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Green Supply Chain Management and Artificial Intelligence: Bibliometric Analysis Based on Web of Science (WoS) Platform*

Yeşil Tedarik Zinciri Yönetimi ve Yapay Zekâ: Web of Science (WoS) Platformuna Dayalı Bibliyometrik Analiz

Şermin ÖNEM

Department of E-Commerce and Marketing, İstanbul Atlas University, İstanbul, Türkiye

İstanbul Atlas Üniversitesi, E-Ticaret ve Pazarlama Programı, İstanbul, Türkiye

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ABSTRACT

This study aims to provide a comprehensive bibliometric analysis of the intersection between green supply chain management (GSCM) and artificial intelligence (AI). As environmental sustainability and digital transformation have become critical priorities for businesses, the integration of AI into GSCM practices has attracted increasing scholarly attention. In this context, the study analyzes the intellectual structure, development trends, and research patterns in this emerging field. Bibliometric data were collected from the Web of Science (WoS) database using relevant keywords, and the dataset was analyzed using the Biblioshiny application based on RStudio. The findings reveal a significant increase in the number of publications, particularly after 2017, indicating growing academic interest driven by sustainability concerns and technological advancements. The analysis also identifies the most influential authors, keywords, and thematic clusters, highlighting the evolution of research from conceptual discussions to more application-oriented studies focusing on performance, sustainability, and digital transformation. The results suggest that AI plays a transformative role in enhancing the efficiency, transparency, and environmental performance of supply chains. This study contributes to the literature by offering a structured overview of the research landscape and providing insights for future academic and practical developments in the field of AI-driven sustainable supply chain management.

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***Sorumlu yazar / Corresponding author**
*E-mail address: sermin.onem@atlas.edu.tr

ÖZ

Bu çalışma, yeşil tedarik zinciri yönetimi (GSCM) ile yapay zekâ (AI) arasındaki kesişimi bibliyometrik analiz yöntemiyle kapsamlı bir şekilde incelemeyi amaçlamaktadır. Günümüzde çevresel sürdürülebilirlik ve dijital dönüşüm, işletmeler açısından kritik öncelikler haline gelmiş olup, yapay zekânın GSCM uygulamalarına entegrasyonu akademik literatürde giderek artan bir ilgi görmektedir. Bu bağlamda çalışmada, söz konusu araştırma alanının entelektüel yapısı, gelişim eğilimleri ve araştırma desenleri analiz edilmiştir. Bibliyometrik veriler, ilgili anahtar kelimeler kullanılarak Web of Science (WoS) veri tabanından elde edilmiş ve veriler RStudio tabanlı Biblioshiny uygulaması aracılığıyla analiz edilmiştir. Elde edilen bulgular, özellikle 2017 yılı sonrasında yayın sayısında belirgin bir artış olduğunu ve bu artışın sürdürülebilirlik odaklı yaklaşımlar ile teknolojik gelişmelerden kaynaklandığını göstermektedir. Ayrıca analiz sonuçları, en etkili yazarları, anahtar kelimeleri ve tematik kümeleri ortaya koyarak, araştırmaların kavramsal tartışmalardan performans, sürdürülebilirlik ve dijital dönüşüm odaklı uygulama alanlarına doğru evrildiğini göstermektedir. Bulgular, yapay zekânın tedarik zincirlerinde verimlilik, şeffaflık ve çevresel performansı artırmada dönüştürücü bir rol oynadığını ortaya koymaktadır. Bu çalışma, ilgili literatüre sistematik bir genel çerçeve sunarak hem akademik araştırmalar hem de uygulayıcılar için yol gösterici nitelikte katkılar sağlamaktadır

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1. INTRODUCTION

In today's global business environment, sustainability has become a central concern for organizations seeking to maintain competitiveness while minimizing their environmental impact. The increasing pressure from stakeholders, regulatory bodies, and consumers has compelled firms to adopt environmentally responsible practices across their operations. In this context, green supply chain management (GSCM) has emerged as a strategic approach that integrates environmental thinking into supply chain activities, including product design, sourcing, production, and logistics.

At the same time, rapid technological advancements have accelerated the digital transformation of supply chains. Among these technologies, artificial intelligence (AI) has gained significant attention due to its potential to enhance decision-making processes, improve operational efficiency, and enable real-time monitoring of complex supply chain networks. AI-driven tools such as machine learning, big data analytics, and predictive modeling offer new opportunities to optimize resource usage, reduce emissions, and support sustainable supply chain practices.

Despite the growing body of research on both GSCM and AI, studies examining the intersection of these two domains remain fragmented and lack a comprehensive analytical perspective. Existing research has primarily focused on conceptual discussions or empirical applications, while a systematic mapping of the intellectual structure and evolution of this emerging field is still limited. This gap makes it difficult for researchers and practitioners to understand the current state of knowledge, identify dominant research themes, and recognize future research directions.

To address this gap, this study aims to provide a comprehensive bibliometric analysis of the intersection between GSCM and AI. By analyzing data obtained from the Web of Science (WoS) database, the study reveals the development trends, key contributors, thematic structures, and research patterns in this field.

This study makes several important contributions to literature. First, it offers a structured and systematic overview of the research landscape at the intersection of GSCM and AI through bibliometric techniques. Second, it identifies the most influential authors, keywords, and thematic clusters, thereby clarifying the intellectual structure of the field. Third, it highlights the evolution of research trends, showing a shift from conceptual discussions toward application-oriented and performance-driven studies. Finally, the study provides valuable insights for both researchers and practitioners by outlining potential future research directions and emphasizing the strategic role of AI in enhancing sustainable supply chain management.

2. CONCEPTUAL FRAMEWORK

GSCM, which originated from the supply chain method, began to emphasize management activities that highlight awareness of management processes, environmental protection, and a sense of responsibility towards nature, particularly in the 1990s, due to increasing competitive pressures on businesses (Chin et al., 2015). GSCM is essentially

supply chain management integrated with a green focus. Therefore, GSCM is an important point for businesses that want to create a new generation of business perception that emphasizes management processes that can minimize their impact on the environment and continues its activities with this perspective. Because creating the perception that businesses that emphasize and implement this are "reliable" and "conscious" is extremely important in the global world (Zeeshan & Hajra, 2024: 53).

GSCM can be described as a new generation approach that should be emphasized in order to stand out from increasing competitive pressure, increase efficiency, strengthen the company's brand image, and gain consumers' positive perception of the company (Sharma et al., 2017). In the current scenario, where our planet is suffering from the dramatic consequences caused by pollution, a commitment to sustainability, and especially GSCM, has become imperative for organizations looking to improve their corporate environmental performance (Wiredu et al., 2023). Today, businesses are adding the words "green" and/or "sustainable" to the beginning of terms at every stage of their operations to enhance awareness and brand image throughout the supply chain (Tietze, 2023: 11).

Managers need to develop collaborative relationships based on trust with stakeholders to fill resource and technical knowledge gaps and ensure shared problem-solving that promotes environmental sustainability (Dzhengiz & Niesten, 2020: 888). Sustainable supply chain management improves long-term performance by integrating the social, economic, and environmental objectives of the supply chain. Therefore, it helps monitor performance over the long term by evaluating business performance based on social, environmental, and economic dimensions (Peesapati, 2024: 30). Advanced companies that use green logistics and environmental improvements in supply chains as a strategic weapon aim to achieve environmental goals through green management innovations such as green product and green process innovation by following sustainable competitive strategies (Jo & Kwon, 2022: 3).

GSCM evaluates all production and value-added steps of goods and services from an ecological, social and economic perspective. This type of supply chain is characterized by approaching all stages of the supply chain, from raw material extraction and production to the direct supplier, with a holistic perspective. The goal is to minimize or even eliminate negative effects and prevent risks in a timely manner. The aim is to promote responsible and sustainable corporate strategy and management (Hass, 2022: 15). Combining environmental philosophy with supply chain management and organizational practices, supply chain management is a multitude of synchronized efforts carried out by companies to intensify their impact on the regular environment throughout the entire life cycle of a product, including raw material sourcing and selection, product design, manufacturing, finished product distribution, and end-of-life product management processes (Perotti et al., 2012).

Based on their definitions in the literature, Liu & Chang (2017: 4) show GSCM in Figure 1. The solid and dashed lines represent the greening of traditional supply chain and reverse logistics activities, respectively.

A green supply chain can be defined as the use of materials needed by the industry in a way that is environmentally friendly and can be used or reprocessed according to corporate needs (Nguyen & Le, 2020). GSCM refers to the way of managing the supply chain in order to reduce Co2 emissions and waste and protect biodiversity (Tseng et al., 2019). According to another definition, GSCM refers to the consideration of environmental impacts at all stages of the chain, starting from the purchasing process, which is the first stage of production, in the process of producing the

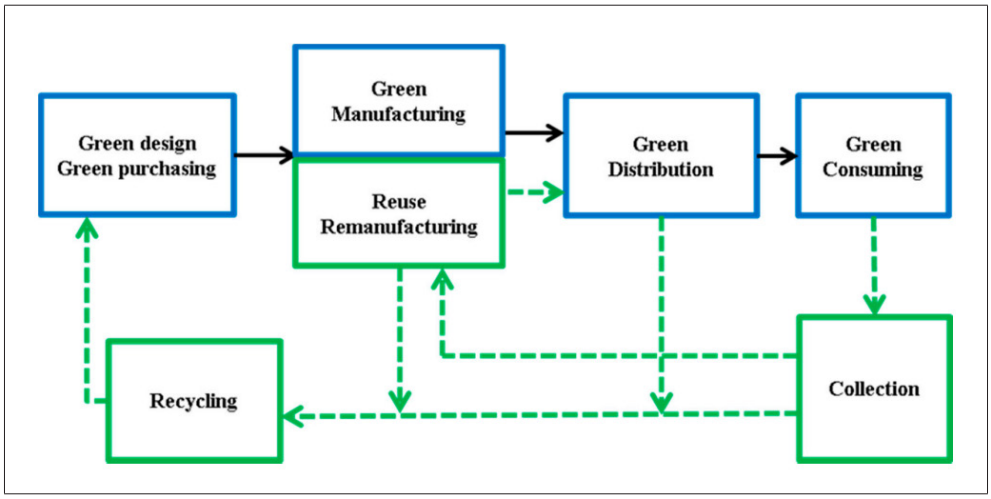

Figure 1. Green supply chain management.
Source: Liu & Chang (2017, s.4).

goods and services needed by the customer, to the recycling of the product after the consumer uses the product (Duran & Şen, 2024: 3). According to Zhu and Sarkis (2004), GSCM; purchasing, operations, marketing and logistics, recycling, reuse, remanufacturing, reverse logistics and monitoring the environmental management process including innovation.

GSCM, integrates environmental factors into supply chain management by covering topics such as "international environmental management," "green procurement," collaboration between customers and the environment, "green logistics," and "ecological design," when compared to traditional supply chain management (Feng et al., 2022). GSCM is defined as an important issue that affects the environmental problems of any business engaged in supply chain activities, which subsequently leads to the improvement of environmental performance (Chin et al., 2015). GSCM aims not only to reveal businesses' environmental sensitivities but also to carefully incorporate competing businesses into their processes. This situation provides businesses with both cost and efficiency advantages in environmental terms (Chu et al., 2017). The development of GSCM should be considered as the inclusion of all elements in the supply chain flow in business processes, approached from an environmental perspective from start to finish (Liu & Ma, 2022; Srivastava, 2007).

The primary objective of GSCM is to conserve resources, reduce pollution, and ensure sustainable environmental development. In addition, both developed and developing countries should actively promote "zero carbon" policies and establish relevant laws and regulations. This will clearly accelerate cooperation and development between the environment and the supply chain, encouraging the implementation of GSCM in different sectors. Therefore, GSCM is a new generation approach applied to strengthen the environmental image of today's businesses, meet public expectations regarding environmental protection, and improve supply chain operations (Lei et al., 2024: 3).

Within the scope of the project funded by the World Bank, the "Türkiye Green Industry Project", which consists of three components: KOSGEB, TUBITAK and the Ministry of Industry and Trade, aims to raise awareness among organizations, companies and individuals related to green transformation, especially businesses in the manufacturing sector, to facilitate networking with various stakeholders and to increase the national visibility of green transformation efforts (Ministry of Industry and Technology, 2024).

Previous research has identified and validated five main components of GSCM practices: Green purchasing, eco-design or design for the environment, investment recovery, customer collaboration for environmental concerns, and internal environmental management (Mastos Gotzamani, 2024; Zahran, 2024: 4). In addition, topics such as carbon border adjustments, green finance, green and circular economy, clean, economical, and secure energy supply, sustainable smart transportation, combating climate change, diplomacy, and awareness-raising activities can also be included in the GSCM components. Within the scope of this plan, our country aims to raise awareness and motivate consumers and producers and to adapt to the green transformation process. In addition, countries are going one step further in the fight against climate change and setting net zero emission targets (Tubitak, 2024). To ensure the sustainability of green supply chain management, today's businesses aim to improve management processes not only by emphasizing green practices across all supply chain factors but also by spearheading the implementation of necessary environmental policies (Agrawal et al., 2022).

GSCM aims to ensure the most efficient logistics aspects of the production process in businesses with a green emphasis. This will also affect the parties involved due to the multifaceted perspective resulting from the inclusion of suppliers, manufacturers, customers, and disposal companies in supply chain activities. For this reason, in the context of GSCM, an interactive link is established between traditional supply chain management and green supply chain factors (Hunke & Prause, 2014: 16).

In today's global world, not only developed countries but also developing countries are prioritizing sustainable approaches, and it is possible to say that they are not only expressing this perspective but also putting it into practice throughout their activities. In addition, it is possible to say that they are taking an extremely sensitive approach to environmental issues around the world, and that both competitors and stakeholders are united on this point. For this reason, the public sector also requires the implementation of environmental management systems and certification, which are mandatory for business activities to address environmental issues. This situation enables the formation of certain standards not only for businesses but for all businesses around the world (Jo & Kwon, 2022: 3).

A literature review reveals that green supply chain management positively impacts business performance by promoting sustainability (Awan et al., 2017; Khan et al., 2019; Yıldız Çankaya & Sezen, 2019). According to Liu et al. (2018), the fundamental way for businesses to adopt green supply chain management is through rapid adaptation to innovations. Furthermore, according to Malviya et al. (2018), implementing green supply chain practices in all operational processes, especially in manufacturing companies, is critical for achieving a long-term sustainable perspective. Kafa et al. (2020) prove that companies need to establish supply chain management processes that take into account adequate criteria to achieve corporate sustainability. Table 1 summarizes the role of artificial intelligence in green supply chain applications:

Table 1. Role of AI in green supply chain practices

Green Supply Chain Practice	The Role of AI
Green procurement	Selecting sustainable suppliers based on environmental and social metrics. Automating repetitive procurement tasks, reducing human error and operational costs. Improving transparency and traceability in supply chains. Providing insights into supplier performance, market trends, and demand forecasting.
Green production	Using intelligent robots to perform repetitive production tasks with high precision and efficiency. Monitoring energy consumption and product output in real time. Reducing unnecessary tasks and emissions through real-time analytics.
Green logistics	Forecasting demand and reducing emissions using predictive analytics and machine learning. Automating warehouse systems. Scheduling vehicles and selecting efficient delivery routes to minimize transportation emissions.
Recycling	Using image recognition and machine learning for waste classification. Analyzing product life cycles and supply chain data to identify waste sources and suggest reduction strategies. Supporting circular economy strategies. Simulating scenarios and evaluating environmental impacts to support decision-making regarding circular economy initiatives.

Beniaich & Hmioui, 2025.

Table 1 clearly demonstrates that artificial intelligence plays a critical role across all stages of green supply chain practices, reinforcing its importance as a key driver of sustainable transformation.

The intersection of AI, GSCM, and technology innovation presents a promising avenue for achieving sustainable performance in supply chains. AI can be used to improve the effectiveness and efficiency of GSCM applications, such as optimizing energy consumption in manufacturing processes, predicting demand for eco-friendly products, and designing sustainable packaging solutions. Furthermore, AI can enable the development of innovative technologies that support GSCM, such as autonomous vehicles for low-emission logistics, smart sensors for real-time monitoring of environmental impact, and blockchain-based platforms for transparent and traceable supply chains (Sharma et al. 2022; Taseen et al., 2024).

It provides the following advantages and opportunities for the integration of AI throughout GSCM (Beniaich & Hmioui, 2025; Fowosere et al., 2025: 329):

- AI-powered optimization of logistics and transportation to reduce emissions and energy consumption,
- AI-powered predictive maintenance and asset management to improve efficiency and extend equipment life,
- AI-based supply chain visibility and traceability to enable better monitoring and reporting of environmental impact,
- AI-powered decision support systems to help make more informed and sustainable choices throughout the supply chain,
- With the development of AI applications, they are becoming more comprehensive, useful, and accessible for business applications.

Overall, the integration of artificial intelligence into green supply chain management represents a significant paradigm shift in how organizations address sustainability challenges. While traditional supply chain approaches primarily focus on cost efficiency and operational performance, AI-driven systems enable predictive, adaptive, and data-driven decision-making processes. This transformation allows organizations to move beyond reactive environmental strategies toward proactive and optimized sustainability practices. In this context, the convergence of AI and GSCM not only enhances operational efficiency but also strengthens long-term environmental performance and competitive advantage, positioning AI as a strategic enabler of sustainable supply chain transformation.

3. MATERIALS AND METHODS

This section presents the purpose of the research, the analyses conducted, and the findings.

3.1. The Purpose of the Research

The primary aim of this study is to examine the intellectual structure, development trends, and thematic evolution of research conducted at the intersection of GSCM and AI. In this context, the study seeks to provide a comprehensive overview of the research landscape by identifying prominent concepts, influential authors, collaboration patterns, and citation structures within the existing literature.

3.2. Data and Analysis

This study employs a bibliometric analysis approach to systematically evaluate the existing body of literature. Bibliometric analysis is widely used to map scientific knowledge, identify research trends, and analyze the intellectual structure of a specific field.

The data used in this study were obtained exclusively from the Web of Science (WoS) database, which is recognized

as one of the most reliable and comprehensive sources of high-quality academic publications. WoS was preferred due to its rigorous indexing standards and its ability to provide structured and consistent bibliographic data.

To ensure a comprehensive dataset, multiple keywords were used during the data collection process. The search query included combinations of terms such as "green supply chain management," "artificial intelligence," and "sustainable supply chain." The search was limited to articles published in English within the Business and Management categories.

Following the initial search, the dataset was refined by applying inclusion criteria such as document type (articles), language (English), and subject area. The final dataset consisted of 151 articles covering the period between 2008 and 2025. The data collection process was completed on November 20, 2025, to ensure consistency and replicability.

For data analysis, the Biblioshiny application based on RStudio was used. This tool enables advanced bibliometric analysis, including data visualization, citation analysis, keyword co-occurrence, and thematic mapping. Through this analysis, the study identifies key research trends, influential contributors, and the evolution of the field over time (Table 2).

4. FINDINGS

This section presents the findings derived from the bibliometric analysis of 151 scientific studies conducted at the intersection of green supply chain management (GSCM) and artificial intelligence (AI).

Figure 2 illustrates the annual scientific production in this research field. The findings indicate that although the first studies appeared around 2008, a significant increase in publication volume has been observed, particularly after 2017. This upward trend suggests a growing academic interest driven by increasing global concerns about sustainability, climate change, and the need for digital transformation in supply chain processes. The acceleration in recent years also reflects the expanding role of artificial intelligence technologies in addressing complex environmental and operational challenges.

Figure 3 presents the average number of citations per year. The results show a notable increase in citations until around 2020, followed by a slight decline in subsequent years. This pattern can be interpreted as a typical citation lifecycle, where earlier foundational studies accumulate more citations over time, while more recent studies have not yet reached their full citation potential. It also indicates that the field has reached a certain level of maturity, with well-established core studies shaping subsequent research.

The word cloud presented in Figure 4 highlights the most frequently used terms in the studies analyzed. Keywords such as "artificial intelligence," "performance," "framework," "management," and "supply chain management" emerge as dominant concepts. This finding suggests that literature has evolved beyond purely conceptual discussions and increasingly focuses on performance measurement, strategic frameworks, and practical implementation issues.

Figure 5, which presents the tree map analysis, provides a more detailed and structured view of keyword frequency. The prominence of terms such as artificial intelligence and performance indicates that researchers are increasingly interested in examining the tangible outcomes of AI integration within GSCM practices. This shift reflects a transition from theoretical exploration to application-oriented research, emphasizing efficiency, sustainability, and operational performance.

Figure 6 presents the three-field plot analysis, which links authors, keywords, and sources. The findings reveal a concentration of research around specific authors and thematic areas,

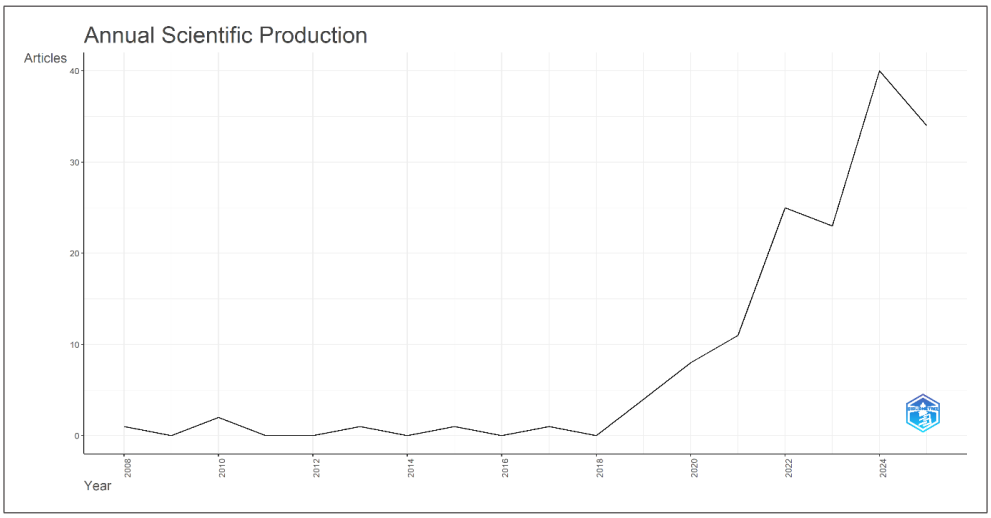

Figure 2. Annual scientific production.

Table 2. Descriptive statistics

Publication year range of articles	**2008-2025**	**Keywords plus (ID)**	**334**
Documents	151	Author's keywords (DE)	515
Annual growth rate %	%23.05	Authors	504
Document average age	2.29	Authors of single-authored docs	18
Average citations per doc	47.45	Co-Authors per Doc	3.75
References	10231	International co-authorships %	%42.38
Web of Sciences			

indicating the presence of influential contributors shaping the intellectual structure of the field. This clustering also suggests the emergence of specialized research streams focusing on AI-driven sustainability and supply chain innovation.

Finally, Figure 7 illustrates the country collaboration network. The results indicate a high level of international collaboration, particularly among developed and emerging economies. This suggests that sustainability and AI-driven supply chain management are global concerns requiring cross-border knowledge exchange and cooperation. The presence of international co-authorship further highlights the interdisciplinary and collaborative nature of this research domain.

Overall, the findings demonstrate that the intersection of GSCM and AI is a rapidly growing and evolving research area. The increasing number of publications, diversification of research themes, and strong international collaboration patterns indicate that this field will continue to expand in the coming years.

In addition to the general trends, further analysis was conducted to identify the most influential studies and sources within the field. Figure 8 presents the most globally cited documents. The findings indicate that a limited number of studies have accumulated a significantly higher number of citations compared to others, highlighting their foundational role in shaping the intellectual structure of the research domain. These highly cited works predominantly focus on the integration of artificial intelligence into supply chain processes and sustainability practices, providing both conceptual frameworks and empirical insights that guide subsequent studies.

In addition, the top 10 most globally cited documents are presented in Table 3. These studies represent the core knowledge base of the field and have significantly influ-

Figure 4. Word cloud.

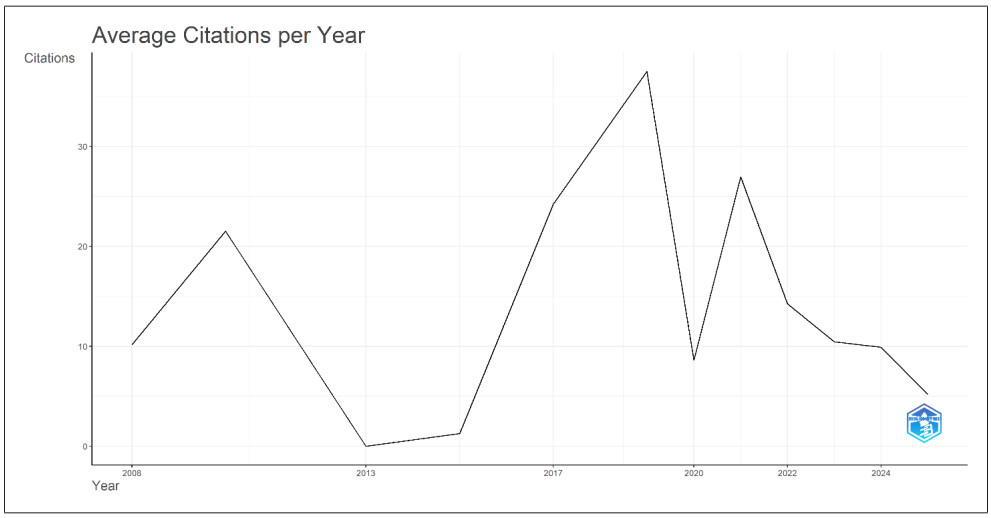

Figure 3. Avarage citations per year.

Table 3. Top 10 most globally cited documents

Rank	Authors	Year	Source	Global Citations
1	Benzidia S.	2021	Technological Forecasting and Social Change	308
2	Dhamija P.	2020	Total Quality Management Journal	177
3	Feng Y.	2022	International Journal of Production Economics	123
4	Sharma R.	2022	International Journal of Production Research	103
5	Bag S.	2021	Journal of Enterprise Information Management	88
6	Ninlawan C.	2010	International Conference (Engineering & Computer)	73
7	Long Q.	2021	IEEE Transactions on Evolutionary Computation	68
8	Zhang Q.	2022	Technological Forecasting and Social Change	48
9	Wang J.	2020	Journal of Cleaner Production	43
10	Wang J.	2020	Computers & Industrial Engineering	42

Web of Sciences

enced subsequent research. The concentration of citations among a limited number of publications indicates that the field is shaped by a set of seminal works, which provide both theoretical foundations and methodological guidance for future studies.

Furthermore, Figure 9 presents the most relevant sources contributing to this research area. The results reveal that journals such as *Sustainability*, *Environmental Science and Pollution Research*, and *International Journal of Production Economics* stand out as the most productive outlets. This concentration suggests that knowledge production in this field is clustered within a limited number of high-impact journals. These findings provide important guidance for future researchers in identifying suitable publication outlets and understanding the core dissemination channels of the field.

Overall, these results provide a comprehensive overview of the intellectual, thematic, and publication structure of the field, offering a solid foundation for further discussion on the implications, research gaps, and future directions.

Figure 5. Tree map.

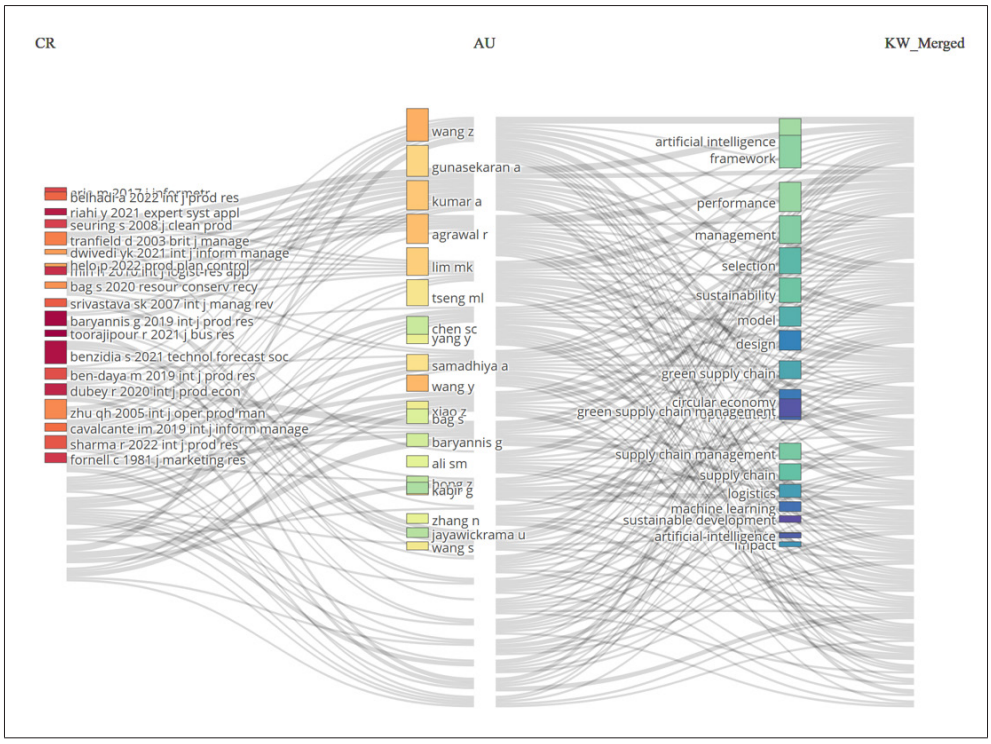

Figure 6. Three-field plot.

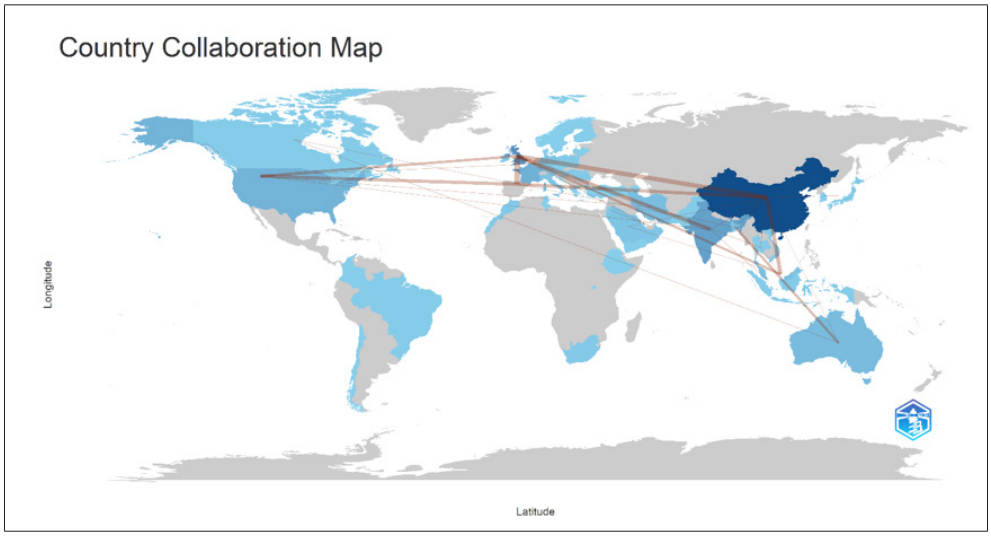

Figure 7. Country collaboration map.

5. RESULTS & DISCUSSION

This study aims to provide a comprehensive bibliometric analysis of the intersection between green supply chain management (GSCM) and artificial intelligence (AI). Considering the environmental challenges faced by today's world, businesses are required to adopt proactive strategies and develop sustainable policies supported by accurate data-driven insights. In this context, GSCM has become a critical approach for achieving both environmental protection and long-term organizational performance.

The findings indicate that the integration of AI into supply chain processes enables organizations to monitor environmental performance in real time, optimize resource allocation, and ensure compliance with sustainability regulations. AI-driven systems enhance decision-making capabilities by processing large volumes of data efficiently, thereby supporting the balance between economic and environmental objectives (Fowosere et al., 2025: 329). In this regard, the

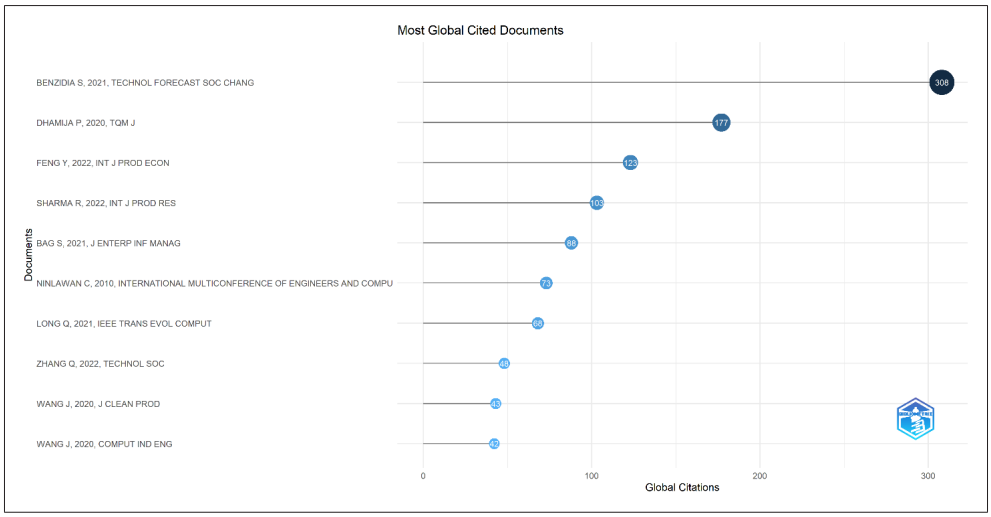

Figure 8. Most global cited documents.

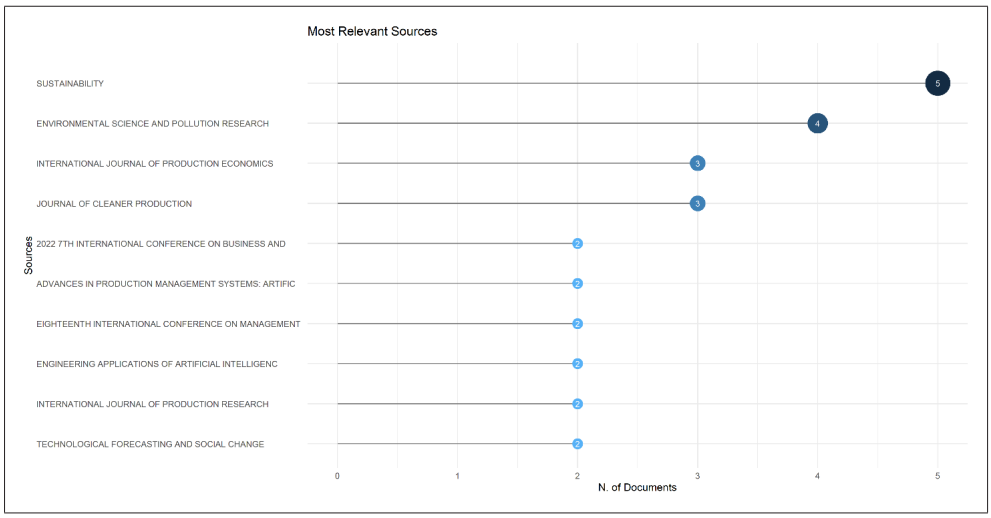

Figure 9. Most relevant sources.

growing adoption of AI technologies plays a key role in improving sustainability performance and operational efficiency (Chen, 2025).

The bibliometric results reveal that although early studies on AI and GSCM emerged around 2008, there has been a significant increase in publication output in recent years. This rapid growth reflects the rising importance of sustainability concerns and the accelerating impact of digital transformation in supply chain management. Moreover, the findings suggest a transition from theoretical discussions to more application-oriented research areas such as operational efficiency, circular economy practices, and sustainability-driven digital transformation. This shift indicates that the field has reached a certain level of maturity and is increasingly aligned with real-world industrial needs.

Consistent with existing literature, the findings show that traditional performance indicators such as cost and return on investment are gradually being replaced by broader strategic concerns such as environmental sustainability, resilience, and corporate reputation (Fowosere et al., 2025: 329). This transformation is supported by the findings of Gallo et al. (2023), who argue that AI capabilities enhance supply chain visibility and facilitate large-scale decision-making, particularly in addressing environmental challenges. Similarly, Singh et al. (2024) emphasize that AI-driven big data analytics significantly contributes to optimizing supply chain processes and maintaining environmentally sustainable operations. Supporting this perspective, Nozari (2024) and Makhdoom et al. (2025) demonstrate that AI adoption positively influences sustainable performance, highlighting the strategic importance of technological investments.

Furthermore, the results suggest that the implementation of AI-driven GSCM practices is highly influenced by contextual factors such as regulatory environments and firm-specif-

ic characteristics. As highlighted by Handoyo (2023; 2024), variations in national regulations, industry dynamics, and organizational structures play a crucial role in shaping sustainability practices. Therefore, a deeper understanding of these contextual factors is essential for both researchers and practitioners aiming to enhance sustainability outcomes.

Despite the significant advantages of integrating AI into GSCM, several challenges remain. These include high implementation costs, data security concerns, lack of technical expertise, and difficulties in integrating AI technologies into existing supply chain infrastructures. Additionally, the environmental impact of AI systems themselves—particularly in terms of energy consumption—should not be overlooked. These challenges highlight the need for a balanced and strategic approach to AI implementation, ensuring that technological advancements do not undermine broader sustainability goals.

This study also makes important theoretical contributions by providing a structured overview of the intellectual landscape of AI-driven GSCM. By identifying influential studies, dominant journals, and emerging research themes, the study offers a valuable roadmap for future research. In particular, the identification of highly cited works provides a strong foundation for scholars seeking to build upon established knowledge structures.

However, this study is not without limitations. Bibliometric analyses are inherently descriptive and may not fully capture the qualitative depth of individual studies. As emphasized in the literature, such analyses reflect the dataset used and may not represent the most recent developments in the field. Additionally, the reliance on a single database may limit the comprehensiveness of the analysis (Handoyo, 2024). Future studies could address these limitations by incorporating multiple databases and complementary research methods such as systematic literature reviews or empirical analyses.

6. CONCLUSION

In conclusion, the findings of this study demonstrate that the integration of artificial intelligence into green supply chain management is a rapidly evolving and strategically important research area. The increasing number of publications, the emergence of influential studies, and the growing emphasis on practical applications indicate that this field will continue to expand in the coming years. Future research is encouraged to build upon the highly cited works identified in this study and to explore emerging themes such as AI ethics, transparency, and sustainability-oriented innovation at both organizational and national levels.

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Peer-review: Externally peer-reviewed.

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REFERENCES

Agrawal V, Mohanty R. P., Agarwal S., Dixit J. K. & Agrawal A.M. (2022). Analyzing critical success factors for sustainable green supply chain management. *Environment, Development and Sustainability, 25,* 8233–8258. [CrossRef]

Alsheibani, S., Messom, D., Cheung, Y., & Alhosni, M. (2020). *Reimagining the strategic management of artificial intelligence: Five recommendations for business leaders*. Americas Conference on Information Systems. [CrossRef]

Awan, U., Kraslawski, A., & Huiskonen, J. (2017). Understanding the relationship between stakeholder pressure and sustainability performance in manufacturing firms in Pakistan. *Procedia Manufacturing*, *11*, 768–777. [CrossRef]

Beniaich, R. & Hmioui, A. (2025). Artificial Intelligence in Green Supply Chain Management: a Literature Review. *International Conference on Artificial Intelligence, Computer, Data Sciences and Applications (ACDSA 2025)*. [CrossRef]

Bytniewski, A., Matouk, K., Chojnacka-Komorowska, A., Hernes, M., Zawadzki, A., & Kozina, A. (2020). *The functionalities of cognitive technology in management control system.* Asian Conference on Intelligent Information and Database Systems. [CrossRef]

Chen, F. (2025). Optimization of Thermal Energy and Logistics Innovation in Flexible Manufacturing Systems Based on Artificial Intelligence: Green Supply Chain Management. *International Journal of System Assurance Engineering and Management*. Preprint. https://doi.org/10.1007/s13198-025-02940-z. [CrossRef]

Chin, T.A., Tat, H.H. & Sulaiman, Z. (2015). Green Supply Chain Management, Environmental Collaboration and Sustainability Performance. *Procedia CIRP, 26*(Supplement C), 695–699. [CrossRef]

Chu, S., Yang, H., Lee, M. & Park, S. (2017). The Impact of Institutional Pressures on Green Supply Chain Management and Firm Performance: Top Management Roles and Social Capital. S*ustainability*, *9*, 764. [CrossRef]

Dzhengiz T. & Niesten E. (2020). Competences for environmental sustainability: A systematic review on

the impact of absorptive capacity and capabilities. *Journal of Business Ethics*, *162,* 881–906. [CrossRef]

Duran Ö. & Şen Y. (2024). A field study on green supply chain management. *International Journal of Social Sciences Troyacademy*, *9*(1), 1–23. [Turkish] [CrossRef]

Enholm, I. M., Papagiannidis E., Mikalef P. & Krogstie J. (2022). Artificial intelligence and business value: a literature review. *Information Systems Frontiers, 24*, 1709–1734. [CrossRef]

Feng, Y., Lai, K.H. & Zhu, Q. (2022). Green supply chain innovation: emergence, adoption and challenges. *International Journal of Production Economics*, *248*(1), 108497. [CrossRef]

Fowosere, S., Esechie O. C., Namboozo, S. & Anwansedo F. (2025). The Role of Artificial Intelligence in Green Supply Chain Management. *International Journal of Latest Technology in Engineering, Management & Applied Science, 14*(2), 325–331. [CrossRef]

Gallo H., Khadem A. & Alzubi A. (2023). The relationship between big data analytic-artificial intelligence and environmental performance: A moderated mediated model of green supply chain collaboration (GSCC) and top management commitment (TMC). *Discrete Dynamics in Nature and Society*, *2023,* 4980895. [CrossRef]

Handoyo, S. (2024) Green supply chain management: A bibliometric analysis of global research trends and future directions. *Production & Manufacturing Research*, *12*(1), 2422614. [CrossRef]

Hass, L. (2022). *Nachhaltiges Lieferkettenmanagement multinationaler Unternehmen in der Textilindustrie*. Heft 49, März 2022, https://www.wiso.uni-hamburg.de/fachbereich-sozoek/professuren/ koerner/fiwa/publikationsreihe.html. Accessed on Oct 07, 2024.

Hunke, K. & Prause, G. (2014). Sustainable supply chain management in german automotive industry: Experiences and success factors. *Journal of Security and Sustainability*, *3*(3), 15–22. [CrossRef]

Jo, D. & Kwon, C. (2022). Structure of green supply chain management for sustainability of small and medium enterprises. *Sustainability*, *14,* 50. [CrossRef]

Kafa, N., Jaegler, A. & Sarkis, J. (2020). Harnessing corporate sustainability decision-making complexity: A field study of complementary approaches. *Sustainability*, 12(24), 1–23. [CrossRef]

Khan, S. A. R., Jian, C., Yu, Z., Golpîra, H. & Kumar, A. (2019). Impact of green practices on Pakistani manufacturing firm performance: A path analysis using structural equation modeling Computational intelligence and sustainable systems. In H. Anandakumar, R. Arulmurugan, & C. C. Onn (Eds.), *Computational intelligence and sustainable systems* (pp. 87–97). Springer. [CrossRef]

Lei, C., Zhang, H., Yan, X. & Miao, Q. (2024). Green supply chain optimization based on two-stage heuristic algorithm. *Processes*, *12*, 1127. [CrossRef]

Liu C. & Ma T. (2022). Green logistics management and supply chain system construction based on internet of things technology. *Sustainable Computing Informatics and Systems, 35*(1), 100773. [CrossRef]

Liu S. & Chang Y. T. (2017). Manufacturers' closed-loop orientation for green supply chain management. *Journal of Sustainability, 9*, 222, 1–29. [CrossRef]

Liu, J., Feng, Y., Zhu, Q. & Sarkis, J. (2018). Green supply chain management and the circular economy: reviewing theory for advancement of both fields. *International Journal of Physical Distribution & Logistics Management, 48,* 794–817. [CrossRef]

Makhdoom, Q., Junejo, I., Sohu J.M., Shah, S. M. M., Alwadi B. M., Ejaz F. & Hossain, M. B. (2025). Impact of green supply chain management on sustainable performance: a dual mediated-moderated analysis of green technology innovation and big data analytics capability powered by artificial intelligence. *F1000Research*, *13,* 1140.

Malviya, R.K., Kant, R. & Gupta, A.D. (2018). Evaluation and Selection of Sustainable Strategy for Green Supply Chain Management Implementation. *Business Strategy and the Environment,* 27, 475–502. [CrossRef]

Mastos, T.D. & Gotzamani, K.D. (2024). Sustainable supply chain management in the food industry: a case study of enablers and inhibitors from greek small enterprises. *World Review of Entrepreneurship, Management and Sustainable Development, 20,* 1–20. [CrossRef]

Nguyen, X. & Le, T. (2020). The impact of global green supply chain management practices on performance: The case of Vietnam. *Uncertain Supply Chain Management*, *8*(3), 523–536. [CrossRef]

Nozari, H. (2024). Green supply chain management based on artificial intelligence of everything. *Journal of Economics and Management*, *46*, 171–188. [CrossRef]

Peesapati, S. R. Y., (2024). Sustainability beyond compliance: Exploring technology`s role in driving sustainability across supply chains. *International Journal of Supply Chain Management*, 13 (2), 29–34. [CrossRef]

Perotti S, Zorzini M, Cagno E. & Micheli GJ (2012). Green supply chain practices and company performance: The case of 3pls in Italy. *International Journal of Physical Distribution & Logistics Management, 42*(7), 640–672. [CrossRef]

Sanayi ve Teknoloji Bakanlığı, (2024). Accessed on: July 03, 2024. https://ticaret.gov.tr/data/65dc9d3113b8762768385d66/STB%20Sunum_T%C3%BCrkiye%20Ye%C5%9Fil%20Sanayi%20Projesi_23022024.pdf.

Sharma, V.K., Chandna, P. & Bhardwaj, A. (2017). Green supply chain management related performance indicators in agro industry: A review. *Journal of Cleaner Production*, *141,* 1194-1208. [CrossRef]

Sharma, R., Shishodia, A., Gunasekaran, A., Min, H. & Munim, Z. H. (2022). The role of artificial intelligence in supply chain management: mapping the territory. *International Journal of Production Research*, *60*(24), 7527–7550. [CrossRef]

Singh, R. K., Modgil, S., & Shore, A. (2024). Building artificial intelligence enabled resilient supply chain: A multi-method approach. *Journal of Enterprise Information Management*, *37*(2), 414–436. [CrossRef]

Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, *9*(1), 53–80. [CrossRef]

Taseen, M., Yongli, W., Sadiq, B., Saleem, M. A. & Noor F. (2024). Study on the Impact of AI-powered Green Supply Chain Management Practices on Organizational Sustainable Performance with the mediation role of Technology Innovation. *2024 International Conference on Emerging Trends in Smart Technologies.* [CrossRef]

Tietze, T. (2023). "*Globale Supply Chains: Analyse in den Nachhaltigkeitsdimensionen Ökologie*", (Bachelorarbeit). Fakultät Informatik und Medien, Studiengang Verpackungstechnologie und Nachhaltigkeit, Germany. [German]

Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A. & Afrin, S. (2019). A Litera-ture review on green supply chain management: Trends and futurechallenges. *Resources, Conservation and Recycling*, *141,* 145–162. [CrossRef]

Tubitak, (2024). Dünya Bankası desteğiyle yürütülecek "Türkiye yeşil sanayi projesi": sanayi kuruluşlarının yeşil inovasyon faaliyetlerinin desteklenmesi" bilgi notu. https://tubitak.gov.tr/sites/default/files/1-tubitak_sanayideyesildonusumprojesibilginotu.pdf. Accessed on: June 01, 2024.

Yıldız Çankaya, S. & Sezen, B. (2019). Effects of Green Supply Chain Management Practices on Sustainability Performance. *Journal of Manufacturing Technology Management*, *30*(1), 98–121. [CrossRef]

Wiredu, J., Yang, Q., Sampene, A. K., Gyamfi, B. A. & Asongu, S. A. (2023). The effect of green supply chain management practices on corporate environmental performance: Does supply chain competitive advantage matter? *Business Strategy and the Environment, 33*(3), 2578–2599. [CrossRef]

Zahran, S. (2024). Investigating the nexus between green supply chain practices and sustainable waste management in advancing circular economy. *Sustainability*, *16,* 3566. [CrossRef]

Zeeshan A. & Hajra B. (2024). Waste reduction and recycling: Schweizer-Sklar aggregation operators based on neutrosophic fuzzy rough sets and their application in green supply chain management. *Neutrosophic Systems with Applications*, *19*, 53–66. [CrossRef]

Zhu, Q. & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management, 22*(3), 265–289. [CrossRef]