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Mapping Sustainable Supply Chain Management Trends and Future Directions in Small and Medium Enterprises: A Bibliometric Analysis

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ABSTRACT
Purpose– This study aims to conduct a bibliometric evaluation of scholarly literature on sustainable supply chain management in small and medium-sized enterprises (SMEs). The analysis will thoroughly examine research articles published in the past twenty years.

Design/methodology/approach– The present study conducted an examination of 255 documents sourced from the Scopus database. The analysis encompassed the utilization of bibliometric techniques, performance analysis, and thematic grouping methodologies. The investigation aimed to evaluate the scholarly productivity of research articles, identify influential authors and papers, and analyze educational institutions and countries. Additionally, the study examined keyword co-occurrences, thematic mapping, co-citations, and the collaborative efforts among authors and countries. VOSviewer was employed as the primary tool for performance analysis and thematic grouping in this study.

Findings– The year 2023 witnessed a total of 48 publications, signifying the highest research productivity within the given timeframe. Notably, Leuphana University Lüneburg in Germany emerged as the institution with the greatest impact, while China exhibited a noteworthy level of productivity as the most prolific country. Amongst the journals, the 'Journal of Cleaner Production' emerged as the most influential publication, while 'Sustainability (Switzerland)' exhibited the highest productivity with 18 publications. The article titled "Sustainability-oriented innovation of SMEs: A systematic review" garnered the highest citation count, underscoring its significance within the field. Furthermore, the study identified and delineated five thematic clusters within the realm of sustainable supply chain management research that specifically focused on SMEs.

Research limitations/implications– This paper offers researchers a comprehensive overview and valuable guidance on the existing literature pertaining to SSCM in SMEs. Moreover, it underscores potential avenues for future research in this domain.

Originality/value– This research is of great significance as it represents the pioneering study that examines the performance and systematically delineates the existing literature on sustainable supply chain management within the realm of SMEs.

Keywords: Sustainable supply chain, small and medium enterprises, bibliometric analysis, co-citation analysis, bibliographic coupling
Paper type- Literature review

1. Introduction and Background

SMEs play a really significant part in the global economic landscape, serving as pivotal drivers of job creation (Gherghina et al., 2020), hubs of innovation (Crupi et al., 2020), and catalysts for overall economic development (Lukács, 2005; Selaković et al., 2023). The incorporation of sustainable concepts into business processes has gained significant attention in recent times, especially in the field of supply chain management (Kot, 2018). Given the pivotal role of SMEs in fostering economic growth and innovation, understanding the integration of sustainable supply chain management practices within this sector becomes imperative. Indeed, SMEs are widely recognized as crucial foundations of developing economies, accounting for over 50% of GDP and 90% of all businesses in emerging economies, thereby significantly contributing to entrepreneurship and employment development (Thaha et al., 2021).

Furthermore, the concept of supply chain management has attracted increased attention from researchers, aligning with the growing emphasis on sustainability within SMEs. According to the APICS Dictionary, "the supply chain encompasses the processes from the initial raw materials to the final consumption of the finished product, spanning across supplier-user companies". It also covers the internal and external operations of a business that support the value chain involved in manufacturing products and rendering services. (Cox, 1999).

These entities may consist of suppliers, carriers, manufacturing sites, distribution centers, retailers, and customers (Lummus & Alber, 1997). The Supply Chain Council (1997) provides a complementary definition, describing the supply chain as every effort involved in producing and delivering a final product. This encompasses sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service, along with the necessary information systems to monitor these activities. Supply chain management is further defined as an integrating philosophy aimed at managing the total flow of a distribution channel from supplier to ultimate customer (Cooper & Ellram, 1993). Integrated supply chain management, as articulated by Monczka & Morgan (1997), involves managing all processes horizontally, starting from the external customer and ensuring value delivery at every stage.

Initiatives for supply chain sustainable development are likely being spread by pioneering organizations into the other supply chain cells. For instance, a more proactive organization in the supply chain starts initiatives for its sustainability and puts even more modest approaches into practice, which will eventually be adopted by other organizations in the supply chain. It is emphasized that knowledge can travel and accrue at variable speeds throughout the various links in the supply chain (Buckley et al., 2022). The integrated approach to supply chain sustainability seeks to create, protect, and enhance the long-term progress of environmental, social, and economic advantages rather concentrating just on mitigating adverse consequences (Negri et al., 2021). The scope of this endeavor is expanded to include all parties participating in the convoluted chain of events that leads to the release of goods and services onto the market. The two primary elements influencing the growth of sustainable supply chains are the issues and opportunities that supply chains encounter, which encourage them to take part in sustainable development projects. (Zhou et al., 2020). It is possible to identify a number of significant factors related to their internal and external surroundings that stand in the way of the development of sustainable supply chains. (Nilsson & Göransson, 2021).

Several research gaps persist in the subject of SSCM in SMEs, despite the insightful information offered by the current literature.First, in order to comprehend the present expansion in this field, more research into the bibliometric pattern is required. Additionally, research on the useful applications of SSCM in SMEs is extremely important. Studies should aim to investigate the real-world applications and implications of sustainable practices on SME operations, performance, and competitiveness. Therefore, a bibliometric analysis of the literature focusing on SSCMs were conducted to determine which nations worldwide have produced and disseminated the most knowledge on sustainable supply chain management (SSCMs) and to identify the organizations that have interacted most frequently with one another to produce greater scientific contributions on SSCMs (Reyes-Soriano et al., 2022). Thus, this study will answer the following research questions:

RQ:1 What has been the academic productivity of research articles in sustainable supply chain management for SMEs in the past twenty years?
RQ:2 Which authors, papers, educational institutions, and countries have made significant contributions to the literature on sustainable supply chain management for SMEs?
RQ:3 What thematic clusters have been identified within the field of research on sustainable supply chain management for SMEs?
RQ:4 How do keywords co-occur and what thematic map emerges from the scholarly literature on sustainable supply chain management for SMEs?

RQ:5 How do co-citations and collaboration among authors and countries contribute to our understanding of sustainable supply chain management for SMEs?
RQ:6 What thematic clusters emerge from the bibliometric analysis of scholarly literature on SSCM within the context of SMEs, and how do these themes contribute to understanding the key areas of focus and research trends in the field?

The current study will inspire readers and academics by enabling them to conduct high-quality future research in this area and by giving them a better grasp of the most well-known and significant publications on SSCM in SME businesses. Researchers would also be able to recognize publishing patterns, advancements in the field of research, and significant publications that will aid in their better understanding of the subject. The most prevalent thematic clusters and current research trends on SSCM research in small and medium firms will also be better understood by academics and researchers. The present study's future research directions will offer a number of chances as well as solutions for small and medium-sized businesses to handle various SSCM issues.

After providing background information on sustainable supply chain management in SMEs, this paper will proceed to explore and reviewing the existing literature. Section 3 will focus on bibliometric research method used in this study. Section 4 will delve into the findings of the research that underlie sustainable supply chain management in SMEs, with the aim of offering a comprehensive understanding of the concepts that drive scholarly exploration in this area. Following this, Section 5 will provide conclusion and implications of sustainable supply chain management in SMEs. Section 6 will address limitations and provide the future research directions in sustainable supply chain management within the context of SMEs.

2. Literature Review

The purpose of this review of the literature is to give a broad overview of recent studies on supply chain management (SSCM) in SMEs. The sustainable supply chain of SMEs have been studied using institutional theory and resource-based view. The variance-based structural equation modeling was used to test the model and it showed that the supply chain connectivity and information sharing have a major impact on environmental performance, but normative and mimetic forces have little effect on top management engagement (Shibin et al., 2020). SMEs are digitally less active sharing information with their suppliers, they must be integrated in digital supply chain transparency or traceability in multi-tier supply chain management (Winter et al., 2023). The moderation effect of market turbulence and the function of blockchain technology in supply chain characteristics influence SMEs' adoption of blockchain technology, suggesting that the impact of blockchain on agility is more significant for SMEs operating in turbulent environments than for SMEs in stable markets (Iranmanesh et al., 2023). Supply chain coordination (SSC) is defined as the voluntary integration of economic, environmental, and social concerns with internal business operations to create coordinated supply chains (Ahi & Searcy, 2013). Integrating sustainable supply chain management (SCM) principles into the operations of small and medium enterprises (SMEs) is seen as highly important. This approach encompasses business, environmental, and social aspects of sustainable development within the supply chain. The study found that all sustainability factors examined were deemed significant by the SMEs under investigation (Kot, 2018). The connections and obligations of SMEs in the context of corporate social responsibility (CSR) within the supply chain are clarified, highlighting their critical role in communicating CSR demands and the need of examining their activities from the viewpoints of suppliers and customers. (Ayuso et al., 2013). The SDGs and green supply chain practices should be actively promoted and supported by SMEs. SMEs may establish a sustainable culture, use government support and senior management to further position themselves as responsible and progressive companies in today's global marketplace, in addition to expanding their environmental and community-focused projects (Ilyas et al., 2020). The integrated production and distribution planning model, consisting of four tiers, is utilized in the shrimp agroindustry supply chain to maximize the movement of commodities and supplies of processed shrimp products.It was suggested to use bi-objective mixed-integer linear programming to reduce overall supply chain expenses while increasing service level. (Herlina et al.,2022). External stakeholders put a lot of pressure on Indian MSMEs to embrace GSCM practices. On-the-job training is one internal factor that pushes MSMEs in India to embrace GSCM methods. Additionally, it has been proven that internal forces completely moderate the relationship between external pressures and GSCM adoption (Mohanty & Prakash, 2014). The need for environmental protection as well as the pursuit of social and economic balance will help customers accept the implementation of sustainable development. Customers, who are not only the final link in the supply chain but also actively participate in it as employees of companies that operate within chains, are becoming more aware of these requirements and legal regulations related to sustainable development (Pohlmann et al., 2020). Green Manufacturing Practices (GMPs) significantly improve EP, EnP, and SP sustainability performance. Once more, GMPs have a very good impact on Green Supply Chain Integration (GSCI). Additionally, GSCI acts as a mediator between sustainable performance and green manufacturing methods (Afum et al., 2020). The PESTEL framework is used to identify obstacles to the adoption of BDA in sustainable supply chains. These obstacles are then finalised with expert opinion and examined using DEMATEL and AHP methodologies to determine their relative

relevance and cause-and-effect correlations (Jain et.al 2023).Networks of SMEs may become crucial for tackling the systemic issues underlying industrial ecology, organizational resilience, and the sustainability of the global supply chain, even if various successful models of the sustainable SME are now in development. For the implementation of the GSCM idea in the auto industry, the Interpretive Structural Modeling (ISM) qualitative analysis was employed to explore the interdependencies between the various barriers. It suggests that the challenges to implementing green supply chain management vary across several Indian sectors that manufacture auto components. However, the supplier barrier dominates their GSCM implementation, particularly for maintaining environmental awareness

The supplier barrier is the key one for sustaining environmental awareness (Mathiyazhagan et al., 2013). Since SMEs make up the bulk of businesses, there are numerous ways to build networks thanks to quickly developing communication technologies (Moore & Manring, 2009). The overall performance of the supply chain and the environment are improved by incorporating green supply chain management methods into the SMEs business plan, particularly reverse logistics and adherence to law and regulation (Centobelli et al., 2021).

3. Bibliometric Research Process

3.1 Defining Search Parameters and Keywords

This study employed the combination of terminology derived from two interdisciplinary fields, namely sustainable supply chain management and SMEs. In order to get a thorough examination of both domains, it was imperative to incorporate terms that are pertinent to each respective field. Table 1 presents the two sets of strings and their corresponding keywords employed for the purpose of data extraction and document selection from Scopus. Following an initial search of notable and relevant scholarly articles, the researchers have compiled the following terms. The concepts associated with sustainable supply chain management encompass various aspects, such as green supply chain, sustainable procurement, eco-friendly operations, environmental sustainability in the supply chain, and social responsibility in the supply chain. Likewise, the terminology encompasses both small and medium-sized enterprises (SMEs) as well as small businesses.

Table 1 Selection criteria

	Scopus	
Criteria	Exclude	Include
Search date: 19-09-2023 Database: Scopus Search Term: "sustainable supply chain" OR "Green supply chain" OR "Sustainable procurement" OR "Eco-friendly operations" OR "Environmental sustainability in supply chain" OR "Social responsibility in supply chain" TITLE-ABS-KEY ("SMEs*" OR "Small and Medium Enterprise*" OR "small business*")		276
Year: 2004-2023	0	276
Subject Area: “Business, Management and Accounting, Engineering, Environmental Science, Computer Science, Decision Sciences, Social Sciences, Energy, Economics, Econometrics and Finance, Psychology and Multidisciplinary”	11	265
Publication Type: “Article, Conference Paper, Review, Book Chapter”	9	256
Language: English	0	256
Erroneous records refinement:	1	**255**

3.2 Data Acquisition and Refinement

Scopus is widely recognized for curating a comprehensive repository of scholarly publications, particularly known for its robust collection of double-blind peer-reviewed articles published in high-impact factor journals (Groff et al., 2020), was the primary database chosen for sourcing information. Employing a meticulous approach, we carefully arrived at a final selection of 264 articles (as shown in Table 1). To filter the most relevant articles, we utilized keywords like "sustainable supply chain," "Green supply chain," "Sustainable procurement," "Eco-friendly operations," "Environmental sustainability in the supply chain," "Social responsibility in the supply chain," in conjunction with terms related to small and medium enterprises ("SME*", "Small and Medium Enterprise*", and "Small Business*"). This ensured inclusion of articles published only in English across diverse disciplines, as outlined in Table 1.

However, It is important to acknowledge that data downloaded from Scopus or any other online database may contain inaccuracies. These inaccuracies often result from errors in bibliographical and bibliometric information, which occur when references to seminal publications are included in subsequent articles (Donthu et al., 2021). Hence, utilizing this

data as is without further refinement can risk inaccurate interpretations. To mitigate this, rigorous data cleaning processes were undertaken.

Following the recommendations of (Zupic & Čater, 2015), we meticulously cleaned and refined the bibliographic and bibliometric data for accurate visualization and interpretation of outcomes. The "natural language processing" tool within the VOSviewer software was employed to clean various terms within the article's titles, abstracts, and keywords, thereby enhancing the precision of the analysis. For instance, converting abbreviations to their full forms or standardizing them for consistency. For example, "SMEs" standardized to "Small and Medium Enterprises. Eliminating special characters, symbols, or punctuation marks that may hinder accurate analysis or visualization. Ensuring consistency in the usage of terminology by aligning synonyms or related terms. For instance, "sustainability" and "sustainable development" could be aligned to a single term for consistency. Detecting and removing duplicate entries to prevent redundancy and ensure the accuracy of the dataset.

3.3 Choice of Analytical Techniques

Bibliometric analysis involves employing quantitative methodologies to scrutinize and quantify textual information (Goyal & Kumar, 2021; Mishra et al., 2018). This approach facilitates the extraction of fresh insights from literature reviews, serving as a valuable supplement to the research process. This involves creating and delivering detailed profiles on a specific subject, identifying complex patterns in a particular research field, and evaluating research projects to offer valuable insights into the overall research landscape (Gao et al., 2021; Hossain et al., 2022).

To examine bibliographic data, researchers commonly use a variety of bibliometric analysis approaches, including co-citation analysis, authorship analysis, citation analysis, bibliographic coupling, and co-word analysis (Donthu et al., 2021). These approaches make it easier to thoroughly examine and understand the state of the study, and they offer insightful information on trends, links, and patterns in academic literature.

4. Findings

4.1 Analysis of Productivity Trends

In Figure 1, we observe the trajectory of publication trends within the domain of supply chain management research in SMEs. Notably, 2023 emerged as the most prolific year. However, Martin Christopher's work on supply chain management in the 1990s, particularly his book "Logistics and Supply Chain Management," helped establish the discipline as a separate function. He emphasized the importance of integrating various supply chain functions and stakeholders. The initial research trends reveal a prevalent focus on SCM rather than SSCM in SMEs research. Ciliberti et al.(2008) examined the methods used and challenges encountered by SMEs when attempting to teach socially conscious conduct to their suppliers in developing nations. The volume of research in this area has significantly increased every year since 2018. Overall, it is clear that research in this area is set to increase in the coming years given the current trajectory.

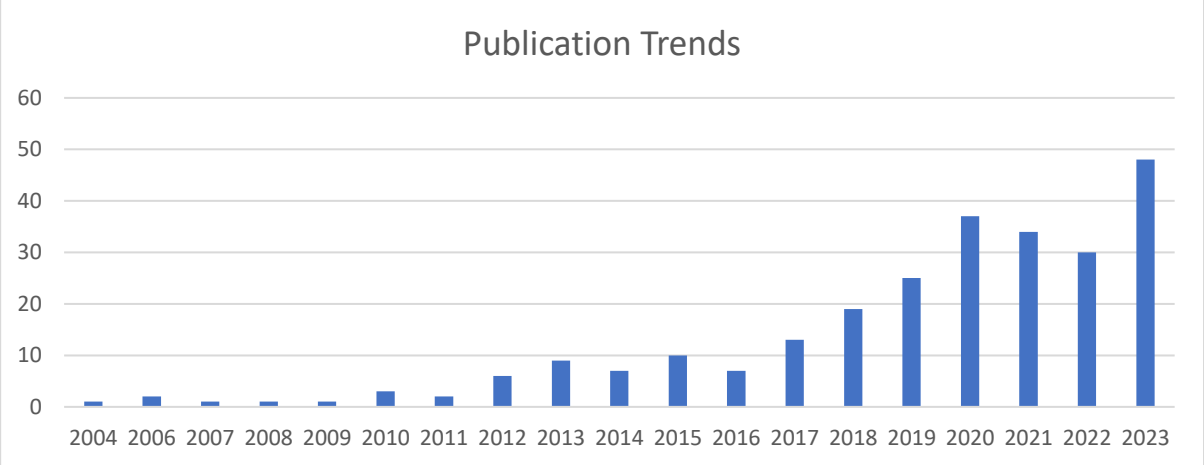

Figure 1 Publication trend of Sustainable supply chain in SMEs research

4.2 Noteworthy Authors, Institutions, and Countries

In Table 2, we can observe the significant authors, organizations, and countries that have made a substantial impact on sustainable supply chain management research in SMEs. Klewitz emerges as the most influential author, boasting 757

citations from a single research paper. Following closely is Mathiyazhagan with one research paper and 587 citations. Shifting the focus to academic institutions, Leuphana University Lüneburg in Germany holds the highest number of citations, totalling 757. In terms of publications, the University of Southern Denmark, Denmark, stands out with two research papers. When examining the contributions on a global scale, China leads the pack with an impressive 1977 citations across 43 publications. Following suit is India, garnering 1927 citations from 52 documents. These numbers underscore the significant research output and impact from these countries, reflecting their strong presence in sustainable supply chain management research for SMEs.

Table 2 Key contributing authors, institutions and country

TC	Author	TP	TC	Organization	TP	TC	Country	TP
757	Klewitz J.	1	757	Leuphana University Lüneburg, Germany	1	1977	China	43
587	Mathiyazhagan K.	1	587	University of Southern Denmark, Denmark	2	1927	India	52
325	Ciliberti F.	1	587	National Institute Of Technology, Tiruchirappalli, India	1	939	US	19
306	Moore S.B.	1	587	Chinese Academy of Sciences, Shenyang, China	1	815	Germany	5
265	Lee S.M.	1	325	Polytechnic of Bari, Italy	1	814	UK	36
131	Mohanty R.P.	1	306	Elon University, United States	1	721	Italy	10
123	Kot S.	1	306	Ouroboros Holdings, Llc., United States	1	717	Denmark	4
118	Zhou F.	1	265	Sol Bridge International School of Business, Daejeon, South Korea	1	613	France	16
115	Shibin K.T.	1	265	University of Nebraska-Lincoln, United States	1	344	South Korea	8
112	Li Y.	1	190	Masdar Institute of Science and Technology, United Arab Emirates	1	266	UAE	7

4.3 Pivotal Journals in Sustainable Supply Chain Management Research

As illustrated in Table 3, we can observe the primary sources of impactful research in sustainable supply chain management concerning SMEs. The paramount source in this domain is the "Journal of Cleaner Production," amassing an impressive 2593 citations across 15 publications. Following closely is "Sustainability (Switzerland)" with 395 citations and 18 publications, making it another noteworthy journal in this field. Interestingly, "Sustainability (Switzerland)" holds the title for the most productive journal with a total of 18 publications, closely followed by the "Journal of Cleaner Production" with 15 publications. Analyzing the trends, the years 2020 to 2023 were particularly productive in terms of impactful publications within the most influential journals.

It's worth noting that while research on sustainable supply chain management in SMEs has begun to gain significant attention and momentum in the late 2000s and early 2010s. There were no publications in the most influential journals during the period from 2000 to 2014. This indicates a shift or evolution in the dissemination of impactful research within these prominent journals over time.

Table 3 Most influential journals

Source	TC		Q1	TP	2005-2014	2015-2019	2020-2023
Journal of Cleaner Production	2593	A		15	6	4	5
Sustainability (Switzerland)	395			18		6	12
Production Planning and Control	374	A		5	1	3	1
Annals of Operations Research	281	A		4			4
Industrial Management & Data Systems	265	A		1	1		
Management of Environmental Quality: An International Journal	261			5		2	3

International Journal of Production Economics	166	A		2			2
Technological Forecasting and Social Change	155	A		3			3
Journal of Manufacturing Technology Management	143	B		4		2	2
Supply Chain Management	137	A		2		2	

4.4 Seminal Articles

A comprehensive overview of the most influential and highly cited articles within the domain of sustainable supply chain management research, particularly focusing on SMEs are presented in Table 4. Topping the list with a substantial 757 citations is the article titled "Sustainability-oriented innovation of SMEs: A systematic review" authored by Klewitz and Hansen (2014), establishing itself as the most influential article. This seminal research investigates sustainability-oriented innovations (SOIs) within SMEs, shedding light on distinct strategic sustainability behaviors exhibited by SMEs. The study underscores eco-innovation as a primary focus and proposes an integrated framework, emphasizing collaboration with external entities to augment SMEs' innovative capabilities. However, notable research gaps exist, particularly regarding understanding radical SOIs, optimizing innovation methodologies, and comprehending SMEs' role in industry transformation and sustainable supply chains. Securing the second position with 587 citations is the study by Mathiyazhagan et al. (2013) on "An ISM approach for the barrier analysis in implementing green supply chain management." This influential research centers on Indian auto component manufacturing industries, predominantly SMEs, striving to implement GSCM to mitigate their environmental footprint. The study meticulously identifies and analyzes barriers to GSCM implementation through a multi-phased approach involving a literature review, interviews with department managers, and an industry-wide survey. Utilizing Interpretive Structural Modeling (ISM) qualitative analysis, the research pinpoints the most dominant barrier hindering GSCM implementation, facilitating effective adoption of green concepts by overcoming this predominant obstacle. The findings underscore varied barriers across industries, with the supplier barrier emerging as the most dominant, particularly in maintaining environmental awareness during GSCM implementation. This approach was applied to ten auto components manufacturing industries in Tamil Nadu, South India, providing valuable insights for the practical adoption of green concepts.

Table 4 Most influential articles

Author	Title	TC
Klewitz & Hansen, (2014)	"Sustainability-oriented innovation of SMEs: A systematic review"	757
Mathiyazhagan et al., (2013)	"An ISM approach for the barrier analysis in implementing green supply chain management"	587
Ciliberti et al., (2008)	"Investigating corporate social responsibility in supply chains: a SME perspective"	325
Moore & Manring, (2009)	"Strategy development in small and medium sized enterprises for sustainability and increased value creation"	306
Lee et al., (2012)	"Green supply chain management and organizational performance"	265
Mohanty & Prakash, (2014)	"Green supply chain management practices in India: An empirical study"	131
Kot, (2018)	"Sustainable supply chain management in small and medium enterprises"	123
Zhou et al., (2018)	"Sustainable recycling partner selection using fuzzy DEMATEL-AEW-FVIKOR: A case study in small-and-medium enterprises (SMEs)"	118
Shibin et al., (2020)	"Examining sustainable supply chain management of SMEs using resource based view and institutional theory"	115
Li & Mathiyazhagan, (2016)	"Application of DEMATEL approach to identify the influential indicators towards sustainable supply chain adoption in the auto components manufacturing sector"	112

4.5 Establishing the Knowledge Foundations through Co-citation Analysis

The co-citation analysis, unveils intricate connections and thematic clusters within scholarly literature by identifying articles that are frequently cited together, thus illuminating key themes and influential works in the research domain (Donthu et al., 2021). Figure 2 visually illustrates the co-citation map, showcasing references that have been cited at least eight times by the articles within our review corpus, providing a comprehensive overview of key connections and influential works in the research domain. Notably, authors such as Seuring, Barney, Carter, Hall, and Rao (depicted as red nodes) significantly cited a specific domain within sustainable supply chain management research for SMEs. Likewise, authors Green, Rao, Zhu, and Sarkis (shown as green nodes) cited works within a distinct area of sustainable supply chain management research in SMEs. Similarly, authors Srivastava, Perron, and Ahi (displayed as blue nodes) have substantially cited works from a specific domain within sustainable supply chain management research for SMEs. Authors Fornell, Nunnally, and Seuring (represented by yellow nodes) have significantly cited works within a particular domain of sustainable supply chain management research in SMEs.

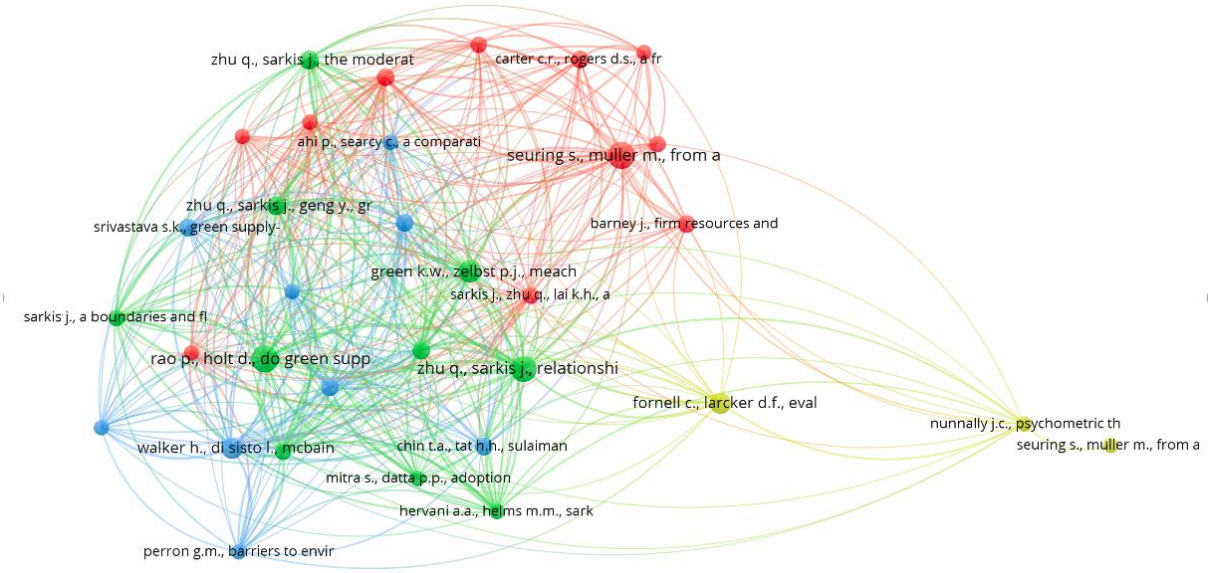

Figure 2 Co-citation of references

4.6 Bibliographic Coupling Analysis: Thematic and Influence Structure

Using bibliographic coupling analysis, Table 5 presents the theme clusters of research on sustainable supply chain management in SMEs. The six topic groupings are as follows: 1. Sustainable Supply Chain Management and Environmental Performance, 2. Sustainability and Responsiveness in SME Supply Chains, 3. Green Supply Chain Management in Small and Medium-sized Manufacturing Enterprises, 4. Sustainable Manufacturing Practises and 5. Green Supply Chain Integration in SMEs, and 6. Advancements in SSCM for SMEs. The inclusion of the most influential articles from each cluster can be observed in Table 5. The five groups encompass all facets of research on sustainable supply chain management within the context of SMEs.

Cluster 1 Sustainable Supply Chain Management and Environmental Performance

A 1987–2010 comprehensive review by Klewitz and Hansen (2014) examines sustainability-oriented innovations (SOIs) in SMEs. It examines varied sustainability and innovation practises and emphasises integrating ecological and social factors into SMEs' goods, processes, and structures. Eco-innovation is common, and the research proposes an integrated framework integrating sustainability behaviours to innovation practises, emphasising radical SOIs in proactive SMEs. Similarly, (Zhou et al., 2020) emphasises sustainable supply chain management practises at the base, evaluating recycling partners based on economic, environmental, and social factors. Fuzzy-based analysis of qualitative and ambiguous data is used to develop a new recycling partner selection paradigm. Moreover, Li & Mathiyazhagan, (2016) discusses industrial pollution and the need for sustainable implementation, especially in SMEs. It develops and analyses Sustainable Development (SD) measurement indicators. Fifteen SD indicators were assessed using DEMATEL and expert talks. Carbon management, specifically embedded or embodied carbon (SI2) indicator, was crucial for gauging sustainable growth.

Cluster 2 SME Supply Chain Sustainability and Responsiveness

The most important work in this cluster examined SSCM of SMEs utilising resource-based view and institutional theory (Shibin et al., 2020). The study emphasises that social, environmental, and economic factors determine an organization's long-term sustainability. The hypothesis testing showed that top management belief and engagement mediated coercive constraints, which significantly influenced resource selection, notably supply chain connection and information sharing. Their impact on environmental performance was enormous. Contrary to expectations, normative and mimetic influences did not affect senior management engagement. Furthermore, Shibin et al., (2018) also examined frugal innovation for SME supply chain sustainability. The research confirms a conceptual framework for developing sustainability-oriented frugal creative supply chain capabilities. Most interpretive relationships are supported by empirical evidence, helping managers acquire frugal innovation skills for sustainability in resource-constrained environments. Moreover, (Ayuso et al., 2013) found that larger businesses are the most demanding customers in terms of CSR requirements imposed on their SME suppliers. SMEs, in turn, effectively transmit these CSR requirements received from larger customers to their own suppliers. This underscores the role of SMEs in propagating CSR requirements through the supply chain, emphasizing their significance in SSCM.

Cluster 3 Green supply chain management in SME manufacturing

An ISM technique for green supply chain management barrier analysis was studied by Mathiyazhagan et al. (2013). Indian auto component manufacturing SMEs face 26 impediments to GSCM implementation. The Interpretive Structural Modelling (ISM) qualitative analysis shows that the supplier barrier is most important, especially for environmental awareness during GSCM implementation. This helps industries prioritise efforts to overcome this major GSCM adoption obstacle.

Lee et al. (2012) examined green supply chain management and organisational performance. Directly linking Green Supply Chain Management (GSCM) practise implementation to corporate performance was not significant, while operational and relational efficiency showed strong indirect linkages. This shows that GSCM increases corporate performance by increasing efficiency. An empirical study by Mohanty and Prakash (2014) on green supply chain management in India. The study indicates that Indian MSMEs experience significant external pressures to implement Green Supply Chain Management (GSCM) practises. MSMEs also embrace GSCM practises due to internal pressure from on-the-job training. External pressures and GSCM adoption in Indian MSMEs are mediated by internal forces.

Cluster 4 SME Sustainable Manufacturing Practises and Green Supply Chain Integration

The most influential work on green data analytics, blockchain technology for sustainable development, and sustainable supply chain practises: evidence from small and medium firms was conducted by Khan et al. (2021). Blockchain and green information systems improve SME supply chain sustainability. Sustainable supply chain practises boost operational, environmental, and economic performance. Thus, these sustainability factors boost organisational performance. The findings demonstrate blockchain technology's benefits and highlight green supply chain practises for organisational success.

They studied Unleashing top management and government assistance in green supply chain management and sustainable development (Ilyas et al., 2020). In Pakistani SMEs, top management support greatly impacts green supply chain management, environmental, and community-based SDGs. Executive support and environmental/community SDG practises are mediated by green supply chain management. Government support enhances top management-green supply chain management links. This shows that top management and government support for SMEs in green SDGs is crucial.

In addition, (Afum et al., 2020) examined how green supply chain integration explains sustainable performance in Ghanaian manufacturing SMEs. The study of Ghanaian manufacturing SMEs found that green manufacturing practises (GMPs) improve economic, environmental, and social sustainability. GMPs also affect green supply chain integration (GSCI), which improves sustainability. Managers should invest in GMPs and promote eco-friendly supply chain relationships to improve sustainability in emerging countries.

Cluster 5 SMEs' Sustainable Supply Chain Management Advancements

One of the most prominent studies in this cluster is Sustainable supply chain management in SMEs (Kot, 2018). SMEs should integrate sustainable supply chain management (SCM) techniques that address business, environmental, and social sustainability. SME supply chain management must balance sustainability across all domains.

Wang et al. (2018) examined how business size affects sustainable supply chain management and performance. SSCM practises improved environmental and social performance in Chinese enterprises. Firm size moderates SSCM's economic impact. SSCM improves large companies' economic performance more than SMEs. A thorough SSCM

practise performance model incorporating firm size as a moderating element offers enterprise-scale-specific SSCM recommendations.

Considering the triple bottom line of sustainable development (economic, environmental, and social factors), Liang et al. (2018) present a new SME financing evaluation model for supply chain finance. It uses Topsis and fuzzy multi-criteria evaluation. The concept addresses supply chain SME funding issues by balancing economic rewards and sustainability. Financial institutions can minimise hazards and promote sustainable SME development using it.

Table 5 Thematic clusters through bibliographic coupling

Theme	Authors	Title	TC
Sustainable Supply Chain Management and Environmental Performance	Klewitz & Hansen, (2014)	"Sustainability-oriented innovation of SMEs: A systematic review"	757
	Zhou et al., (2018)	"Sustainable recycling partner selection using fuzzy DEMATEL-AEW-FVIKOR: A case study in small-and-medium enterpries (SMEs)"	118
	Li & Mathiyazhagan, (2016)	"Application of DEMATEL approach to identify the influential indicators towards sustainable supply chain adoption in the auto components manufacturing sector"	112
Sustainability and Responsiveness in SME Supply Chains	Shibin et al., (2020)	"Examining sustainable supply chain management of SMEs using resource based view and institutional theory"	115
	Shibin et al., (2018)	"Frugal innovation for supply chain sustainability in SMEs: multi-method research design"	90
	Ayuso et al., (2013)	"SMEs as "transmitters" of CSR requirements in the supply chain"	89
Green Supply Chain Management in Small and Medium-sized Manufacturing Enterprises	Mathiyazhagan et al., (2013)	"An ISM approach for the barrier analysis in implementing green supply chain management"	587
	Lee et al., (2012)	"Green supply chain management and organizational performance"	265
	Mohanty & Prakash, (2014)	"Green supply chain management practices in India: An empirical study"	131
Sustainable Manufacturing Practices and Green Supply Chain Integration in SMEs	Khan et al., (2021)	"Green data analytics, blockchain technology for sustainable development, and sustainable supply chain practices: evidence from small and medium enterprises"	108
	Ilyas et al., (2020)	"Unleashing the role of top management and government support in green supply chain management and sustainable development goals"	87
	Afum et al., (2020)	"Green manufacturing practices and sustainable performance among Ghanaian manufacturing SMEs: the explanatory link of green supply chain integration"	71
Advancements in Sustainable Supply Chain Management for SMEs	Kot, (2018)	"Sustainable supply chain management in small and medium enterprises"	123
	Wang et al., (2018)	"Moderating the role of firm size in sustainable performance improvement through sustainable supply chain management"	67
	Liang et al., (2018)	"Small and medium-sized enterprises sustainable supply chain financing decision based on triple bottom line theory"	39

4.7 Thematic trends of sustainable supply chain management research in SMEs

In building upon the foundations and subject areas revealed through co-citation analysis and bibliographic coupling, we delve into the prevailing themes within sustainable supply chain management (SSCM) research concerning SMEs using co-occurrence analysis. The analysis is based on authors' keywords and a chronological filter is applied to spotlight the evolving trends in SSCM for SMEs featured in a minimum of three articles within our review corpus. This thematic analysis and its progression are visually presented in Figure 3.

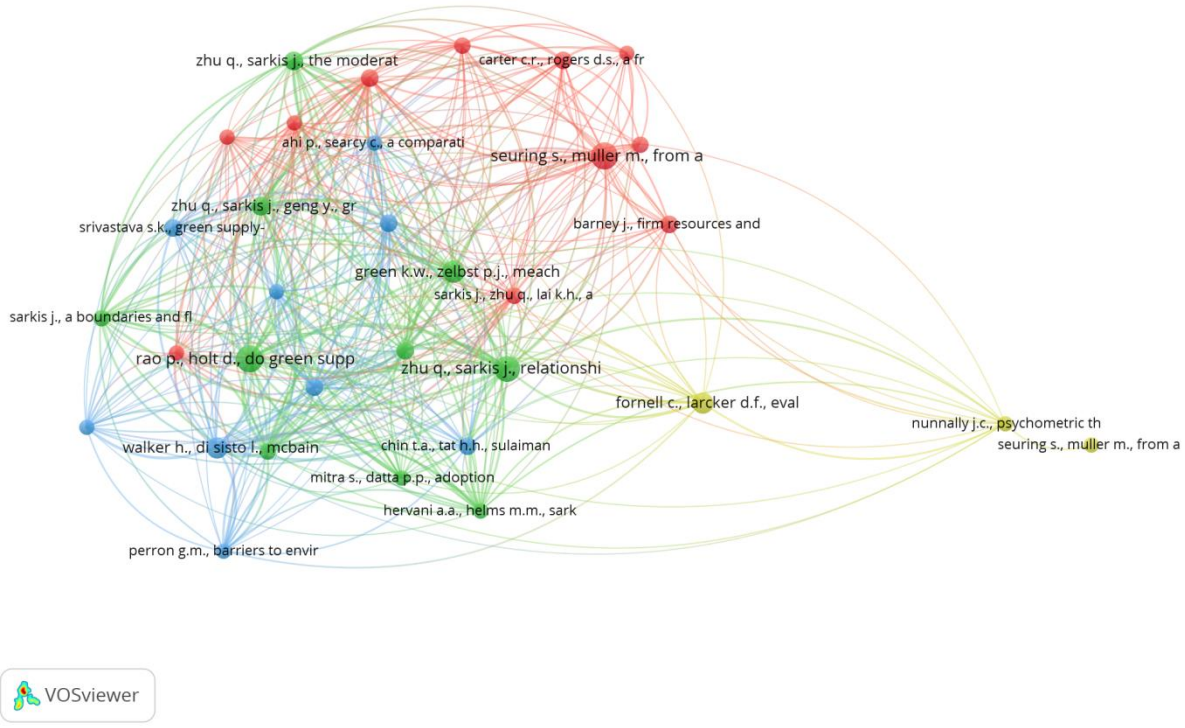

Figure 3 Thematic trend of SSCM in SMEs

5. Conclusion and implications

The analysis of productivity trends, noteworthy authors, institutions, countries, pivotal journals, and seminal articles in sustainable supply chain management research in SMEs has provided valuable insights into the current state and trajectory of research in this field. Particularly, 2023 emerged as a productive year, indicating a growing momentum in research output. Authors such as Klewitz and Mathiyazhagan, institutions like Leuphana University Lüneburg, and countries such as China and India have significantly contributed to the body of knowledge in this area. The "Journal of Cleaner Production" and "Sustainability (Switzerland)" have become important sources of study due to their notable publications discussing sustainability-oriented innovation and challenges to the adoption of green supply chain management. Thematic patterns found by co-occurrence analysis also point to important areas of emphasis, such as improvements in SMEs' sustainable supply chain management, environmental performance, supply chain sustainability and responsiveness, and GSCM in SME manufacturing. These results highlight how crucial it is to carry out further research in order to close knowledge gaps and enhance our understanding of sustainable supply chain management for SMEs. The insights garnered from this analysis have significant implications for academia, industry, and policy makers. Academically, the identification of research gaps, thematic trends, and influential contributors provides a roadmap for future research endeavors. Scholars can leverage this knowledge to explore underexplored areas, develop theoretical frameworks, and conduct empirical studies to enhance understanding and drive innovation in sustainable supply chain management for SMEs. Industry practitioners can benefit from the identification of best practices, barriers, and emerging trends to inform decision-making and strategic planning in implementing sustainable supply chain practices. Policy makers can use these insights to design supportive policies and initiatives that foster sustainability in SME supply chains, thereby contributing to broader societal and environmental goals. Overall, this detailed review and analysis prepares the ground for collaboration between researchers, practitioners and policy makers to develop

sustainable supply chain management strategies and drive positive social, economic and environmental effects in small and medium-sized enterprises.

6. Limitations and future research directions

Although this study offers insightful information on SSCM research in SMEs, it should be noted that it has some limitations. Firstly, the bibliometric analysis used in this study mostly relies on quantitative data from scholarly publications, which may leave out qualitative nuances and contextual factors that have an impact on SMEs' SSCM practices.Subsequent investigations ought to supplement bibliometric analysis with qualitative techniques like focus groups, interviews, and case studies to offer a more thorough comprehension of the challenges associated with the application of SSCM in SMEs..

Secondly, the scope of this study is limited to academic publications that are indexed in the scopus database. This may overlook relevant literature that has been published in other databases, such as conference proceedings and the web of science, which could offer crucial insights into the difficulties faced by SMEs and SSCM practices. Future research could broaden the scope to include a more extensive range of data sources.

Additionally, although the thematic analysis revealed important topics and trends in SSCM research, the analysis is based only on the keywords provided by the authors, which might not adequately convey the breadth and complexity of SSCM practices and issues facing SMEs. Further research might make use of advanced text mining and natural language processing techniques to examine full-text articles and provide deeper insights into the evolving themes and trends in SSCM studies. Despite these limitations, this study offers valuable insights into the current state and trends of SSCM research within SMEs, laying the groundwork for future research endeavors. Further research might make use of advanced text mining and natural language processing techniques to examine full-text articles and provide deeper insights into the evolving themes and trends in SSCM studies.

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