

Green Supply Chain Finance: A Bibliometric Review of Financing Instruments, Challenges, and Opportunities

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ABSTRACT

Green Supply Chain Finance (GSCF) has emerged as a pivotal approach for businesses to reconcile financial objectives with environmental sustainability imperatives. This bibliometric review synthesizes the evolving landscape of GSCF literature, analyzing financing instruments, challenges, and opportunities. Leveraging data from 967 papers spanning 1992 to 2024, the review reveals a substantial scholarly interest with a cumulative citation count of 82,996. Through network visualizations and citation analyses, key themes such as sustainable practices, financial innovations, and technology integration are identified. The review underscores the significance of GSCF in advancing sustainable supply chain management and calls for continued research and collaboration to address emerging challenges and capitalize on opportunities.

Keywords: Green Supply Chain Finance, Financing Instruments, Bibliometric Analysis

1. INTRODUCTION

In recent years, the concept of Green Supply Chain Finance (GSCF) has gained significant attention within the realms of sustainability and financial management [1]–[3]. This burgeoning field intersects the principles of supply chain management with environmentally conscious practices and financial strategies. GSCF aims to integrate environmental considerations into the financing mechanisms of supply chains, fostering sustainable operations and reducing carbon footprints [4]–[6]. Amidst growing concerns over climate change and environmental degradation, the adoption of GSCF has emerged as a critical approach for businesses to mitigate their environmental impact while optimizing financial performance.

The integration of sustainability principles into supply chain management has led to the development of various financing instruments tailored to support environmentally friendly practices [7]–[10]. These instruments encompass a range of financial mechanisms, such as green bonds, carbon financing, and eco-friendly supply chain credits, designed to incentivize sustainable behavior across the supply chain [11]–[13]. However, despite the proliferation of GSCF instruments, challenges persist in their widespread adoption and effective implementation. These challenges stem from complexities in aligning financial incentives with environmental objectives, regulatory uncertainties, and the need for collaboration among stakeholders across the supply chain.

Amidst the growing discourse surrounding GSCF, a comprehensive understanding of its financing instruments, challenges, and opportunities is crucial for businesses, policymakers, and researchers alike [14]–[17]. This bibliometric review aims to address this need by systematically analyzing existing literature on GSCF [18]. By synthesizing the current state of research, this review seeks to identify key research gaps, trends, and emerging opportunities in the field of GSCF, thereby providing valuable insights for practitioners, scholars, and policymakers seeking to advance sustainable supply chain finance strategies.

Comprehensive understanding regarding the financing instruments, challenges, and opportunities associated with its implementation. This knowledge gap hinders the effective adoption of GSCF practices by businesses and policymakers, impeding progress towards sustainable supply chain management [19]–[22]. Addressing this gap is essential for promoting environmental sustainability within supply chains while ensuring financial viability.

This bibliometric review seeks to systematically analyze the existing literature on Green Supply Chain Finance (GSCF) to identify financing instruments, challenges, and opportunities. By synthesizing and evaluating the current state of research, the objective is to provide a comprehensive understanding of GSCF practices, highlight key research gaps, and offer insights for advancing sustainable supply chain finance strategies.

The significance of this research lies in its potential to inform and guide stakeholders, including businesses, policymakers, and researchers, in their efforts to promote sustainable supply chain finance practices. By identifying financing instruments, challenges, and opportunities associated with GSCF, this review aims to contribute valuable insights that can facilitate the adoption and implementation of environmentally conscious financial strategies within supply chains. Ultimately, this research endeavors to advance the discourse on GSCF and support the transition towards more sustainable and resilient supply chain management practices.

2. LITERATURE REVIEW

2.1 *Green Supply Chain Finance*

Green Supply Chain Finance (GSCF) is a financing method that focuses on promoting environmental protection and sustainable development within supply chains. It aims to minimize the negative impact on the environment while maximizing the use of resources and ensuring timely delivery of processes and services. GSCF considers the financing channels from both banks and consumers and involves the design of optimization models to balance the trade-off between benefits and emissions [23]. The risks associated with GSCF are complex and diverse, and the use of technologies like BP neural networks can help manage these risks effectively [21]. Digital twin technology, combined with big data analysis, can be applied to analyze enterprise supply chains under the green financial system, leading to improved financial, market, and operational performance [24]. The combination of blockchain technology and AI can address challenges in green supply chain finance, such as the lack of unified standards and information sharing mechanisms, and can lead to improved communication and development of the supply chain finance system [25]. Blockchain technology can also be used to improve the accuracy of green product information, leading to lower green credit interest rates and achieving Pareto improvement for green supply chain members [26].

3. METHODS

This bibliometric review employs a systematic approach to analyze the existing literature on Green Supply Chain Finance (GSCF). Firstly, a comprehensive search of scholarly databases such as Web of Science, Scopus, and Google Scholar is conducted using predefined search terms related to GSCF, financing instruments, challenges, and opportunities. The search strategy is designed to

capture relevant articles, conference papers, and book chapters published in peer-reviewed journals and conference proceedings. Next, the retrieved publications are screened based on predefined inclusion and exclusion criteria to ensure relevance to the research objectives. Data extraction involves capturing key bibliometric information such as publication year, authors, journals, keywords, and citation metrics. Subsequently, thematic analysis is performed to identify recurring themes, trends, and research gaps within the literature. This process involves categorizing and synthesizing the extracted data to derive insights into the landscape of GSCF research. Through rigorous methodological procedures, this review aims to provide a comprehensive overview of financing instruments, challenges, and opportunities in the field of Green Supply Chain Finance.

4. RESULTS AND DISCUSSION

4.1 Research Data Matriks

Table 1. Research Data Metrics

Publication years	: 1992-2024
Citation years	: 32 (1992-2024)
Paper	: 967
Citations	: 82996
Cites/year	: 2593.63
Cites/paper	: 85.83
Cites/author	: 36749.99
Papers/author	: 516.71
Author/paper	: 2.54
h-index	: 81
g-index	: 285
hI,norm	: 69
hI,annual	: 2.16
hA-index	: 54
Papers with ACC	: 1,2,5,10,20:497,351,201,138,93

Source: Publish or Perish Output, 2024

Table 1 presents key bibliometric metrics derived from the analysis of literature on Green Supply Chain Finance (GSCF) spanning the years 1992 to 2024. The dataset comprises 967 papers with a cumulative citation count of 82,996, resulting in an impressive average citation rate of 2,593.63 cites per year. On average, each paper received approximately 85.83 citations, demonstrating the considerable impact of GSCF research within the academic community. Authors within this field exhibit prolificacy, with an average of 516.71 papers per author and 2.54 authors per paper. The h-index, a widely used measure of scholarly impact, stands at 81, indicating that 81 papers within the dataset have been cited at least 81 times. Additionally, the g-index, a variant of the h-index that considers the distribution of citations among papers, is calculated to be 285. Notably, the hI,norm value of 69 and hI,annual value of 2.16 provide insights into the normalized h-index and annual h-index, respectively. Furthermore, the hA-index, reflecting the h-index adjusted for co-authorship, is determined to be 54. Finally, the table identifies the number of papers with different levels of accumulated citations (ACC), ranging from 1 to 20, with the highest count observed for papers accumulating 1, 2, and 5 citations. Overall, these metrics offer a comprehensive overview of the scholarly impact and productivity within the domain of GSCF research, highlighting its significance and influence within academia.

4.2 Network Visualization

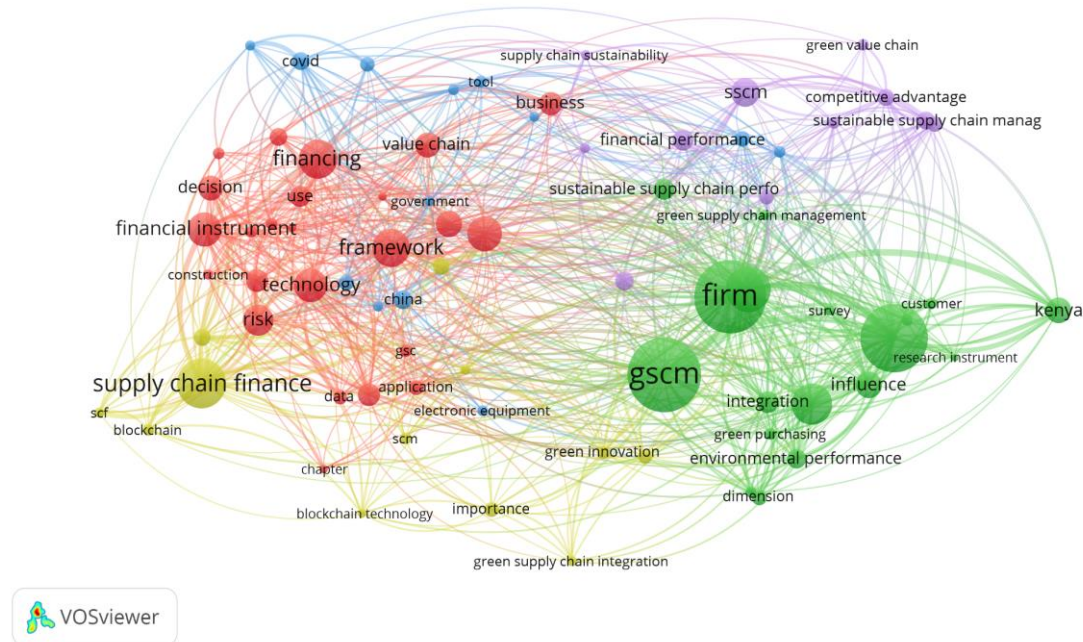


Figure 1. Network Visualization

Source: Data Analysis Result, 2024

In the network visualization, we see various terms that are likely keywords from research papers, clustered by color to indicate thematic groupings within the domain of supply chain management.

1. **Red Cluster:** This cluster seems to focus on the financial and technological aspects of supply chains, with terms like "financing," "financial instrument," "decision," "risk," and "technology." It suggests a concentration on the financial mechanisms and decision-making processes in supply chains, as well as the risks associated with them.
2. **Yellow Cluster:** Keywords such as "supply chain finance," "blockchain," "data," and "blockchain technology" indicate a theme related to innovative financial practices and the use of emerging technologies within supply chain finance.
3. **Green Cluster:** The largest cluster includes terms like "firm," "gscm" (green supply chain management), "integration," "customer," and "environmental performance," which points to a focus on sustainable and green practices within supply chain management and the integration of these practices into the broader business strategies of firms.
4. **Blue Cluster:** This seems to center on sustainability and performance, with keywords such as "supply-chain sustainability," "business," "financial performance," "green value chain," and "competitive advantage." It highlights the intersection of sustainability practices with business performance and competitiveness.
5. **Purple Cluster:** The less prominent purple cluster with terms like "framework," "china," and "government" could represent a focus on the regulatory and structural frameworks that govern supply chain practices, possibly with a specific emphasis on the context in China.

Each of these clusters represents a different facet of supply chain research, from the financial and technological tools used to manage the supply chain to the integration of green practices and the importance of sustainability for business performance and competitive advantage. The presence of geographic-specific terms like "China" and "Kenya" also suggests a regional focus within some of the research.

4.3 Overlay Visualization

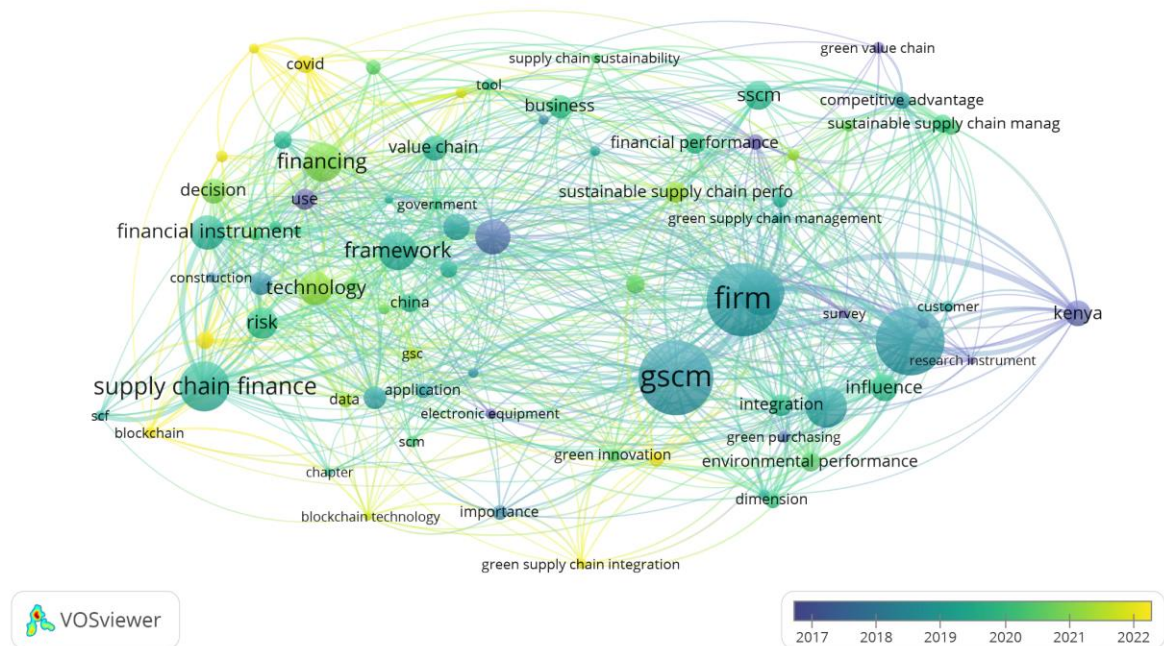


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2024

The visualization above is used to track the research trends within the field of green supply chain finance from 2017 to 2022, using a color gradient to indicate the change over the years:

1. 2017 (Blue): The research topics associated with blue nodes suggest a focus on sustainable practices within the supply chain, such as "sustainable supply chain management," "green value chain," and "sustainable supply chain performance." This indicates that in 2017, sustainability was already a significant concern in supply chain management research.
2. Transitioning from Blue to Green (2018-2019): As the colors shift from blue to green, the terms seem to bridge between the initial focus on sustainability and a growing interest in the integration of new technologies and frameworks. During this period, there could have been a blend of continuing the exploration of sustainable practices and beginning to look at how technology and financial instruments can support these efforts.
3. 2020 (Green): In 2020, the presence of green nodes suggests that technology and risk management, possibly influenced by the onset of the COVID-19 pandemic, became more prominent. Terms like "risk" and "technology" indicate a pivot towards understanding how supply chains can manage disruption and leverage technology for resilience and continuity.
4. 2021 (Yellow): By 2021, indicated by the yellow nodes, there's a noticeable shift toward topics that might relate to the aftermath of the pandemic's impact on supply chains.

Research could be focusing on the financial aspects of supply chains ("financing," "financial instrument") and possibly the continued adaptation to changes brought about by COVID-19, along with a strong ongoing interest in "supply chain finance."

4.4 Citation Analysis

Table 3. The Most Impactful Literatures

Citations	Authors and year	Title
5410	CR Carter, DS Rogers	A framework of sustainable supply chain management: moving toward new theory
3537	Q Zhu, J Sarkis	Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing
3330	P Rao, D Holt	Do green supply chains lead to competitiveness and economic performance?
2896	S Saberi, M Kouhizadeh, J Sarkis	Blockchain technology and its relationships to sustainable supply chain management
2749	J Sarkis, Q Zhu, K Lai	An organizational theoretic review of green supply chain management literature
2240	AA Hervani, MM Helms, J Sarkis	Performance measurement for green supply chain management
2220	M Pagell, Z Wu	Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars
1988	H Walker, L Di Sisto, D McBain	Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors
1946	S Vachon, RD Klassen	Extending green practices across the supply chain: the impact of upstream and downstream integration
1830	KW Green, PJ Zelbst, J Meacham	Green supply chain management practices: impact on performance

Source: Publish or Perish Output, 2024

Table 3 provides a snapshot of the most impactful literature within the field of Green Supply Chain Management (GSCM), based on citation counts. Topping the list is the seminal work by Carter and Rogers (2008), "A framework of sustainable supply chain management: moving toward new theory," with 5410 citations, emphasizing the significance of developing theoretical frameworks for advancing sustainability in supply chain management. Following closely is the study by Zhu and Sarkis (2007), which explores the relationship between operational practices and performance in early adopters of green supply chain management practices in China. Additionally, research by Rao and Holt (2005) investigates the link between green supply chains, competitiveness, and economic performance, shedding light on the business implications of sustainability initiatives. Other notable contributions include studies on blockchain technology's role in sustainable supply chain management (Saberi et al., 2019), organizational theoretical reviews (Sarkis et al., 2011), and performance measurement frameworks (Hervani et al., 2005). These impactful works not only contribute to the academic discourse but also provide practical insights for businesses and policymakers striving to integrate environmental sustainability into supply chain practices.

CONCLUSION

In conclusion, the bibliometric review of Green Supply Chain Finance (GSCF) literature provides valuable insights into the field's evolution, trends, and areas of focus. The analysis reveals a robust scholarly interest in GSCF, as evidenced by the substantial number of publications and citations over the years. Key themes identified include the integration of sustainability principles into supply chain management, the development of innovative financing instruments, and the leveraging of technologies such as blockchain and AI to enhance financial and environmental performance. The visualization analyses highlight the interdisciplinary nature of GSCF research, encompassing financial, technological, and sustainability perspectives. Additionally, the citation analysis underscores seminal works that have significantly contributed to advancing theoretical frameworks and practical applications within GSCF. Overall, this review underscores the importance of continued research and collaboration to address challenges, seize opportunities, and promote sustainable practices within supply chain finance.

REFERENCES

- [1] C. Qin and Y.-T. Hong, "Quadripartite Evolutionary Game of Sustainable Development of Supply Chain Finance with Government Participation," *Sustainability*, vol. 15, no. 4, p. 3788, 2023.
- [2] Z. Wang, Z. Jian, and X. Ren, "Pollution prevention strategies of SMEs in a green supply chain finance under external government intervention," *Environ. Sci. Pollut. Res.*, vol. 30, no. 15, pp. 45195–45208, 2023.
- [3] D. Zhao and Y. Zhao, "Research on Benefit Distribution of Green Supply Chain Finance under Uncertainty Demand Conditions," *Financ. Eng. Risk Manag.*, vol. 6, no. 6, pp. 17–22, 2023.
- [4] B. Feng, C. Feng, and S. Zhao, "Green Supply Chain Finance Credit Market under Government Regulation: An Evolutionary Game Theory Analysis," *Polish J. Environ. Stud.*, vol. 32, no. 5, pp. 3999–4010, 2023.
- [5] Y. Lu, S. Sun, M. Zhang, and Z. Yang, "Moving Towards Sustainable Development: Can Supply Chain Finance Promote Corporate Green Innovation?," *J. Knowl. Econ.*, pp. 1–26, 2023.
- [6] N. Marlianti, I. H. Wahyunadi, and I. Harsono, "The role of agricultural sector on the economy of West Nusa Tenggara (input-output analysis approach)," *J. Ekon. dan Stud. Pembang.*, vol. 9, no. 2, pp. 176–189, 2017.
- [7] L. G. VASILESCU and A. POPA, "Modern instruments in rural financing," *Bull. Univ. Agric. Sci. Vet. Med. Cluj-Napoca. Hortic.*, vol. 65, no. 2, 2008.
- [8] Z. Kräussl, Z. Baida, S. Post, B. Rukanova, and Y.-H. Tan, "Digital Infrastructures for Monitoring Circular Economy Investments by Financial Institutions and Government: A Research Agenda," in *Proceedings of Ongoing Research, Practitioners, Posters, Workshops, and Projects.*, CEUR Workshop Proceedings, 2023.
- [9] L. Li, Z. Wang, and X. Zhao, "Configurations of financing instruments for supply chain cost reduction: evidence from Chinese manufacturing companies," *Int. J. Oper. Prod. Manag.*, vol. 42, no. 9, pp. 1384–1406, 2022.
- [10] I. Harsono and I. A. P. Suprapti, "The Role of Fintech in Transforming Traditional Financial Services," *Account. Stud. Tax J.*, vol. 1, no. 1, pp. 81–91, 2024.
- [11] A. Koren, V. Vodopyanova, and A. Pustovarov, "Development of a supply chain policy for financing instruments system of foreign economic activity," *Int. J. Supply Chain Manag.*, vol. 8, no. 6, pp. 549–554, 2019.
- [12] L. Su and Y. Cao, "Dynamic Evolutionary Game Approach for Blockchain-Driven Incentive and Restraint Mechanism in Supply Chain Financing," *Systems*, vol. 11, no. 8, p. 406, 2023.
- [13] W. Wang, I. Harsono, C.-J. Shieh, V. Samusenkov, and S. Shoar, "Identification of critical paths leading to cost claims for underground metro projects: a system dynamics approach," *Kybernetes*, vol. 52, no. 5, pp. 1861–1878, 2023.
- [14] L. Fan, L. Li, Z. Ma, S. Lee, H. Yu, and L. Hemphill, "A bibliometric review of large language models research from 2017 to 2023," *arXiv Prepr. arXiv2304.02020*, 2023.
- [15] K. B. Benameur, M. M. Mostafa, A. Hassanein, M. Z. Shariff, and W. Al-Shattarat, "Sustainability reporting scholarly research: a bibliometric review and a future research agenda," *Manag. Rev. Q.*, pp. 1–44, 2023.
- [16] Z. Sun *et al.*, "Carbon peak and carbon neutrality in the building sector: a bibliometric review," *Buildings*, vol. 12, no. 2, p. 128, 2022.
- [17] F. J. García-Corral, J. A. Cordero-García, J. de Pablo-Valenciano, and J. Uribe-Toril, "A bibliometric review of cryptocurrencies: how have they grown?," *Financ. Innov.*, vol. 8, pp. 1–31, 2022.
- [18] F. Rosso and E. E. García-Salirrosas, "Strategic trends in management by competencies: a bibliometric review," *Int. J. Prof. Bus. Rev. Int. J. Prof. Bus. Rev.*, vol. 8, no. 9, p. 15, 2023.
- [19] V. Mankar, C. Vichoray, N. Somani, and A. Deogaonkar, "Identifying the barriers to green supply chain practices for small and medium enterprises with reference to central India," *Int. J. Prof. Bus. Rev. Int. J. Prof. Bus. Rev.*, vol. 8, no. 6, p. 27, 2023.
- [20] L. I. Tianqi, T. R. Pertheban, and X. Gao, "Driving Environmental Sustainability and Supply Chain Competitiveness through Green Logistics Management," 2023.

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- [21] H. Zhao, "Risk management of supply chain green finance based on sustainable ecological environment," *Sustainability*, vol. 15, no. 9, p. 7707, 2023.
- [22] S. Wang, H. Yu, and M. Wei, "The effect of supply chain finance on sustainability performance: empirical analysis and fsQCA," *J. Bus. Ind. Mark.*, vol. 38, no. 11, pp. 2294–2309, 2023.
- [23] Y. Shi and L. Zhang, "Trade credit or credit insurance? A green supply chain finance design scheme with multi-objective programming," *J. Intell. Fuzzy Syst.*, no. Preprint, pp. 1–15, 2023.
- [24] D. Li and J. Li, "Big data of enterprise supply chain under green financial system based on digital twin technology," *Kybernetes*, vol. 53, no. 2, pp. 543–556, 2024.
- [25] H. Zhou, "Green supply chain financial governance and technology application based on block chain and AI technology," *BCP Bus. Manag.*, vol. 38, pp. 881–888, Mar. 2023, doi: 10.54691/bcpbm.v38i.3791.
- [26] D. Wang, D. Zhao, and F. Chen, "Research on financing strategy of green energy-efficient supply chain based on blockchain technology," *Energies*, vol. 16, no. 7, p. 2985, 2023.