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SUSTAINABLE SUPPLY CHAIN RESEARCH (2002-2024): A BIBLIOMETRIC ANALYSIS OF GLOBAL TRENDS AND ASIAN COLLABORATION

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Abstract

This study provides a comprehensive bibliometric analysis of sustainable supply chain research from 2002 to 2024, examining global trends, Asian collaborations, and key research domains. Based on 1,014 Scopus-indexed articles, the analysis reveals exponential growth in the field, with a notable increase in publications from Asia. Thematic clustering identifies four key areas: environmental management and circular economy, digital innovation and Industry 4.0, risk and resilience, and social responsibility and stakeholder engagement. Emerging co-authorship patterns, particularly within ASEAN countries, highlight the growing strength of South-South knowledge exchange. The findings offer insights into regional research gaps, underexplored research linkages, and future research directions aligned with the UN Sustainable Development Goals (SDGs). This study provides practical insights for scholars, practitioners, and policymakers seeking to enhance sustainable supply chain practices, particularly in the context of rapid industrialization and complex sustainability challenges in Asia. The analysis contributes to the sustainability discourse by highlighting the evolution of research themes and collaborative networks in the field.

Keywords: Sustainable Supply Chain, Bibliometric Analysis, Global Trends, Asian Collaboration, Research Evolution

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Introduction

Global companies' strategic priorities in the 21st century have become supply chain performance and sustainability. From an operational support function to a key source of competitive advantage, supply chain management's role has changed substantially (Al-Khawaldah et al., 2022; Le et al., 2022). This change shows the rising complexity of worldwide corporate operations, as corporations must strike a balance between efficiency and rising social and environmental obligations. Early supply chain performance models stressed lean operations and cost efficiency. But with time, this single-mindedness has grown to encompass social responsibility and ecological effect as the primary performance criteria (Ding et al., 2023; Kalaitzi & Tsolakis, 2022). This shift fits with increasing stakeholder pressure and the understanding that sustainable practices influence long-term competitiveness. Recent research indicates that businesses with official sustainability pledges currently account for a significant portion of the worldwide GDP (Ellili, 2024). The COVID-19 epidemic further highlighted the need for resilient, sustainable supply networks. The broad disturbances set off a rethinking of global sourcing, inventory control, and risk reduction techniques (Eggert & Hartmann, 2023; Ozdemir et al., 2022). Many companies have been motivated by this to include sustainability more profoundly in performance management systems (Mio et al., 2022).

In the last two decades, academic interest in supply chain performance and sustainability has increased dramatically. A bibliometric scan of Scopus shows that the number of publications in this field rose from only 45 in 2002 to 1,890 by 2023, a growth rate of almost 4,000% (Geng et al., 2017; Theeraworawit et al., 2022). Research production is led by the United States, China, and the United Kingdom, hence underlining worldwide awareness of these interrelated concerns (Alaloul et al., 2022; Enciso-Alfaro & García-Sánchez, 2023). Notwithstanding this development, essential research voids still exist. Many earlier bibliometric studies have looked at supply chain performance and sustainability independently, therefore missing the synergies and trade-offs between them, particularly in a post-pandemic setting (Kuipers et al., 2022; Malacina & Teplov, 2022). Most current studies, therefore, are based on traditional academic outputs, hence ignoring the growth of alternative distribution routes, including social platforms and open-access repositories (Siems et al., 2023; Farooq, 2024).

Little study has explored how geographical and economic settings influence sustainability priorities and research methods, a gap particularly relevant considering the challenges faced by developing countries (Golgeci et al., 2021). While digital transformation is widely recognized as a game-changer, its impact on both research directions and practical applications in supply chain sustainability remains underexplored (Nayal et al., 2024). To address these gaps, this study undertakes a comprehensive bibliometric analysis (Zhang et al., 2021) that integrates sustainability and performance perspectives across two decades, incorporates both traditional and emerging publication sources, examines how regional and economic contexts influence research directions, analyzes the effects of global disruptions like COVID-19 on academic priorities, and evaluates the impact of digital and technological innovations on the field's development. This analysis aims to offer valuable insights into the intellectual landscape and evolution of sustainable supply chain management, providing direction for future research and practical strategies in the era of global uncertainty and digital innovation.

Methods

This study employs a comprehensive bibliometric analysis to examine the evolution and trends in supply chain performance and sustainability research. The research design follows a systematic and structured approach that ensures both reliability and reproducibility of results, addressing key methodological considerations highlighted in recent bibliometric studies (Hettiarachchi et al., 2022; Malacina & Teplov, 2022; Theeraworawit et al., 2022).

For data collection, the researchers used the Scopus database with the search terms “supply chain” combined with “performance” or “efficiency” and “sustainability” or “sustainable development” in the title, abstract, or keywords. The search was conducted on March 15, 2024, limited to peer-reviewed English-language publications. Editorials, letters, and retractions were excluded. Data analysis was performed using R software with the Bibliometrix and Biblioshiny packages. Louvain clustering was applied for network analysis to ensure the reliability and reproducibility of the results.

Table 1 Main Bibliometric Information of Supply Chain Performance and Sustainability Research (2002-2024)

Description	Results
Main Information About Data	
Timespan	2002-2024
Sources (Journals, Books, etc)	593
Documents	979
Annual Growth Rate %	32.42
Document Average Age	2.84
Average citations per doc	0
References	39,335
Document Contents	
Keywords Plus (Id)	3,555
Author's Keywords (De)	2,306
Authors	
Authors	2,628
Authors Of Single-Authored Docs	110
Authors Collaboration	
Single-Authored Docs	113
Co-Authors Per Doc	2.85
International Co-Authorships %	22.47
Document Types	
Article	404
Book	15
Book Chapter	134
Conference Paper	270
Conference Review	113
Erratum	3
Note	3
Review	33
Short Survey	4

Scope and Data Collection

This paper investigates the development of supply chain performance and sustainability studies from 2002 to 2024. Widely regarded as one of the most complete stores of peer-reviewed literature, the Scopus database provided the data. Scopus was selected because of its extensive article coverage and consistent bibliometric indexing, which are well-suited for longitudinal studies.

Initially driven by the methodology suggested by Zrelli & Rejeb (2024), the search strategy followed an organized and systematic approach, first guided by current bibliometric studies in supply chain management, such as that by Garcia-Buendia et al. (2022). Comprising 979 papers from 593 different sources, including scholarly journals, books, and conference proceedings,

the final dataset. This broad coverage guarantees that significant field contributions were included and thoroughly assessed.

Data Analysis Framework

The study employed a mix of quantitative and qualitative bibliometric tools to draw out significant results. Three fundamental approaches shaped the analytical process: relying on generally known bibliometric measures, where performance analysis examined publishing patterns, citation statistics, and the output of published sources (Cucari et al., 2023); utilizing science mapping, which comprised co-citation analysis, bibliographic coupling, and keyword co-occurrence analysis to reveal the intellectual structure of the study field (Kleminski et al., 2022); and employing social network analysis methods, where network analysis investigated knowledge transfer between countries and institutions as well as cooperation dynamics (Isfandyari-Moghaddam et al., 2023).

Analytical Tools and Procedures

R Studio with specialized bibliometric software designed for advanced scientific mapping was used to conduct all studies. The methodological basis corresponds to the suggested framework (Farooq, 2024) , which stresses bibliometric research's reproducibility, openness, and statistical accuracy.

To further deepen the analysis, several advanced bibliometric techniques were employed as follows: advanced bibliometric metrics, including betweenness centrality and modularity, were applied to identify influential keywords and thematic clusters. An overlay visualization was also generated to capture the temporal evolution of key research themes across the dataset. These techniques allowed for a more granular understanding of the structural shifts and emerging focal points within the field of supply chain sustainability. The modularity optimization was based on the Louvain algorithm, while temporal overlays were constructed using the Thematic Map function in Biblioshiny, enabling year-based topic differentiation and cluster evolution tracking.

Quality Control Measures

Several quality assurance procedures were implemented to ensure the authenticity and reliability of the dataset. Following methods developed by Rzymski et al. (2020), bibliographic data were systematically standardized and cleaned. Key indicators and citation statistics underwent verification through multiple cross-validation processes. Any inconsistencies identified were addressed and resolved through a combination of automated techniques and manual review procedures.

Analytical Framework

Descriptive Analysis, to find trends in publication volume, authorship patterns, and source dispersion. To investigate how research collaborations have changed over time across universities and nations. To track the evolution of significant research themes and their change over time. Grounded in accepted bibliometric techniques, this integrated system also uses current developments in data visualization and analytics (Jing et al., 2024). A thorough knowledge of the structural and thematic evolution of sustainable supply chain research is made possible by the combination of strong methodologies and technological tools.

Result

Publication Trends

From 2002 to 2024, the bibliometric findings indicate that notable changes in research production are connected to supply chain performance and sustainability. Publication trends, source distributions, and authorship traits are thoroughly examined in this part.

Temporal Evolution of Publications

Over the time examined, the findings indicate an extraordinary increase in research production related to supply chain performance and sustainability. Starting with only 1 publication in 2002,

the number of articles grew modestly through the early years, reaching 10 in 2009. It then accelerated rapidly to 137 in 2023 and peaked at 482 publications in 2024. This exponential growth trend is clearly illustrated in Table 2, which presents the annual publication output from 2002 to 2024. A notable inflection point occurred in 2013 with 21 publications, signaling the beginning of sustained scholarly attention. The upward trajectory continued through 2020-2024, reflecting both increasing academic interest and global emphasis on sustainability-oriented supply chains. This pattern aligns with the findings of Theeraworawit et al. (2022), who noted the growing momentum in research focused on sustainable supply chain management. The quantitative data shown in Table 2 not only substantiates this trend but also underscores the critical periods of acceleration in the field's intellectual development.

Table 2 Annual Publication Output (2002-2024)

Year	Articles
2002	1
2003	3
2004	5
2005	4
2006	2
2007	7
2008	4
2009	10
2010	14
2011	12
2012	12
2013	21
2014	17
2015	15
2016	14
2017	25
2018	24
2019	28
2020	34
2021	57
2022	51
2023	137
2024	482

Leading Publication Sources

The journal Sustainability (Switzerland) emerges as the most prominent publication venue, contributing 24 articles to the field, followed by Lecture Notes in Networks and Systems (22 articles) and IFIP Advances in Information and Communication Technology (15 articles). These leading sources indicate the highly interdisciplinary nature of supply chain sustainability research, integrating themes from environmental science, engineering, and information systems. As illustrated in Figure 1, the cumulative occurrences of publications across these top sources reveal distinct temporal patterns. Notably, IFIP Advances shows a steady progression from the early 2000s. At the same time, Sustainability (Switzerland) demonstrates a sharp rise starting around 2021, highlighting its recent emergence as a dominant outlet for high-impact contributions. The accelerated growth of Lecture Notes in Networks and Systems and the increasing presence of conference proceedings such as the International Conference on Industrial Engineering and Operations Management reflect the field's responsiveness to

technological change and practitioner-focused dissemination. The visual trendlines in Figure 1 not only confirm the growth in academic output but also emphasize the diversification of research dissemination platforms in the post-pandemic period, marking a shift toward more dynamic and multi-disciplinary scholarly communication.

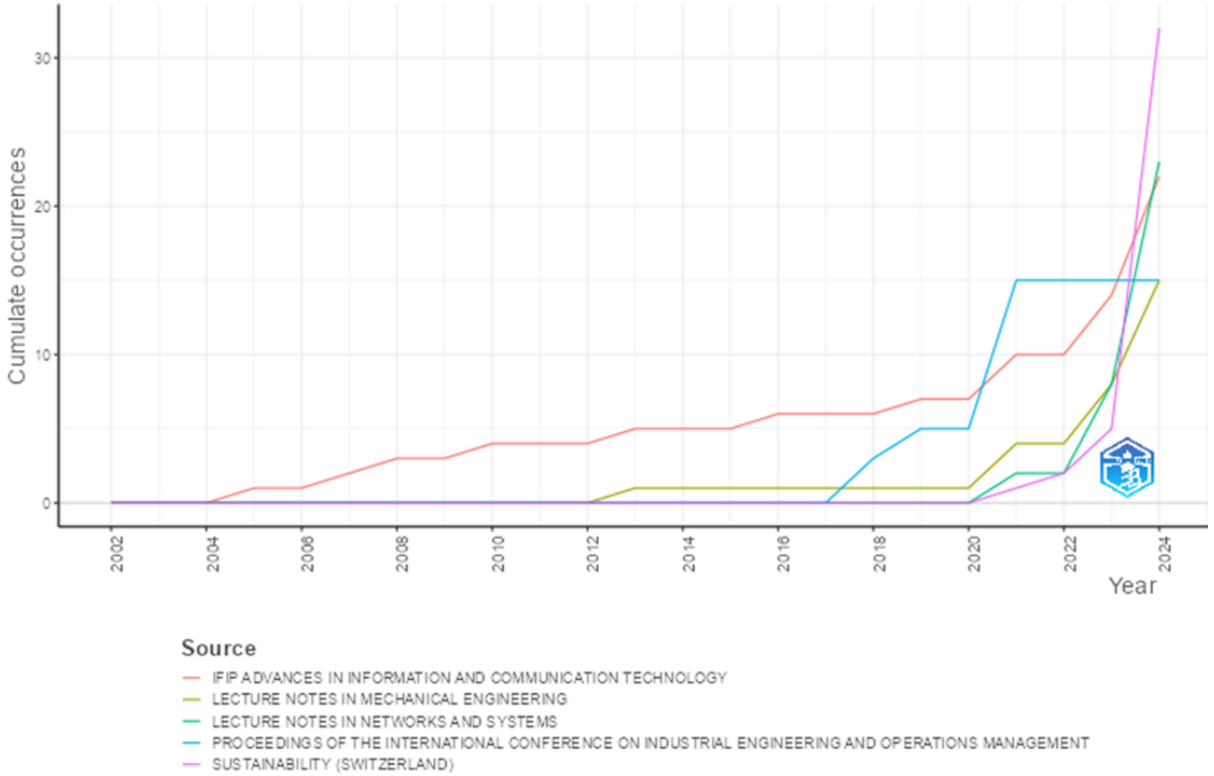

Figure 1 Source Production Over Time

Author Productivity Analysis

The productivity analysis of leading authors highlights those who have significantly shaped the advancement of research on supply chain performance and sustainability. The most productive contributors lead the field with six publications (fractionalized count = 1.78), followed by several scholars with five articles (fractionalized counts between 1.53 and 2.58). One author demonstrates a particularly high fractionalized score, signifying a strong influence in collaborative research output. Others produced four publications each, reflecting the field's broad intellectual participation and extensive multi-institutional collaboration.

This pattern is visually depicted in Figure 2, which illustrates the temporal distribution of author activity and publication output from 2016 to 2024. The size of each circle corresponds to the number of articles, while the timeline shows when those contributions occurred. The figure clearly indicates a surge in author productivity in the period 2022-2024, aligning with the global intensification of interest in sustainable supply chain topics. In contrast, newer contributors show concentrated productivity in recent years, reflecting an influx of fresh perspectives into the discourse. The integration of this visual data enhances our understanding of the field's development dynamics and reinforces the significance of these authors in steering theoretical and practical advancements.

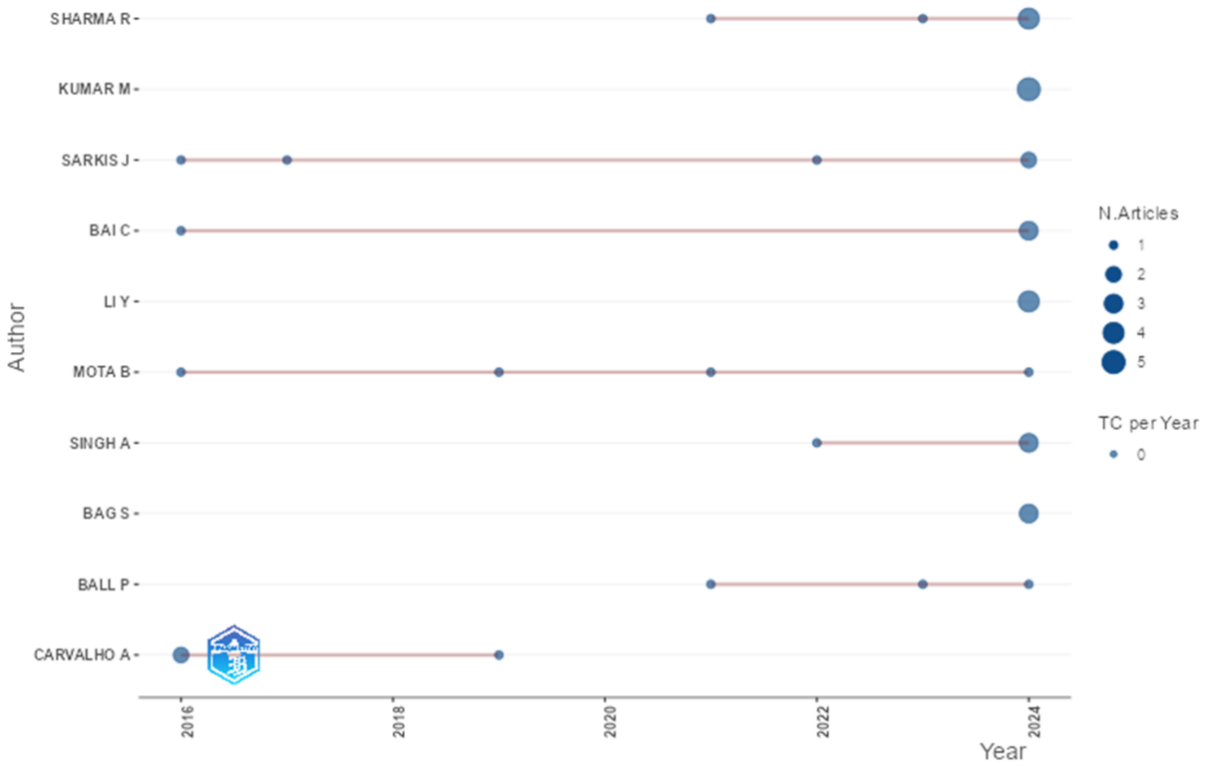

Figure 2 Author Production over Time

Temporal Analysis of Author Production

Analysis of authors' production over time reveals that most researchers began publishing consistently from 2016 onward, with heightened activity during 2022-2024. This pattern, as observed by Handoyo (2024), reflects increased attention to supply chain sustainability issues following the COVID-19 pandemic. The temporal distribution of publications indicates a maturing field with both established research streams and emerging new directions (Sahebi et al., 2024).

Publication Types and Impact

The publication types included 404 research articles, 270 conference papers, 53 review articles, 134 book chapters, and 15 books. This diverse publication profile, with an average document age of 2.84 years and an annual growth rate of 32.42%, indicates the field's rapid expansion. The high proportion of empirical research articles suggests increasing maturity in the field's theoretical foundations.

Current Trends and Cooperative Dynamics in Sustainable Supply Chain Research

The research scene in sustainable supply chain management has changed significantly throughout the last five years, showing a definite movement toward more integrated and forward-looking topics. Scholars have increasingly focused on topics including digital transformation, circular economy integration, resilience and sustainability trade-offs, social sustainability indicators, and the evaluation of climate change effects from 2020 to 2024. As Negri et al. (2021) underline, these new issues show how the sector responds to fast-changing global concerns and technical developments. The increasing interdisciplinarity of current studies and the complexity of their approaches further demonstrate a field in constant change. Not only is this momentum a sign of the academic maturity of the area, it also reflects its significance in tackling several of the most urgent problems of our time (Calzolari et al., 2022). Simultaneously, cooperation has become a defining characteristic of high-impact research in this domain. The bibliometric study of institutional affiliations and co-authorship trends uncovers a dynamic and geographically scattered network of scholarly activity. With 19

articles, Islamic Azad University is a notable contributor, indicating high institutional dedication to sustainability research. Though in some situations, the authors' identities were unknown, several other universities have also made noteworthy contributions, totaling 15 articles. Especially, while Bina Nusantara University and the University of Johannesburg follow closely with 12 and 11 publications, respectively, the Consiglio per la Ricerca in Agricultura e L'analisi dell'Economia Agraria and IPB University have both published 13 works. This variety emphasizes the worldwide reach of the field and the need for regional leadership in promoting sustainability objectives.

Examining the trends of academic cooperation more closely uncovers a fair combination of team-based and solo study. With an average of 2.85 authors per paper, there seems to be a reasonable degree of cooperative research across borders and disciplines. The 22.47% international co-authorship rate also indicates significant involvement in cross-national academic collaborations, which are vital for addressing global sustainability issues. The existence of 113 single-author papers is intriguing, as it implies that although cooperation is common, there is still room for individual contributions to provide concentrated, in-depth insights.

These developments taken together suggest a study area that is dynamic, inclusive, and increasingly sensitive to the practical complexity of sustainable supply chain management. The mix of innovative ideas, strong institutional involvement, and varied cooperation networks not only emphasizes the academic vibrancy of the area but also prepares the way for significant, solution-oriented research in the years to come.

Current Trends and Cooperative Dynamics in Sustainable Supply Chain Research

The sustainable supply chain management research landscape has significantly evolved in the last five years, demonstrably shifting toward more integrated and forward-looking topics. Scholars have increasingly focused on themes such as digital transformation, circular economy integration, resilience, sustainability trade-offs, social sustainability metrics, and climate change impact assessment during 2020-2024. As highlighted by Negri et al. (2021), these new areas of inquiry reflect the field's responsiveness to urgent global challenges and technological disruption. This increasing interdisciplinarity and methodological diversity points to a field undergoing intellectual maturation, underscoring the relevance and necessity of supply chain sustainability research in addressing complex socio-environmental problems (Calzolari et al., 2022).

Simultaneously, collaborative research has emerged as a hallmark of high-impact contributions. The bibliometric analysis of institutional affiliations and co-authorship trends reveals an expansive, globally distributed network of academic activity. As shown in Table 3, Islamic Azad University leads with 19 articles, underscoring its institutional commitment to sustainability research. Close behind are institutions such as IPB University and the Consiglio per la Ricerca in Agricoltura e L’analisi dell’Economia Agraria, each with 13 publications. Notably, Bina Nusantara University and the University of Johannesburg contribute 12 and 11 articles, respectively. Other contributors from diverse regions, including Suan Sunandha Rajabhat University (Thailand), Kwame Nkrumah University of Science and Technology (Ghana), and Università Politecnica Delle Marche (Italy), demonstrate that sustainability scholarship is not confined to any one geography but rather is deeply embedded in regional research ecosystems across continents. The wide institutional distribution reflected in Table 3 indicates a healthy mix of developed and emerging economies, suggesting increasing democratization of knowledge production in the sustainability domain.

A closer look at collaborative dynamics shows a balanced pattern between solo-authored and multi-authored contributions. The average of 2.85 co-authors per paper, along with an international co-authorship rate of 22.47%, suggests vibrant cross-border scholarly cooperation. However, the presence of 113 single-author publications also indicates that

individual intellectual contributions remain a valuable component of the field. This duality—collective and individual scholarship enriches the research landscape by accommodating both broad, networked inquiries and deep, focused investigations.

Taken together, these findings depict a research domain that is not only dynamic and inclusive but also increasingly attuned to the complex realities of sustainable supply chain management. The convergence of innovative thinking, institutional diversity, and global collaboration, as reflected in Table 3, sets the stage for the next generation of impactful, solution-driven research.

Table 3 Top Contributing Institutions in Supply Chain Sustainability Research

Affiliation	Articles
Islamic Azad University	19
Notreported	15
Consiglio Per La Ricerca in Agricoltura E L'analisi Dell'economia Agraria	13
IPB University	13
Bina Nusantara University	12
Iran University of Science and Technology	12
University of Johannesburg	11
University of Perugia	11
Kwame Nkrumah University of Science and Technology	10
University of Agricultural Sciences	9
Kiit Deemed to Be University	8
Suan Sunandha Rajabhat University	8
Swinburne University of Technology	8
The Hong Kong Polytechnic University	8
Chalmers University of Technology	7
Ferdowsi University of Mashhad	7
Institute of Advanced Materials for Sustainable Manufacturing	7
Università Politecnica Delle Marche	7

Geographic Distribution and International Collaboration

Regarding national contributions, India has confirmed itself as the top nation with 325 papers, followed by the United States with 229 papers, Italy with 224 papers, China with 222 papers, and Indonesia with 160 papers. This distribution reflects the worldwide character of supply chain sustainability concerns, with notable contributions from both developed and developing economies. Single Country Publications (SCP) and Multiple Country Publications (MCP) show different patterns of cooperation. "Countries like France, China, and Italy show especially high MCP ratios, suggesting strong international research networks."

Cross-Country Collaboration Analysis

Bilateral collaboration has become a central feature of sustainable supply chain research, facilitating knowledge exchange across cultural, economic, and regulatory boundaries. As shown in Table 4, the most active partnership is between China and Pakistan, producing 8 joint publications, reflecting shared interests in sustainability. The Italy-Spain collaboration follows closely with 6 co-authored works, highlighting strong intra-European academic engagement.

Other prominent pairings—including China-United Kingdom, India-China, India-France, India-UAE, India-USA, and United Kingdom-Australia—each resulted in 5 publications, indicating a balanced mix of Global North and South collaboration. India stands out as a central hub, involved in five of the top ten partnerships.

Outside of these high-frequency alliances, Thailand engages in several collaborations with countries such as Ethiopia, France, and Pakistan, albeit at lower levels. However, a notable

trend is the rise of Thailand-Malaysia collaboration, now evident in two peer-reviewed studies. The first, by Ishak et al. (2025), is a systematic literature review on sustainable supply chains in the electronics sector. The second, by Aunyawong et al. (2021), examines transportation practices during the COVID-19 crisis. Both reflect growing ASEAN-based cooperation.

These patterns illustrate a shift toward South-South and inter-regional collaboration, reducing reliance on Global North networks. The emergence of the Thailand-Malaysia partnership exemplifies how regional research clusters are forming to address local sustainability challenges while contributing to global discourse.

Table 4 Top International Research Collaborations

No.	From	To	Frequency
1	China	Pakistan	8
2	Italy	Spain	6
3	China	United Kingdom	5
4	India	China	5
5	India	France	5
6	India	United Arab Emirates	5
7	India	Usa	5
8	United Kingdom	Australia	5
9	China	Malaysia	4
10	India	United Kingdom	4
....	Thailand	Malaysia	2
....	Thailand	Ethiopia	1
....	Thailand	France	1
....	Thailand	Pakistan	1

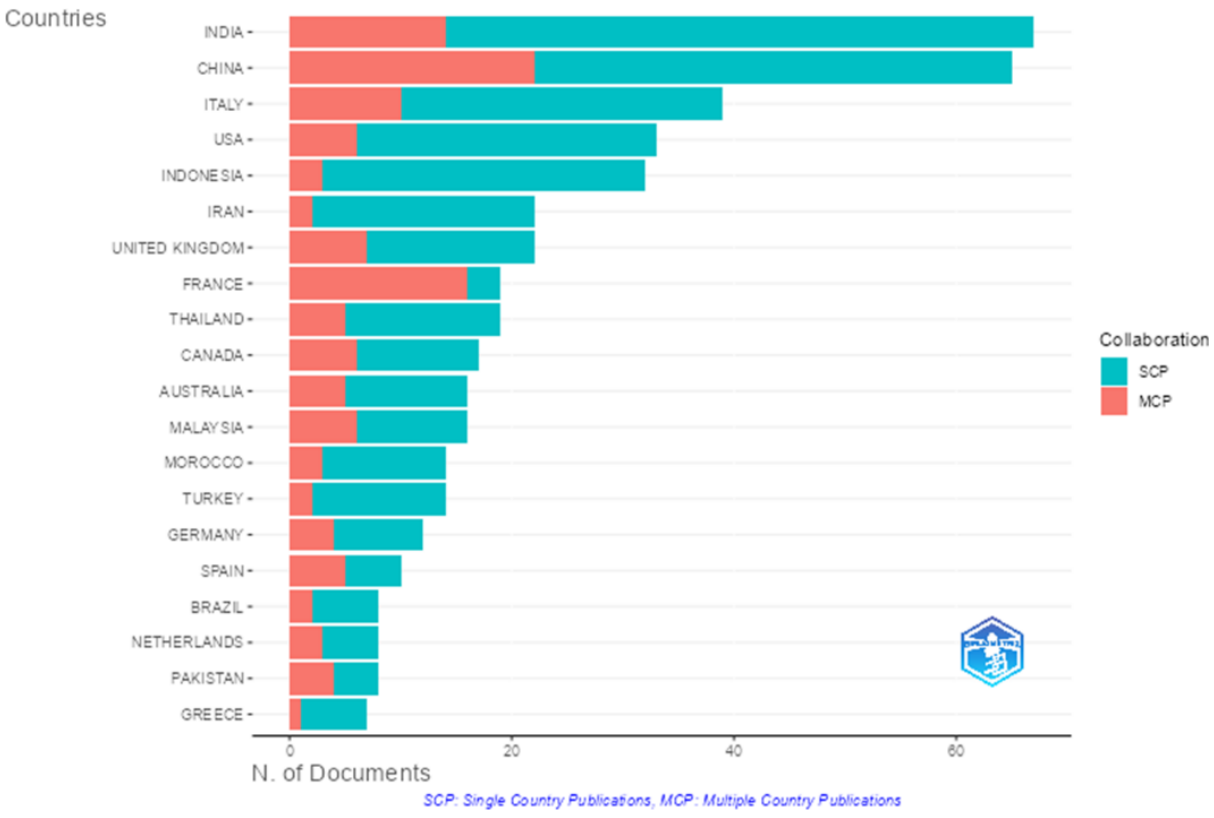

Figure 3 Corresponding Author's Countries

Table 5 Leading Countries in Supply Chain Sustainability Research

No.	Region	Freq
1	India	325
2	Usa	229
3	Italy	224
4	China	222
5	Indonesia	160
6	Uk	132
7	Australia	94
8	Iran	79
9	Malaysia	69
10	Spain	60
11	Germany	56
12	Thailand	54

Evolution and Future Directions

Temporal studies of collaboration networks reveal increasing internationalization and complexity, indicating the field's maturing sophistication (Garcia-Buendia et al., 2022). Virtual research environments and global platforms significantly advanced digital collaboration during 2020-2024 (Nureen et al., 2023). Emerging trends point to stronger industry-academia alliances and more cross-disciplinary cooperation, with improved regional networks and greater Global South involvement anticipated (Tsai et al., 2021). This contrasts with countries like Thailand, which exhibit more spatially varied cooperation patterns. Overall, the growth patterns of collaborative networks, particularly in the last five years, demonstrate ongoing enhancement and increasing awareness of the need for knowledge transfer. Nations with high publication outputs typically possess both robust domestic research capacity and extensive international cooperation networks, especially evident among BRICS countries (Masood et al., 2023). This variety of cooperative interactions suggests a dynamic and evolving research ecosystem in supply chain sustainability, with diverse areas and nations contributing in ways that suit their specific situations (Ellili, 2024).

Keyword Co-Occurrence Analysis

The analysis of keyword co-occurrence in supply chain performance and sustainability research from 2002 to 2024 reveals complex thematic relationships and evolving research priorities, as demonstrated through sophisticated bibliometric analysis techniques Kleminski et al. (2022).

Primary Keyword Distribution

The keyword co-occurrence analysis provides critical insights into the thematic focus of sustainable supply chain research. As illustrated in Figure 4, the term "sustainable development" stands out as the most frequently used keyword, appearing in 237 publications (15%), underscoring the central role of sustainability in the field. This is followed by "supply chains" with 211 mentions (13%) and "supply chain management" with 135 occurrences (8%), reflecting continued emphasis on integrating sustainability with core logistical functions. The network structure in the figure reveals strong linkages between these terms and other emerging concepts, such as resilience, circular economy, and digital transformation. By visualizing these relationships, Figure 4 not only confirms dominant research interests but also highlights the evolving intellectual landscape. This visual evidence supports the argument that sustainability is no longer an adjunct but a foundational principle in modern supply chain research.

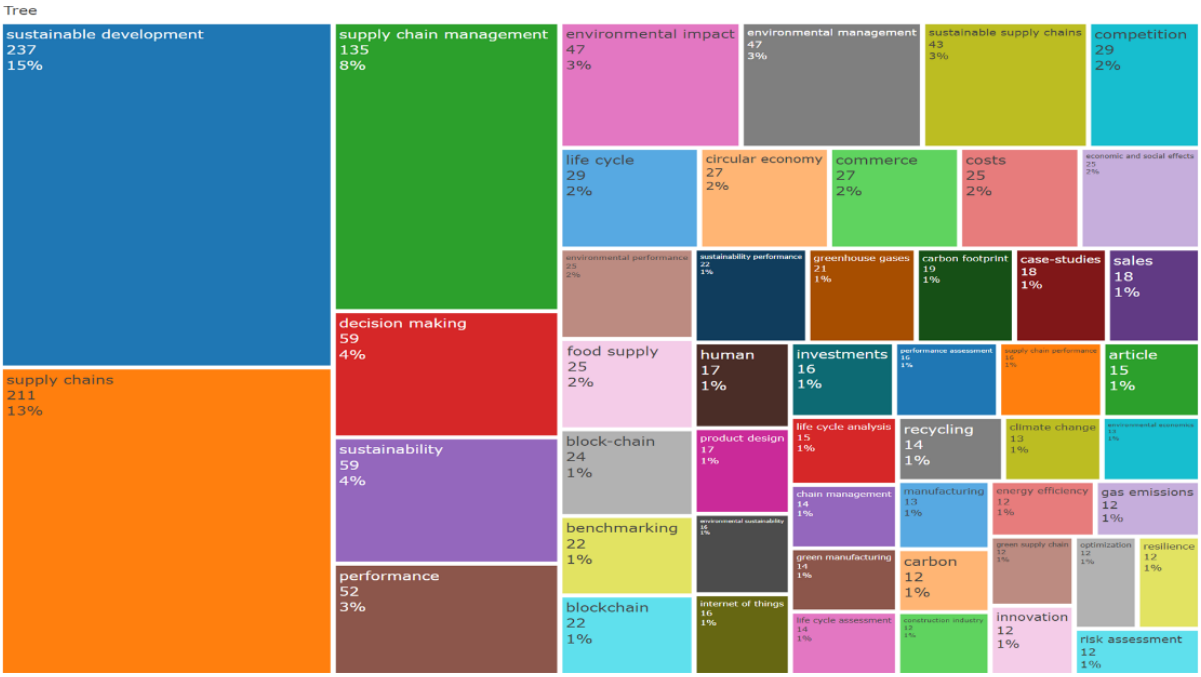

Figure 4 Keyword Co-occurrence Analysis

Environmental Dimension Analysis

The environmental cluster emerges as particularly prominent in keyword analysis. "Environmental impact" and "environmental management" each appear 47 times (3% of total occurrences). More specific environmental themes include "greenhouse gas emissions" (21 occurrences) and "carbon footprint" (19 occurrences), indicating growing attention to climate-related metrics in supply chain management research.

Emerging Management Concepts

The co-occurrence network visualization in Figure 5 reveals the growing prominence of modern management concepts in sustainable supply chain research. Notably, keywords such as “life cycle assessment” (29 occurrences), “circular economy” (27 occurrences), “blockchain technology” (22 occurrences), and “Internet of Things” (16 occurrences) form distinct thematic clusters, indicating strong interconnections with core sustainability terms. These concepts, visualized through interconnected nodes and color-coded communities, reflect a shift toward technology-driven and data-informed supply chain strategies. The central positioning of “sustainable development” and “supply chain management” further highlights their integrative roles in linking emerging innovations to established research foundations. As Kumar et al. (2023) noted, this convergence signifies the practical adoption of Industry 4.0 principles in sustainability-focused operations. Figure 5 thus supports a clearer understanding of how conceptual trends are evolving and interacting across the discipline.

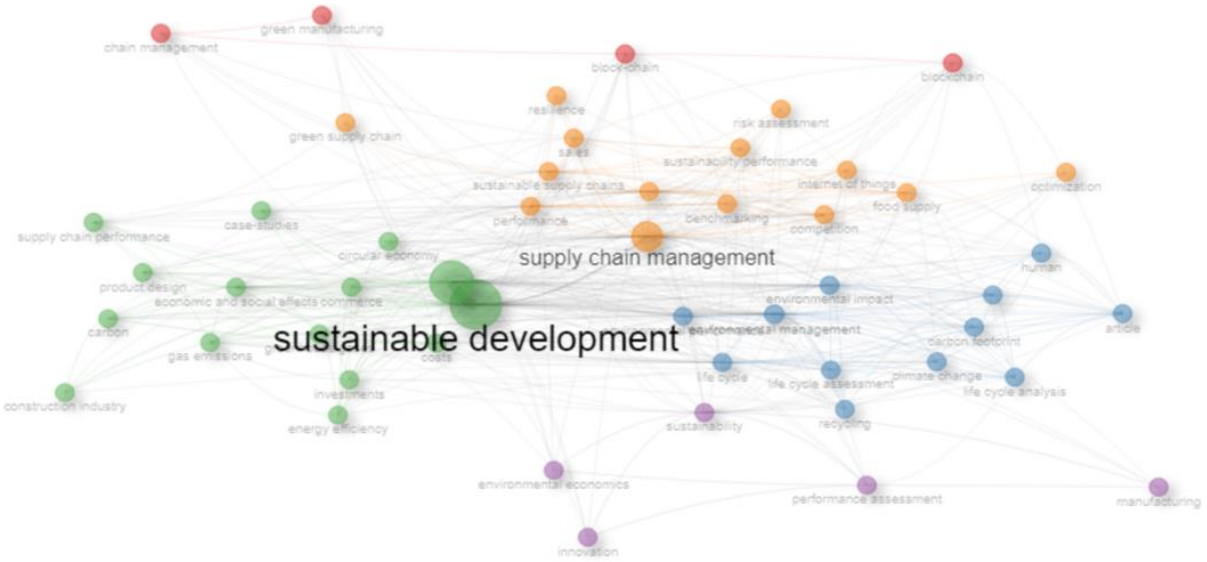

Figure 5 Keyword Co-occurrence Network Visualization

The keyword network analysis of this bibliometric study uncovered a tangled web of themes that have formed the research scene on supply chain performance and sustainability. Five notable keyword groupings appeared via network visualization, each stressing a unique field of academic concentration. One of the most dynamic clusters concentrated around technology and production innovation, where phrases like "blockchain," "chain management," and "green manufacturing" were essential. "Blockchain" especially showed a notable betweenness centrality score, suggesting its increasing importance in sustainable production systems (Hettiarachchi et al., 2022). This cluster highlights the growing integration of modern technology into supply chain management, acting as both an enabler and a disruptor of conventional procedures.

Equally noteworthy was the cluster concentrating on environmental impact management, where terms like "environmental management" and "environmental performance" showed great centrality, reflecting the strong academic focus on life cycle assessment and climate-related strategies (Fernando et al., 2022). Much of the quantitative and policy-driven work on the subject still stems from this domain. Another important area of attention was the economic and social aspects of sustainability, where keywords like "supply chains" and "economic and social impacts" ruled the scene. "Supply chains"' unusually high centrality score highlights its role as a conceptual center for combining economic viability with social and environmental issues, and manifestation of the triple bottom line strategy (Fernando et al., 2022).

The sustainability development cluster, on the other hand, showed an integrative viewpoint connecting environmental economics with invention and manufacturing. "Sustainability" as a significant node in this cluster highlights the unifying function it serves in spanning several subfields (Hettiarachchi et al., 2022). However, maybe the most strategically relevant is the cluster surrounding decision-making. Here, words such as "decision making" and "supply chain management" showed very high betweenness scores, suggesting their key function in linking various research topics and steering practical use (Zhang et al., 2021). The study of keyword use over time showed significant changes in research emphasis, especially in the post-2020 era. The statistics indicate a definite shift from conventional performance measures toward more comprehensive sustainability frameworks. According to Kuipers et al. (2022), the COVID-19 epidemic has significantly impacted this change by driving interest in resilience, risk management, and adaptive solutions within global supply networks. Apart from groupings, the research also found several notable works and important academics who have shaped the intellectual path of this discipline. Stroumpoulis & Kopanaki's (2022) conceptual framework

for sustainable supply chain management, which integrates environmental, economic, and social factors into a consistent structure, is among the most frequently cited and fundamental studies. Likewise, Saberi et al. (2019) published a groundbreaking article on the function of blockchain in sustainable supply chains, signaling a turning point in the integration of digital technology with sustainability goals.

Earlier works, such as Kalaitzi & Tsolakis' (2022) resource-based view, have reinforced theoretical foundations crucial for grasping competitive advantage in sustainable settings. Framed by environmental, economic, and social pillars, Carter & Rogers' (2008) work remains a touchstone for academics and practitioners (Goyal et al., 2021). Methodologically, Fornell & Larcker's (1981) work on structural equation modeling has had a lasting influence on the design and verification of empirical investigations, with its ongoing relevance emphasizing the need for thorough quantitative methods (Theeraworawit et al., 2022). Among recent contributions, Koberg & Longoni's (2019) study of global supply chain sustainability has influenced academic debate by addressing contemporary issues and opportunities, informing future research priorities (Handoyo, 2024). Similarly, Pagell & Wu's (2009) case study offered significant empirical proof of optimal practices, serving as a standard for qualitative research (Sauer & Seuring, 2023). The field's breadth has also been greatly influenced by regional viewpoints, exemplified by Geng et al.'s (2017) meta-analysis on green supply chain practices in Asian emerging economies, which is distinguished by its contextual depth and policy significance. This complex knowledge of regional dynamics (Karmaker et al., 2023) has shaped how sustainability is approached in various socio-economic settings. Together, these term clusters and prominent papers offer a comprehensive picture of the subject's theoretical and spatial development. They reflect a dynamic, multidisciplinary, and increasingly global research environment where technology, resilience, and sustainability converge to shape the future of supply chain management.

Figure 6 Evolution of Research Topics before and after COVID-19 (2002-2019 vs 2020-2024)

Future Research Directions in Sustainable Supply Chain Management

Analysis of research trends from 2002 to 2024 highlights four key directions poised to shape the future of sustainable supply chain management (SSCM). As visualized in Figure 6, terms such as “supply chain management,” “sustainability,” and “environmental impact” have gained substantial momentum, particularly post-2020, signaling a shift in research priorities.

Firstly, the integration of digital technologies with sustainability decision-making is paramount. While AI, big data, blockchain, and IoT enable real-time responses to sustainability challenges, practical frameworks for measuring their actual sustainability impact remain underdeveloped (Li et al., 2024).

Secondly, there is an urgent need to improve sustainability performance measurement. Despite increased mentions of "sustainability performance" and "environmental impact" (Figure 6), the literature lacks integrated indicators that holistically capture environmental, social, and economic dimensions. Silvestri et al. (2024) advocate for combining quantitative and qualitative tools, especially for assessing social sustainability impacts within life cycle assessments.

Thirdly, the resilience of global supply chains, especially post-COVID-19, remains a central concern. The pandemic exposed vulnerabilities, leading to increased focus on balancing resilience with sustainability values. Negri et al. (2021) and Ozdemir et al. (2022) advocate for flexible, contingency-ready supply networks committed to sustainability principles.

Fourthly, social sustainability and stakeholder inclusion are gaining overdue recognition. The 237 occurrences of "sustainable development" (Figure 7) highlight rising attention to CSR, equity, and stakeholder engagement. Researchers such as Rasool et al. (2022) and Kalaitzi & Tsolakis (2022) argue for aligning social goals with operational metrics to ensure inclusive, ethical, and resilient supply chain strategies.

Together, Figures 6 and 7 depict how the evolution of term frequency and topic clusters has shifted SSCM toward more integrated, technologically enabled, and socially aware pathways. These visualizations reinforce that the field is not only expanding in scale, but also in scope—setting a robust agenda for impactful and responsive future research.

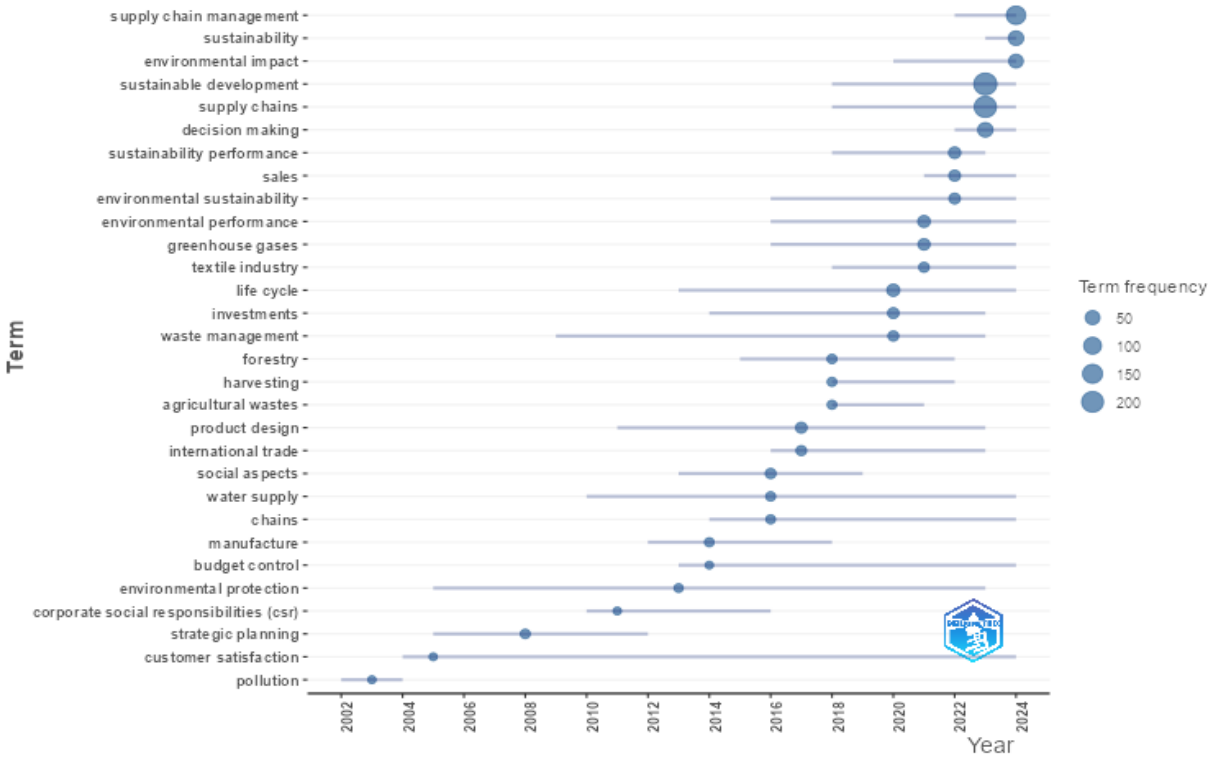

Figure 7 Trend Topics in Supply Chain Sustainability Research

Table 6 Most Influential Papers in Supply Chain Performance and Sustainability

Paper Title	Journal	Cited	Methodology	Reference
From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management	Journal of Cleaner Production	32	Literature review	Seuring & Müller (2008)
Blockchain Technology and its Relationships to Sustainable Supply Chain Management	International Journal of Production Research	14	Literature review	Saberi et al. (2019)
Firm Resources and Sustained Competitive Advantage	Journal of Management	13	Conceptual	Barney (1991)
A Framework of Sustainable Supply Chain Management: Moving Toward New Theory	International Journal of Physical Distribution & Logistics Management	13	Literature review	Carter & Rogers (2008)
Evaluating Structural Equation Models with Unobservable Variables and Measurement Error	Journal of Marketing Research	13	Methodological	Fornell & Larcker (1981)
A Systematic Review of Sustainable Supply Chain Management in Global Supply Chains	Journal of Cleaner Production	11	Systematic literature review	Koberg & Longoni (2019)
Building a More Complete Theory of Sustainable Supply Chain Management Using Case Studies of 10 Exemplars	Journal of Supply Chain Management	11	Multiple case studies	Pagell & Wu (2009)
Green Supply-Chain Management: A State-of-the-Art Literature Review	International Journal of Management Reviews	10	Literature review	Srivastava (2007)
The Relationship Between Green Supply Chain Management and Performance: A Meta-Analysis of Empirical Evidences in Asian Emerging Economies	International Journal of Production Economics	9	Meta-analysis	Geng et al. (2017)
Enhancing Supply Chain Performance Through Supplier Social Sustainability: An Emerging Economy Perspective	International Journal of Production Economics	9	Survey-based empirical study	Mani et al. (2018)
Integrating Sustainability and Resilience in the Supply Chain: A Systematic Literature Review and a Research Agenda	Business Strategy and the Environment	9	Systematic literature review	Negri et al. (2021)
Do Green Supply Chains Lead to Competitiveness and Economic Performance?	International Journal of Operations & Production Management	9	Survey-based empirical study	Rao & Holt (2005)
A Framework of Sustainable Supply Chain Management: Moving Toward New Theory	International Journal of Physical Distribution and Logistics Management	8	Literature review	Carter & Rogers (2008)
The Impact of Sustainable Supply Chain Management Practices on Firm Performance Lessons from Indian Organizations	Journal of Cleaner Production	8	Survey-based empirical study	Das (2018)
Achieving Sustainable Performance in a Data-Driven Agriculture Supply Chain A Review for Research and Applications	International Journal of Production Economics	8	Literature review	Kamble et al. (2020)
Evolution of Sustainability in Supply Chain Management: A Literature Review	Journal of Cleaner Production	8	Literature review	Rajeev et al. (2017)

Paper Title	Journal	Cited	Methodology	Reference
An Organizational Theoretic Review of Green Supply Chain Management Literature	International Journal of Production Economics	8	Literature review	Sarkis et al. (2011)
Effects of Green Supply Chain Management Practices on Sustainability Performance	Journal of Manufacturing Technology Management	8	Survey-based empirical study	Çankaya & Sezen (2019)
Sustainable Supply Chain Management (SSCM) in Malaysia: A Survey	International Journal of Production Economics	8	Survey-based empirical study	Zailani et al. (2012)

Key Contributors to the Field

To understand the intellectual structure and institutional landscape of research on supply chain performance and sustainability, a comprehensive overview of leading contributors is essential. As summarized in Table 6, the most prolific authors demonstrate high fractionalized authorship scores, signifying their strong engagement in collaborative and high-impact research.

On the institutional level, Islamic Azad University, IPB University, and University of Johannesburg stand out as top contributors, reflecting the growing academic investment in sustainability research across the Global South. From a country perspective, India, China, and Iran lead in publication output, underscoring the global diffusion of sustainability scholarship beyond traditional Western centers.

In terms of publication venues, Sustainability (Switzerland) emerges as the most influential journal, followed by others that specialize in operations, environment, and technology management. These patterns, clearly detailed in Table 6, provide important insights into the diversity and decentralization of the field, reinforcing the idea that a broad, international community of scholars and institutions now drives sustainable supply chain research.

By explicitly integrating the data from Table 6 into the discussion, the coherence of the analysis is strengthened, enhancing readers' understanding of the context and significance of the bibliometric findings.

Conclusion and Discussion

Over the past two decades, sustainable supply chain research has evolved from a niche academic pursuit into a strategic imperative, driven by global crises, regulatory pressure, and rising stakeholder expectations. As evidenced by the bibliometric findings of this study, which reflect broader economic transitions, the post-COVID acceleration of digital technologies in supply chains is not merely theoretical; it directly aligns with firms' restructuring for resilience and ESG compliance. While blockchain, AI, and IoT are now active components in achieving traceability, reducing emissions, and fulfilling ESG obligations (Ayan et al., 2022; Belhadi et al., 2022), many firms remain reactive due to a lack of harmonized metrics linking digital adoption to sustainability outcomes (Mio et al., 2022).

Despite gaining traction in literature, social sustainability still lags in practice. With ESG frameworks becoming mandatory, issues like labor rights, inclusive sourcing, and equitable value distribution can no longer be treated as peripheral (Cucari et al., 2023; Fernando et al., 2022). This highlights the need for context-sensitive, regionally adaptive strategies, particularly in Asia. ASEAN's growing economic role presents an opportunity to develop homegrown benchmarks and reporting standards that reflect both global SDG targets and local realities. Collaboration models like the Thailand-Malaysia co-authorships analyzed herein offer templates for institutional capacity building and South-South knowledge exchange (Aunyawong et al., 2021; Ishak et al., 2025).

Therefore, policymakers, corporate leaders, and scholars must redefine supply chain success beyond cost-efficiency, toward resilience, inclusiveness, and long-term value creation. Future

research must transcend mapping exercises to investigate real-world implementation challenges, such as embedding ESG metrics across fragmented supply bases and identifying effective governance structures in fragile economies. Furthermore, Asia's role as both a manufacturing hub and a climate-vulnerable region necessitates leading, not following, in sustainable innovation. These are not rhetorical questions, and this study provides a foundation for shifting from descriptive analysis to prescriptive action, realigning supply chain research with contemporary urgencies.

In conclusion, this study's comprehensive bibliometric analysis of 1,014 research articles (2002-2024) on supply chain performance and sustainability clarifies the field's evolution in response to global and regional sustainability imperatives. The rapid increase in scholarly output since 2013 signals intensified academic focus (Theeraworawit et al., 2022). Thematic analysis identified four dominant research clusters: (1) environmental management and circular economy, (2) digital innovation and Industry 4.0, (3) risk and resilience, and (4) social responsibility and stakeholder engagement, reflecting the increasing interdisciplinarity and responsiveness to challenges like climate change, digital transformation, and socio-economic inequalities (Calzolari et al., 2022; Negri et al., 2021). Geographically, Asia has gained visibility through collaborations like those between Thailand and Malaysia (Aunyawong et al., 2021; Ishak et al., 2025). However, gaps persist in theoretical integration, South-South cooperation, and policy alignment. Addressing these gaps requires future studies to employ more integrative models, engage stakeholders directly, and assess measurable impacts aligned with the SDGs (Li et al., 2024; Silvestri et al., 2024).

In sum, this study contributes to both scholarly understanding and practical strategy by mapping research across global and regional landscapes. Advancing sustainable supply chains, especially in Asia, hinges on strengthening collaboration, contextual depth, and applied relevance. The next decade of research must shift from fragmented studies to regionally informed, policy-oriented frameworks that translate academic insight into systemic change, especially in ASEAN, where opportunity and vulnerability coexist.

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