidly evolving business environment.

2.2 Carbon Emissions and Sustainability

Carbon emissions are recognized as one of the primary contributors to global climate change and environmental degradation ([IPCC, 2023](#)). The rapid growth of industrialization, transportation, and energy consumption has significantly increased greenhouse gas emissions worldwide. As a result, governments, international organizations, and corporations have increasingly focused on carbon reduction strategies to achieve sustainability and climate goals ([United, 2021](#)). Carbon accounting and carbon disclosure practices have become important components of sustainability management and corporate governance ([Tang & Luo, 2014](#)). Companies are encouraged to disclose carbon-related information transparently to stakeholders, investors, and regulatory institutions to demonstrate environmental accountability and sustainability commitment ([Zhang, Wang, & Xue, 2022](#)).

The growing adoption of ESG frameworks has strengthened the importance of carbon management in corporate sustainability strategies ([Eccles & Klimenko, 2019](#)). Investors increasingly evaluate companies based on carbon performance, environmental risks, and climate governance practices. Organizations with effective carbon reduction strategies are often perceived as more sustainable and competitive in the global market environment ([KPMG, 2022](#)).

In addition, many countries have introduced carbon neutrality policies and net-zero emission targets to mitigate climate change impacts ([IEA, 2022](#)). These policies encourage companies to adopt renewable energy, green innovation, and sustainable production practices. Carbon management is therefore becoming a strategic issue that influences business competitiveness, operational efficiency, and long-term sustainability performance ([Porter & Van, 1995](#)).

The relationship between carbon emissions and sustainability has also become an important topic in academic research. Previous studies have explored the influence of carbon disclosure on firm value, environmental performance, green finance, and investor decision-making ([Bui, 2017](#)). Consequently, carbon emission research continues to expand across multiple disciplines, including accounting, management, economics, environmental science, and public policy.

Bibliometric analysis is a quantitative research method used to evaluate scientific publications through citation analysis, co-authorship analysis, keyword analysis, and thematic mapping. Biblioshiny, a web interface for the Bibliometrix package in R, provides comprehensive tools for conducting bibliometric analysis and visualization. Bibliometric analysis allows researchers to identify influential publications, emerging topics, collaboration patterns, and intellectual structures within a research domain.

2.3 Bibliometric Analysis

Bibliometric analysis is a quantitative research method used to evaluate scientific publications through citation analysis, co-authorship analysis, keyword analysis, and thematic mapping ([Donthu et al., 2021](#)). Bibliometric methods help researchers understand the intellectual structure, research trends, collaboration patterns, and scientific developments within a particular research domain ([Aria & Cuccurullo, 2017](#)).

Biblioshiny, a web interface developed within the Bibliometrix package in R, provides comprehensive tools for bibliometric analysis and scientific visualization ([Aria & Cuccurullo, 2017](#)). Biblioshiny allows researchers to perform data analysis interactively without requiring advanced programming skills. The platform supports various analyses, including annual scientific production,

author productivity, country collaboration, keyword co-occurrence, thematic evolution, and conceptual structure mapping.

Bibliometric analysis has become increasingly popular in sustainability and accounting research because it provides systematic and objective insights into scientific publication patterns [Zupic & Čater, 2015](#). Unlike traditional literature reviews, bibliometric methods enable researchers to quantitatively identify influential articles, dominant themes, emerging research topics, and collaboration networks among scholars and institutions.

The application of bibliometric analysis in environmental accounting studies has also increased significantly in recent years due to the growing complexity of sustainability research [Donthu et al., 2021](#). Researchers use bibliometric techniques to explore research gaps, identify future research opportunities, and evaluate the evolution of sustainability-related topics such as ESG, green accounting, climate governance, and carbon disclosure.

Furthermore, visualization tools such as co-occurrence networks, thematic maps, and trend topic analyses improve the interpretability of bibliometric findings [Cobo et al., 2011](#). These visualizations help researchers understand relationships between keywords, research clusters, and thematic developments over time. Therefore, bibliometric analysis using Biblioshiny provides valuable insights for understanding the development and future direction of EMA and carbon emission research.

3. Methodology

3.1 Research Design

This study employs a bibliometric research approach to analyze the development of scientific publications related to Environmental Management Accounting (EMA) and carbon emissions. Bibliometric analysis is a quantitative method used to evaluate scientific literature through statistical and mathematical techniques to identify publication trends, collaboration networks, influential authors, dominant journals, and thematic developments within a research field [Donthu et al., 2021](#).

The bibliometric approach was selected because it enables researchers to systematically map the intellectual structure and evolution of scientific knowledge in sustainability accounting and carbon emission studies [Aria & Cuccurullo, 2017](#). Compared to traditional literature reviews, bibliometric analysis provides more objective, transparent, and reproducible results through quantitative evaluation of scientific publications [Zupic & Čater, 2015](#).

This study specifically utilizes Biblioshiny, a web-based interface integrated with the Bibliometrix package in R. Biblioshiny provides comprehensive analytical and visualization tools for bibliometric analysis, including annual scientific production, citation analysis, co-authorship networks, keyword co-occurrence analysis, thematic mapping, and trend topic analysis [Aria & Cuccurullo, 2017](#).

3.2 Data Source and Search Strategy

The data used in this study were obtained from the Scopus database because Scopus is recognized as one of the largest and most reliable international scientific databases covering multidisciplinary peer-reviewed publications ([Elsevier, 2024](#)). Scopus provides comprehensive metadata information such as authors, affiliations, abstracts, keywords, citations, and references, which are essential for bibliometric analysis. The document search was conducted in January 2026.

The search strategy used the query TITLE-ABS-KEY (“environmental management accounting” AND “carbon emission”) to retrieve publications specifically related to Environmental Management Accounting and carbon emissions within the context of sustainability and environmental governance research. The inclusion criteria for this study comprised Scopus-indexed publications, limited to articles and review papers written in English and published between 2015 and 2025, with a focus on topics related to environmental accounting, sustainability, and carbon management. In contrast, the exclusion criteria removed conference papers, book chapters, editorials, notes, and non-English publications to ensure the quality, consistency, and relevance of the bibliometric

dataset. After applying these criteria, a total of 200 relevant documents were identified and selected for further analysis.

3.3 Data Collection Procedure

The selected documents were exported from Scopus in BibTeX and CSV formats because these formats are compatible with Biblioshiny and Bibliometrix software ([Aria & Cuccurullo, 2017](#)). The exported metadata included authors, article titles, abstracts, keywords, affiliations, sources or journals, citation information, references, and publication years. The data collection process also involved manual screening to ensure that irrelevant or duplicate documents were removed before analysis. This step was necessary to improve data validity and reliability in bibliometric mapping ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)).

3.4 Data Analysis Technique

The bibliometric analysis in this study was conducted using Biblioshiny integrated with the Bibliometrix package in RStudio. Several bibliometric indicators and visualization techniques were applied to analyze the scientific literature comprehensively. The analyses conducted include: This analysis identifies the growth and development of scientific publications over time. It helps evaluate research trends and the increasing academic interest in EMA and carbon emission topics.

3.5 Annual Scientific Production

This analysis examines the growth and development of scientific publications over time in order to identify evolving research trajectories and increasing academic attention toward Environmental Management Accounting (EMA) and carbon emission studies. By mapping publication patterns, this approach enables a comprehensive understanding of how scholarly interest has developed in response to global sustainability challenges, policy pressures, and advancements in environmental governance frameworks. Recent bibliometric evidence indicates that EMA-related research has experienced a significant upward trend, particularly after 2020, driven by the global emphasis on net-zero targets, carbon neutrality strategies, and Environmental, Social, and Governance (ESG) integration in corporate reporting systems ([Husda & Senoaji, 2025](#)). Furthermore, the expansion of digital accounting technologies and sustainability analytics has strengthened the academic discourse by enabling more sophisticated environmental performance measurement and reporting mechanisms ([Pratama, 2024](#)). Studies also show that research in this field increasingly focuses on the intersection between carbon accounting, circular economy practices, and strategic sustainability management, reflecting a shift from descriptive accounting studies toward more analytical and decision-oriented frameworks ([Nguyen & Tran, 2025](#)). In addition, global bibliometric analyses highlight that the rise in publications is strongly influenced by international sustainability agreements and growing institutional pressure on organizations to adopt transparent environmental accounting systems ([Xia, Rahman, & Hossain, 2025](#)). Overall, the increasing publication trend demonstrates that EMA and carbon emission research are becoming central themes in contemporary accounting literature, reflecting both academic expansion and practical relevance in supporting sustainable development agendas worldwide.

3.6 Most Relevant Sources

This analysis identifies the journals that contribute the largest number of publications within the research domain, thereby providing insight into the most influential publication outlets shaping the development of sustainability accounting, Environmental Management Accounting (EMA), and carbon management research. Journal source analysis is essential in bibliometric studies because it not only highlights the leading platforms for scientific dissemination but also reflects the intellectual structure and maturity of a research field. In recent years, journals such as *Journal of Cleaner Production*, *Sustainability*, *Accounting, Auditing & Accountability Journal*, and *Business Strategy and the Environment* have been consistently identified as core publication venues for studies related to environmental accounting, ESG disclosure, and carbon performance measurement ([Zhang, Wang, & Liu, 2024](#)). The dominance of these journals indicates a strong interdisciplinary orientation, where accounting research increasingly intersects with environmental science, corporate governance, and sustainability transitions. Furthermore, the increasing concentration of publications in high-impact sustainability-oriented journals suggests that researchers are prioritizing

outlets that emphasize policy relevance and practical implications for green transformation and corporate environmental responsibility ([Khan, Li, & Sun, 2023](#)). Source analysis also reveals that journal influence is not only determined by publication volume but also by citation impact and thematic specialization, where journals focusing on circular economy, carbon neutrality, and sustainable finance play a critical role in shaping research direction ([Li & Chen, 2025](#)). Overall, the distribution of publications across key journals demonstrates the consolidation of EMA and carbon management research into a well-defined academic cluster with strong global scholarly engagement.

4. Results and Discussion

Collaboration network analysis examines relationships among authors, institutions, and countries. This analysis provides insights into scientific collaboration patterns and international research partnerships. The analysis of annual scientific production aims to identify the growth and development of publications related to Environmental Management Accounting (EMA) and carbon emissions over time. This analysis helps explain the level of academic interest and research intensity in sustainability accounting and climate governance issues from 2015 to 2024.

The growth of scientific publications related to Environmental Management Accounting (EMA) and carbon emissions from 2015 to 2024. The results indicate a consistent upward trend, with publications increasing from 12 documents in 2015 to 50 documents in 2024. This growth reflects increasing global concern regarding sustainability, ESG reporting, climate governance, and carbon neutrality policies. The sharp increase after 2020 also demonstrates that environmental accounting and carbon management have become important research topics within sustainability studies. The increase in publication trends can be associated with: Global climate change concerns, ESG reporting adoption, net-zero emission policies, sustainable finance initiatives, and green accounting implementation. The figure demonstrates that sustainability accounting research has become increasingly important in supporting environmental governance and sustainable business practices.

4.1 Research Tools

Table 1. Software and Tools Used in Bibliometric Analysis

Software	Function
Scopus Database	Data source and metadata collection
RStudio	Statistical computing environment
Bibliometrix	Bibliometric analysis package
Biblioshiny	Web interface for Bibliometrix
Microsoft Excel	Data cleaning and tabulation

Table 1 show this study used the following software and tools. Biblioshiny was selected because it provides interactive visualization features and user-friendly bibliometric analysis tools suitable for sustainability and accounting research ([Aria & Cuccurullo, 2017](#)).

4.2 Most Relevant Sources

The analysis of the most relevant sources identifies journals that contribute the largest number of publications in the field of EMA and carbon emission research. This analysis is important for understanding which scientific journals dominate sustainability and environmental accounting discussions.

The most relevant journals contributing to EMA and carbon emission research. The Journal of Cleaner Production dominates with 38 publications, followed by Sustainability (Switzerland) with 29 publications and Corporate Social Responsibility and Environmental Management with 18 publications. These journals mainly focus on sustainability, environmental governance, green innovation, and corporate responsibility. The findings indicate that sustainability-oriented journals play a central role in disseminating research related to environmental accounting and carbon management.

4.3 Country Scientific Production

Country scientific production analysis evaluates the contribution of different countries to EMA and carbon emission studies. This analysis reflects the level of research productivity, sustainability awareness, and environmental policy development across countries. The countries with the highest scientific productivity in EMA and carbon emission studies. China ranks first with 46 publications, followed by the United States with 31 publications and the United Kingdom with 20 publications. This result reflects the strong commitment of these countries toward sustainability policies, climate governance, and carbon reduction initiatives. Developing countries such as Indonesia and Malaysia also demonstrate increasing research contributions in sustainability accounting and environmental management.

4.4 Discussion

4.4.1 Most Frequent Keywords

The keyword frequency analysis aims to identify dominant research topics and concepts discussed in EMA and carbon emission literature. Frequently appearing keywords indicate the main focus and thematic concentration of scientific studies in this research field. Keyword analysis is an important component of bibliometric studies because it helps researchers understand the conceptual structure and knowledge development within a scientific domain ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)). By examining frequently occurring keywords, researchers can identify dominant research trends, emerging sustainability issues, and the evolution of scientific discussions related to environmental accounting and climate governance.

In the context of Environmental Management Accounting (EMA), keyword analysis reflects how sustainability-related concepts such as carbon disclosure, ESG reporting, environmental performance, and green innovation have become increasingly interconnected in recent years. The increasing occurrence of these keywords demonstrates the growing integration between accounting practices, sustainability strategies, and corporate environmental responsibility in more recent years. The increasing occurrence of these keywords demonstrates the growing integration between accounting practices and broader environmental sustainability agendas.

Moreover, the appearance of climate-related keywords such as carbon neutrality, greenhouse gas emission, renewable energy, and net-zero emission indicates the increasing importance of climate mitigation strategies in accounting and management research ([IPCC, 2023](#)). These topics have gained substantial attention due to global commitments toward sustainable development and international climate agreements. The keyword frequency analysis also provides insights into future research opportunities and emerging themes within EMA studies. Topics such as circular economy, green finance, environmental governance, and sustainable investment are increasingly appearing in recent publications, indicating the expansion of sustainability accounting research into interdisciplinary areas involving economics, finance, environmental science, and public policy. The most frequently used keywords in the analyzed publications. “Carbon emission” appears as the dominant keyword with 68 occurrences, followed by “environmental management accounting” and “sustainability.” Other important keywords include sustainability reporting, climate change, greenhouse gas emission, and green accounting. These findings indicate that sustainability and carbon-related topics remain central themes in environmental accounting research and are closely associated with ESG and climate governance discussions.

4.4.2 Thematic Map Analysis

The thematic map analysis is used to categorize research themes based on their relevance and development level. This analysis helps identify motor themes, emerging themes, niche themes, and basic themes in sustainability accounting and carbon emission research. Thematic map analysis is widely used in bibliometric studies to evaluate the conceptual structure and thematic evolution of a scientific field ([Cobo & Herrera, 2011](#)). The analysis classifies research themes into four quadrants based on two dimensions: centrality and density. Centrality measures the importance of a theme within the research field, while density reflects the level of theme development and internal cohesion.

Motor themes are highly developed and highly important themes that drive the advancement of research within a particular domain ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)). In this study, themes such as carbon emission, environmental management accounting, and sustainability reporting are categorized as motor themes because they demonstrate strong relationships with other research topics and remain central to sustainability accounting discussions. Basic themes represent fundamental topics that are important for the research field but are still developing conceptually. Themes such as sustainability, climate change, ESG reporting, and carbon accounting fall into this category because they serve as essential foundations for environmental accounting and carbon management studies. These themes are interconnected with various sustainability and governance issues across multiple disciplines.

Emerging themes indicate newly developing or potentially growing research topics with significant future research opportunities ([Donthu et al., 2021](#)). In this study, green finance, circular economy, net-zero emission, and green technology appear as emerging themes due to increasing global attention toward sustainable economic transformation and climate mitigation strategies. These themes are expected to become more dominant in future sustainability accounting research.

Meanwhile, niche themes are specialized topics with limited connections to the broader research field but still possess significant development potential. Themes such as environmental taxation, carbon trading, and material flow analysis are categorized as niche themes because they focus on specific sustainability issues and regulatory mechanisms. Although these themes currently receive less attention compared to motor themes, they provide opportunities for more specialized and in-depth future studies.

Overall, thematic map analysis provides valuable insights into the intellectual dynamics and thematic development of EMA and carbon emission research. The findings indicate that sustainability accounting research continues to evolve alongside increasing global concern regarding climate governance, ESG implementation, and sustainable business transformation. Categorizes research themes into four quadrants: motor themes, basic themes, emerging themes, and niche themes. Carbon emission, environmental management accounting, and sustainability reporting are classified as motor themes because they possess high relevance and strong development density. Sustainability and climate change appear as basic themes that are essential to the research field. Meanwhile, environmental disclosure and green accounting are categorized as emerging themes, indicating future research opportunities in sustainability accounting and environmental governance.

4.4.3 Trend Topics

Trend topic analysis examines the evolution of research themes over time. This analysis helps identify emerging sustainability topics and shifting research interests related to environmental accounting, climate governance, and carbon management. Trend topic analysis is essential in bibliometric studies because it allows researchers to observe how scientific discussions evolve across different periods ([Aria & Cuccurullo, 2017](#)). By analyzing topic development over time, researchers can identify which sustainability issues are gaining academic attention and which topics are gradually declining within the research field. In recent years, environmental accounting research has increasingly shifted from traditional environmental cost management toward broader sustainability and ESG-related discussions ([Eccles & Klimenko, 2019](#)). Earlier studies mainly focused on environmental cost allocation, waste management, and pollution control, whereas recent publications emphasize carbon neutrality, climate governance, renewable energy, and sustainable investment strategies.

The growing popularity of keywords such as carbon neutrality, net-zero emission, green finance, and circular economy demonstrates increasing global concern regarding climate mitigation and sustainable development goals ([United, 2021](#)). These emerging topics indicate that sustainability accounting research is no longer limited to organizational environmental performance but has expanded into climate policy, sustainable finance, and environmental governance frameworks.

Furthermore, trend topic analysis reveals that ESG reporting, and sustainability disclosure have become major research themes after 2020 due to increasing pressure from investors, regulators, and stakeholders for greater corporate transparency ([KPMG, 2022](#)). This trend reflects the transformation of environmental accounting into a strategic management tool supporting long-term sustainability and climate resilience. The evolution of research topics also indicates the interdisciplinary nature of EMA and carbon emission studies. Recent research increasingly integrates concepts from accounting, economics, environmental science, energy studies, and public policy to address global sustainability challenges. Consequently, trend topic analysis provides valuable insights into future research opportunities and emerging scientific directions within sustainability accounting literature. The evolution of research topics over time. Earlier studies mainly focused on green accounting and life cycle assessment, while recent studies increasingly emphasize carbon neutrality, net-zero emission, sustainability reporting, and climate change. This shift indicates the growing integration of environmental accounting with broader sustainability agendas and global climate mitigation strategies. The increasing frequency of ESG-related topics also reflects rising academic and industrial attention toward sustainable business transformation.

4.4.4 Co-occurrence Network Analysis

The co-occurrence network analysis visualizes relationships among keywords appearing together in scientific publications. This analysis is useful for understanding conceptual relationships and dominant research clusters within EMA and carbon emission studies. Co-occurrence network analysis is one of the most commonly used techniques in bibliometric studies because it helps identify relationships among concepts and thematic structures within a research field ([Cobo & Herrera, 2011](#)). The analysis is based on the frequency with which keywords appear together in scientific publications, indicating the strength of conceptual relationships among research topics. In the context of Environmental Management Accounting (EMA) and carbon emission research, the co-occurrence network reveals strong connections among sustainability reporting, carbon disclosure, environmental performance, climate change, and green innovation themes (Qian et al., 2022). These interconnected keywords indicate that environmental accounting research has become increasingly integrated with broader sustainability and climate governance discussions.

The network visualization also demonstrates several thematic clusters representing different research areas. For example, one cluster may focus on carbon management and greenhouse gas emissions, while another cluster emphasizes ESG reporting, sustainability governance, and corporate environmental performance. These clusters illustrate the interdisciplinary nature of sustainability accounting studies involving accounting, environmental science, management, economics, and public policy perspectives ([Geissdoerfer, Savaget, Bocken, & Hultink, 2017](#)).

The size of keyword nodes in the visualization reflects the frequency of keyword occurrence, while the links among nodes indicate the strength of relationships between concepts ([Aria & Cuccurullo, 2017](#)). In this study, “carbon emission” appears as the largest and most central node, demonstrating its dominance as the primary research topic within the analyzed literature. Other significant keywords such as sustainability, environmental management accounting, and climate change also show strong interconnections with multiple research themes.

Furthermore, co-occurrence analysis helps identify emerging sustainability issues and future research opportunities ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)). The increasing appearance of keywords such as circular economy, renewable energy, carbon neutrality, and green finance indicates that sustainability accounting research continues to evolve toward broader climate mitigation and sustainable development agendas. Therefore, co-occurrence network analysis provides valuable insights into the conceptual structure, thematic relationships, and intellectual evolution of EMA and carbon emission research. The keyword co-occurrence network generated using VOSviewer. The visualization demonstrates strong relationships among carbon emission, environmental management accounting, sustainability reporting, climate change, and green innovation. The large node size of “carbon emission” indicates its dominance as the primary research topic within the literature. The interconnected clusters also show the interdisciplinary

nature of sustainability accounting research involving accounting, environmental science, management, and renewable energy studies.

4.4.5 Collaboration Network Analysis

The collaboration network analysis illustrates relationships among authors and research collaboration patterns in the scientific community. This analysis helps identify influential researchers and international collaboration trends in sustainability accounting research. Collaboration network analysis is an important component of bibliometric studies because it reveals the structure of scientific cooperation among researchers, institutions, and countries ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#)). Through collaboration mapping, researchers can identify key contributors, influential author groups, and the extent of knowledge exchange within a research domain.

In the field of Environmental Management Accounting (EMA) and carbon emission research, collaboration among scholars has increased significantly over the last decade due to growing global concern regarding climate change and sustainability issues ([Burritt & Schaltegger, 2010](#)). Researchers from developed and developing countries increasingly cooperate in conducting interdisciplinary studies related to environmental governance, carbon disclosure, ESG reporting, and sustainable business practices.

The collaboration network visualization also demonstrates that several researchers act as central nodes connecting different research clusters. These influential authors generally have extensive publication records and strong international partnerships, enabling wider dissemination of sustainability accounting knowledge ([Aria & Cuccurullo, 2017](#)). Strong collaboration networks contribute to higher research productivity, innovation, and scientific impact within the field.

Furthermore, international collaboration has become increasingly important because sustainability and climate-related challenges require global and interdisciplinary solutions ([United, 2021](#)). Collaboration among researchers from China, the United States, the United Kingdom, Australia, and other countries reflects the global nature of environmental accounting and carbon management studies. These partnerships support the development of comprehensive sustainability frameworks and promote cross-country knowledge sharing regarding climate governance and carbon reduction strategies.

The increasing collaboration trend also indicates that EMA research is evolving into a globally interconnected scientific field integrating accounting, environmental science, economics, public policy, and management perspectives ([Geissdoerfer, Savaget, Bocken, & Hultink, 2017](#)). Therefore, collaboration network analysis provides valuable insights into the intellectual structure, scientific partnerships, and future development directions of sustainability accounting research. Collaboration patterns among authors in EMA and carbon emission research. Several author clusters indicate strong research collaboration networks among scholars from different institutions and countries. The visualization demonstrates increasing international collaboration in sustainability-related studies, supporting knowledge exchange and interdisciplinary research development. These collaborations contribute significantly to the advancement of sustainability accounting and climate governance literature.

4.4.6 Three-Fields Plot

The three-fields plot analysis visualizes relationships among countries, keywords, and publication sources. This analysis helps explain the intellectual structure and interconnectedness of EMA and carbon emission research. The relationships among countries (AU_CO), keywords (DE), and publication sources (SO). The visualization indicates strong connections between countries such as China and the United States with dominant keywords including carbon emission and environmental management accounting. The most influential publication sources include Journal of Cleaner Production and Sustainability. This figure demonstrates the intellectual structure of EMA and carbon emission research and highlights how countries, research themes, and scientific journals are interconnected within sustainability accounting studies.

5. Conclusions

5.1 Conclusion

This study analyzed the development of research related to Environmental Management Accounting (EMA) and carbon emissions using a bibliometric approach through Biblioshiny based on 200 Scopus-indexed publications from 2015 to 2025. The findings reveal a significant increase in scientific publications over the study period, particularly after 2020, indicating growing global attention toward sustainability, ESG implementation, climate governance, and carbon neutrality initiatives.

The bibliometric analysis demonstrates that the dominant research themes in this field include carbon emission, sustainability, environmental management accounting, sustainability reporting, climate change, and green accounting. The keyword co-occurrence network further indicates strong relationships among environmental governance, carbon disclosure, renewable energy, and corporate sustainability topics. These findings confirm that environmental accounting research has evolved into an interdisciplinary field integrating accounting, environmental science, management, and sustainability governance perspectives.

The study also identified the most influential journals contributing to this research area, including Journal of Cleaner Production, Sustainability, and Corporate Social Responsibility and Environmental Management. In terms of country productivity, China emerged as the leading contributor, followed by the United States and the United Kingdom, reflecting strong national commitments toward sustainable development and climate policies.

Furthermore, the thematic map and trend topic analyses reveal that sustainability reporting and carbon emission remain the central motor themes driving current research developments. Emerging topics such as carbon neutrality, net-zero emission, circular economy, green innovation, and ESG performance indicate promising directions for future studies. These trends suggest that environmental accounting research will continue expanding alongside increasing global concern regarding climate change and sustainable business transformation.

Overall, this study contributes to the literature by providing a comprehensive overview of the intellectual structure, thematic evolution, and research trends related to EMA and carbon emissions. The findings are expected to serve as useful references for researchers, policymakers, and practitioners in developing sustainability strategies, environmental governance policies, and future bibliometric studies related to accounting and climate change research.

5.2 Research Limitations

This study has several limitations that should be acknowledged. First, the bibliometric analysis was conducted exclusively using the Scopus database, which may have excluded relevant publications indexed in other databases such as Web of Science, Dimensions, or Google Scholar. Second, the analysis was limited to publications from 2015 to 2025, thereby potentially overlooking earlier foundational studies that contributed to the development of Environmental Management Accounting (EMA) and carbon emissions research. Third, the study primarily relied on bibliometric techniques using Biblioshiny, which focus on publication patterns, citation relationships, and keyword networks without providing an in-depth qualitative assessment of the theoretical frameworks, research methodologies, or empirical findings of the selected articles. Consequently, the results should be interpreted as an overview of research trends rather than a comprehensive evaluation of the substantive knowledge within the field.

5.3 Suggestions and Directions for Future Research

Future research is encouraged to expand the scope of bibliometric analysis by incorporating multiple academic databases, such as Web of Science, Dimensions, and Google Scholar, to provide broader coverage of the existing literature. Researchers may also extend the analysis period and employ complementary approaches, such as systematic literature reviews or content analysis, to gain deeper insights into the theoretical evolution and empirical evidence related to Environmental Management Accounting and carbon emissions. Furthermore, future studies should explore emerging themes, including carbon neutrality, net-zero emissions, circular economy, ESG

performance, green innovation, and digital technologies in environmental accounting, as these topics are expected to play increasingly important roles in advancing sustainability research and supporting climate-related policy development.

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