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BIBLIOMETRIC ANALYSIS OF PUBLICATIONS ON SUSTAINABLE SUPPLIER SELECTION IN THE CONTEXT OF SUPPLY CHAIN MANAGEMENT

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Abstract

Supplier selection is the process of identifying the most suitable supplier to meet a company's needs, directly affecting the effectiveness of its supply chain. Sustainable supplier selection evaluates suppliers based on economic, environmental, and social responsibility criteria. This study aims to conduct a bibliometric analysis of publications on sustainable supplier selection in the WoS database from 2010 to 2024.The study involved searching the WoS database using the keyword "sustainable supplier selection," resulting in a review of 302 publications. These publications were analyzed based on criteria such as distribution by year, prominent authors, high-impact journals, leading institutions, and countries.The research identifies key trends, highly cited works, and the development of the sustainable supplier selection field. This study provides an overview of the knowledge accumulated in the literature and offers recommendations for future research. The purpose of this study is to examine bibliometrically the studies published in the WoS database between 2010 and 2024 on sustainable supplier selection

Keywords: Sustainable Supply Chain Management, Sustainable Supplier Selection, Supplier Evaluation, Multi-criteria supplier selection

JEL Classification: M11, D81, Q56

Article Type: Bibliography

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TEDARİK ZİNCİRİ YÖNETİMİ KAPSAMINDA SÜRDÜRÜLEBİLİR TEDARİKÇİ SEÇİMİNE YÖNELİK YAYINLARIN BİBLİYOMETRİK İNCELENMESİ

Öz

Tedarikçi seçimi, bir işletmenin ihtiyaç duyduğu mal veya hizmetleri sağlayacak en uygun tedarikçiyi belirleme sürecidir. Bu süreç, işletmenin tedarik zincirinin etkinliğini ve verimliliğini doğrudan etkiler. Sürdürülebilir tedarikçi seçimi ise,, bir işletmenin tedarikçilerini seçerken ekonomik, çevresel ve sosyal sorumluluk kriterlerini dikkate alarak uzun vadeli ve sürdürülebilir iş ilişkileri kurmayı amaçlayan bir yaklaşımdır. Bu kavram, geleneksel tedarikçi seçim süreçlerine ek olarak, sürdürülebilirlik odaklı kriterlerin de değerlendirilmesini içerir. Sürdürülebilir tedarikçi seçimi, işletmeler için risk yönetimi, maliyet tasarrufu ve verimlilik, rekabet avantajı, müşteri memnuniyeti ve sadakati, uzun vadeli işbirlikleri, çevresel ve sosyal sorumluluk, yenilik ve inovasyon, finansal performans, yasal ve regülasyon uyumu, iş gücü ve çalışan memnuniyeti gibi bir dizi önemli avantaj ve fayda sağlar. Bu çalışmanın amacı, sürdürülebilir tedarikçi seçimi konusunda 2010-2024 yılları arası Web of Science veri tabanında yayınlanan çalışmaların bibliyometrik açıdan incelenmesidir.

Anahtar Kelimeler: Sürdürülebilir Tedarik Zinciri Yönetimi, Sürdürülebilir Tedarikçi Seçimi, Tedarikçi Değerlendirme

JEL Sınıflandırması: M11, D81, Q56

Makale Türü: Bibliyografi

I. INTRODUCTION

Organizations worldwide are taking critical steps in sustainable supply chain management to reduce negative impacts from their business processes and create a positive impact on the environment. Evaluating and selecting suppliers to establish a sustainable supply chain plays a crucial role in achieving this goal (Suraraksa & Shin, 2019). Sustainable supplier selection integrates economic and social elements with environmental consciousness, adding a different dimension to traditional supply chain management (Sen, Datta, & Mahapatra, 2018). Supplier selection is a complex process that requires balancing multiple, often conflicting criteria-such as environmental, economic, and social factors (Memari et al., 2019). Sustainable supplier selection requires decision-makers to consider and evaluate both qualitative and quantitative factors due to its multi-criteria decision-making nature (Wang, Yang, & Cheng, 2019).

Green and sustainability-focused supplier selection is a critical strategy for businesses in industrial supply chains to support sustainability goals and gain a competitive advantage. This decision helps achieve objectives such as reducing environmental impacts, increasing resource efficiency, and fulfilling social responsibility. Research by Govindan et al. (2013) and Grimm et al. (2014) demonstrates that this strategy enhances business performance and provides a competitive advantage.

Key Elements of Sustainable Supplier Selection (Memari et al., 2019; Sen et al., 2018; Suraraksa & Shin, 2019);

A.Economic Sustainability;

- Financial Stability: The supplier's ability to maintain stable and strong financial health.
- Long-Term Collaboration Potential: Capacity for sustained partnerships.
- Competitive Pricing: Offering fair and competitive pricing structures (Memari et al., 2019).

B.Environmental Sustainability;

- Environmental Management Systems: Implementation of effective policies for environmental impact management.
- Waste & Emission Reduction: Active efforts to minimize waste and emissions.

- Resource Efficiency: Optimized use of energy and natural resources (Sen et al., 2018).
- Eco-Friendly Products: Provision of environmentally responsible products and services (Suraraksa & Shin, 2019).

C.Social Sustainability;

- Employee Rights & Safety: Commitment to employee welfare and a safe work environment.
- Diversity & Equality: Promotion of workplace diversity and equitable practices.
- Social Responsibility: Engagement in societal contributions and ethical projects.
- Ethics & Compliance: Adherence to business ethics and regulatory standards (Memari et al., 2019; Sen et al., 2018).

Sustainable supplier selection contributes to various aspects for businesses. Practices in sustainable supply chain management assist suppliers in reducing their environmental impacts, encompassing measures such as reducing carbon footprint, minimizing waste, and enhancing the efficient use of natural resources. Working with sustainability-focused suppliers can enhance cost efficiency in the long run. For instance, collaborating with suppliers that prioritize energy efficiency can lower energy costs. Another contribution is gaining a competitive advantage. Sustainability is increasingly vital in responding to the rising demands of consumers and stakeholders. Hence, a sustainability-focused supply chain can increase market share and bolster brand reputation. It aids businesses in fulfilling their social responsibilities and positively ontribute to their communities. Practices such as ensuring fair working conditions and supporting local communities enhance businesses' social impacts. These contributions represent just a few of advantages provided sustainable hain management practices. These practices assist businesses in achieving various objectives and ensuring their long-term success.

Despite these contributions, there are challenges to consider. The concept of sustainability encompasses a broad spectrum, requiring consideration of numerous criteria such as environmental, economic, and social factors. Evaluating and balancing each criterion can be challenging. Collecting and analyzing the necessary data to assess suppliers' sustainability performance is time-consuming and difficult. Moreover, concerns regarding the

reliability and accuracy of this data may arise. Contradictions may exist among sustainability criteria. For example, the most environmentally sustainable supplier may not be economically visable. Additionally, differing priorities among businesses can lead to conflicting criteria. The complexity of global supply chains can further complicate sustainable supplier selection. The involvement of the supply chain with various geographic regions and suppliers makes data collection and evaluation processes complex. Sustainable supply chain management necessitates strong collaboration and communication with suppliers. However, establishing collaboration and communication among different stakeholders in the supply chain, especially with suppliers from different cultures and business practices, can be challenging. Despite these challenges, businesses can enhance their environmental, economic, and social sustainability by effectively managing sustainable supplier selection. Utilizing appropriate strategies and tools is crucial in this process. Sustainable supplier selection generally involves the following steps:

Determination of Criteria: The first step involves establishing criteria that evaluate suppliers from environmental, economic, and social sustainability perspectives. For example, criteria such as carbon footprint, energy efficiency, and occupational health and safety practices can be defined (Memari et al., 2019).

Collection of Supplier Data: At this stage, data about suppliers' environmental and social performance, financial status, quality management systems, and other relevant aspects need to be collected. This data can be gathered through supplier surveys, existing databases, certifications, and reports (Suraraksa & Shin, 2019).

Data Analysis and Evaluation: The collected data are then analyzed and evaluated based on the identified criteria. Suppliers are ranked according to their sustainability performance, highlighting their strengths and weaknesses (Wang, Yang, & Cheng, 2019).

Supplier Selection and Decision Making: Based on data analysis results, decisions are made to select the most suitable suppliers. This decision may consider business priorities, supplier performance, and other factors, with communication and negotiation processes also taking place at this stage (Govindan et al., 2013).

Establishment of Contracts and Collaboration: Contracts are signed with selected suppliers, and collaboration is officially initiated. At this stage, it’s crucial to clarify specific goals, commitments, and responsibilities between the parties (Grimm et al., 2014).

Performance Monitoring and Feedback: After collaboration begins, suppliers' performance should be regularly monitored, and feedback provided. This helps suppliers achieve their sustainability goals and enables continuous improvements (Luthra et al., 2017).

These stages provide general guidance and can be tailored to the specific needs and priorities of businesses. Sustainability in supply chain management is becoming increasingly important for businesses to gain competitive advantage and fulfill their social responsibilities.

The first part of the study focuses on defining Sustainable Supplier Selection, emphasizing its importance and the role of strategies. It discusses the stages and challenges involved. The second part identifies the problem. In the third part, a bibliometric analysis of the literature in the field of "Sustainable Supplier Selection" is conducted. By analyzing the authors, institutions, and keywords in this field, the prominent trends and findings of the field are evaluated. Existing knowledge is assessed. Subsequently, regions and products with possible applicability are researched and prioritized. In the fourth part, a summary of the findings and discussion on future research areas are presented.

II. LITERATURE

In the scope of sustainability, supplier selection is of paramount importance and necessity for businesses to fulfill their environmental, economic, and social responsibilities and support sustainability goals. It is critical in terms of reducing environmental impacts, supporting social and ethical standards, managing risks and seizing innovation opportunities, complying with legal and regulatory regulations, meeting customer and investor demands, maintaining customer satisfaction and loyalty, among other factors. Selecting suppliers not only based on environmental but also economic and social sustainability principles enhances businesses' competitive advantage and contributes to a sustainable future. In this context, working with suppliers who adopt and implement sustainability policies is crucial.In this study, a review was conducted on the field of sustainable supplier selection by scanning books, articles, conference papers, etc., through WoS. An assessment of 286 publications was made based on criteria such as the number of publications per year in the relevant literature, leading articles and authors in the field, leading journals, prominent universities, and countries. The aim was to identify trends in the field and to characterize the most influential publications and researchers.

III. METHODOLOGY

III.I. Bibliyometric Analysis

Aria and Cuccurullo's work made a significant contribution by introducing Bibliometric, an open-source R package designed for comprehensive bibliometric analysis. This tool has facilitated the analysis of trends, developments, and knowledge structures within scientific publications and played a crucial role in popularizing bibliometric methods in academic research (Aria & Cuccurullo, 2017).Eugene Garfield's contributions laid the foundation for bibliometric analysis, especially through the development of citation analysis. Garfield's work promoted the widespread use of citation-based bibliometric methods, which have become essential for tracking the influence and interconnections of scholarly publications (Garfield, 1972). In recent years, bibliometric analysis has gained significant importance in social research. Factors behind this popularity include the development of bibliometric software such as Gephi, Leximancer, and VOSviewer, as well as the increased accessibility and usability of scientific databases. Bibliometric analysis involves collecting analyzing and measuring data related to scientific publications. This method is used to understand various aspects of the literature in a specific research field, identify trends in a particular topic or discipline, and identify the most influential publications or researchers. Bibliometric studies are used to reveal the status, trends, and development of studies in a specific scientific field. This analysis is typically conducted by examining various characteristics of publications in a research field, such as the number of publications, citation counts, publication dates, authors, published journals, and geographical distribution. The data obtained from scientific databases are analyzed using bibliometric software, and results are obtained through various visualizations and statistical analyses. To achieve these objectives, this study focused on scientific research types by searching for books, journals, articles, and conference papers with the keyword "sustainable supplier selection" in the titles in the WoS database. The study aimed to determine the trends in sustainable supplier selection by analyzing the geographical and demographic characteristics of publications, the publications with the highest number of citations, authors, and the journals with the highest impact factors. Thus, the aim was to reveal trends in this field and understand developments in the literature.

III.II. Collection of Data And Analysis

WoS, provided by Thomson Reuters (now Clarivate Analytics), is a scientific research platform that serves as a comprehensive multidisciplinary academic database. It is a crucial resource for tracking current developments in scientific literature, conducting academic

research, performing citation analyses, and evaluating academic performance. The platform encompasses a wide range of scientific journals, conference proceedings, books, and patent data. Users can search the extensive databases within WoS, find relevant articles, view citation information, and conduct bibliometric analyses.

On April 24, 2024, a search was conducted with the keyword "Sustainable Supplier Selection" in the "title" field, yielding 302 results. These results span various disciplines/fields, with the oldest publication dating back to 2011 and the most recent to 2024. Among the 302 results, there were 256 articles, 20 conference papers, 11 unpublished works, 8 review articles, 3 correction publications, 2 book chapters, and 2 retraction publications.

This study has two limitations. Firstly, it relies solely on content indexed in the WoS database, excluding sources not indexed in databases such as Scopus or ScienceDirect, as well as offline materials. Secondly, only publications written in English were included in the analysis.

III.II.I. Distribution of Publications by Type

Between 2010 and 2023, a total of 302 publications are listed. The distribution of publications by type is presented in Figure I. Among the total publications, the number of articles published is 256, accounting for 84.77% of the total, indicating a high share.

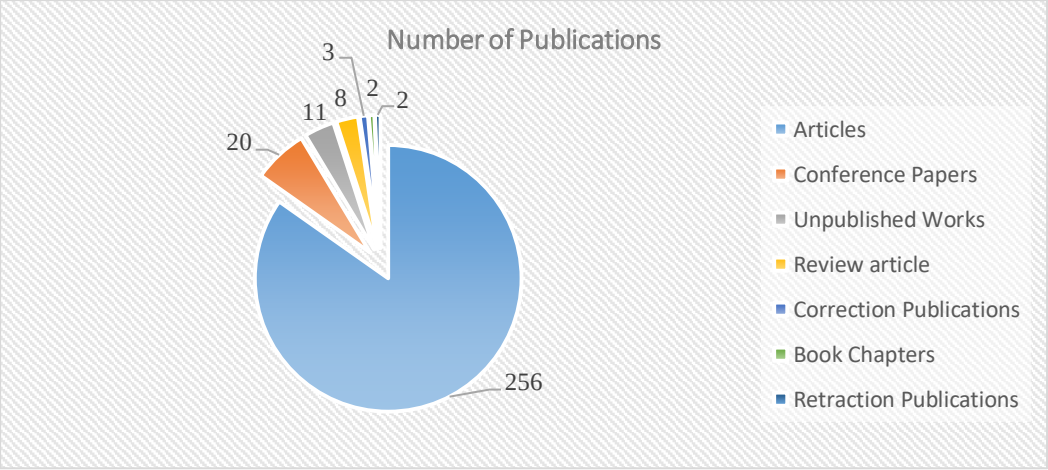

Figure I. Distribution of Publications by Type

III.II.I. Distribution of Publications by Years

Between 2010 and 2024, the graph in Figure II illustrates the distribution of publications on an annual basis. The total number of publications between 2011 and 2018 was 30, with an upward trend beginning in 2018 with 30 publications alone. It is observed that

there is a total of 245 publications after this date. There has been a significant increase since 2018. The primary reasons behind the increase in studies in the field of Sustainable Supplier Selection in 2022 and 2023 can be attributed to increasing awareness and demand, regulations and standards, the desire to provide risk management and competitive advantage, technological advancements, and academic and industry collaborations. At the forefront of these reasons is the 17 Sustainable Development Goals (SDGs) published in the United Nations' "2030 Agenda for Sustainable Development" adopted in 2015. Sustainable supply chain management entails managing businesses' supply chains considering their environmental, economic, and social impacts. Therefore, the adoption of the United Nations Sustainable Development Goals (SDGs) may have encouraged businesses and researchers to focus more on sustainability-related issues.

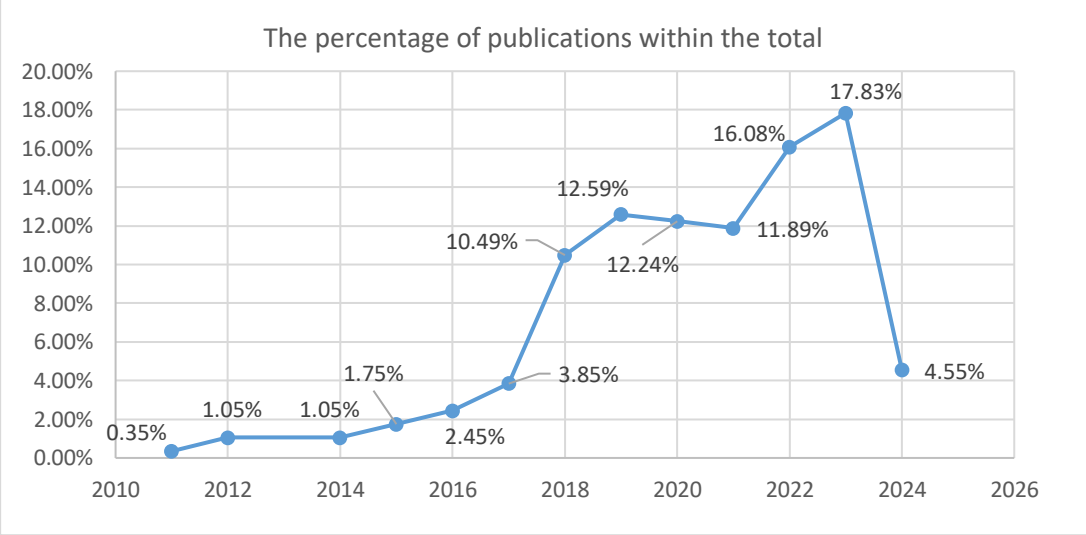

Figure II. Distribution of Publications by Years

III.II.III. Leading Publications in the Field

When identifying significant publications contributing to a field, citation count is an important metric. Table I. lists leading publications in the field along with their total citation counts.

Table I. Leading Publications in the Field

Authors	Publication Year	Citation Count
Stevic, Z; Pamucar, D; Puska, A; Chatterjee, P	2020	545
Luthra, S; Govindan, K; Kannan, D; Mangla, SK; Garg, CP	2017	529
Amindoust, A; Ahmed, S; Saghafinia, A; Bahreininejad, A	2012	379
Büyüközkan, G; Çifçi, G	2011	348
Awasthi, A; Govindan, K; Gold, S	2018	335
Memari, A; Dargi, A; Jokar, MRA; Ahmad, R; Rahim, AA	2019	322
Zimmer, K; Fröhling, M; Schultmann, F	2016	264
Azadnia, AH; Saman, MZM; Wong, KY	2015	241
Kannan, D	2018	219
Yu, CX; Shao, YF; Wang, K; Zhang, LP	2019	218
Ecer, F; Pamucar, D	2020	215
Tirkolaee, EB; Mardani, A; Dashtian, Z; Soltani, M; Weber, GW	2020	213
Abdel-Baset, M; Chang, V; Gamal, A; Smarandache, F	2019	210
Sarkis, J; Dhavale, DG	2015	198
Fallahpour, A; Olugu, EU; Musa, SN; Wong, KY; Noori, S	2017	181
Bai, CG; Kusi-Sarpong, S; Ahmadi, HB; Sarkis, J	2019	174
Vahidi, F; Torabi, SA; Ramezankhani, MJ	2018	165
Arabsheybani, A; Paydar, MM; Safaei, AS	2018	162
Rashidi, K; Cullinane, K	2019	161
Chen, ZH; Ming, XG; Zhou, TT; Chang, Y	2020	156

Asian countries lead the way in research in this field. Collaborations have been established with researchers from various geographies, including Asian countries, the USA, and European countries.

III.II.IV. Leading Authors in the Field

The study included 302 publications authored by a total of 754 authors. Authors with at least 5 or more publications are shown in Table II.

Table II. Leading Authors in the Field

Authors	Publication Number	Citation
Pamucar D	7	863
Wong KY	7	652
Kannan D	6	1046
Tavana M	6	396
Barnes D	5	140
Govindan K	5	1150
Rani P	5	115
Stevic Z	5	857
Wang CN	5	109
Wu C	5	140

When examining Table II, it is evident that the most prolific authors in terms of their contributions to Sustainable Supplier Selection are Kannah and Govindan. Since the publication with the highest citation count is often considered the most impactful in the field, these authors are presumed to have the greatest influence on this area..

III.II.V. Distribution by Categories in Web Of Science (WoS)

WoS is a scientific research platform provided by Clarivate Analytics, offering a vast multidisciplinary academic database. This platform serves as a comprehensive source used for tracking current developments in scientific literature, conducting academic research, performing citation analyses, and evaluating academic performance. When conducting research in WoS, users can filter by these categories and access literature in their respective fields more easily. These categories help researchers gain in-depth knowledge on specific subjects and facilitate the discovery of relevant studies. The categories in Wos are typically determined by publishers and editors, who assign publications to specific categories. Of the 302 publications included in the study, a total of 40 record assignments were reported in the WoS database. Publications with 10 or more records are tabulated. The distribution based on category-specific record numbers is shown in Table III. Upon examining the table, "Green Sustainable Science Technology" and "Environmental Sciences" categories are ranked first and second, respectively. The combined ratio of these two categories, which occupy the top two positions, is 51.40%, representing the highest coefficient and ratio, equivalent to half of the total. Therefore, it can be concluded that the primary focus of research in the field of sustainable supplier selection revolves around green and sustainable environmental topics, primarily pursued by profiles working in this area.

Table III. Distribution by Categories in WoS

Web Of Science Categories	Record Number	Distribution
Green Sustainable Science Technology	76	26.57%
Environmental Sciences	71	24.83%
Engineering Industrial	49	17.13%
Operations Research Management Science	49	17.13%
Computer Science Artificial Intelligence	38	13.29%
Environmental Studies	38	13.29%
Computer Science Interdisciplinary Applications	34	11.89%
Engineering Environmental	28	9.79%
Management	27	9.44%
Engineering Manufacturing	21	7.34%
Computer Science Information Systems	16	5.59%
Engineering Multidisciplinary	14	4.90%
Business	11	3.85%
Engineering Electrical Electronic	11	3.85%

III.II.VI. Leading Journals in the Field

The list of journals with at least 5 or more publications in a total of 302 academic studies, along with the publication counts and their distribution percentages within the total, is shown in Table IV. In terms of total publication count and percentages, the most significant journals are 'Sustainability' and 'Journal of Cleaner Production'

Table IV. Leading Journals in the Field

Journal	Publication No	Distribution
SUSTAINABILITY	32	11.19%
JOURNAL OF CLEANER PRODUCTION	24	8.39%
COMPUTERS INDUSTRIAL ENGINEERING	13	4.55%
EXPERT SYSTEMS WITH APPLICATIONS	9	3.15%
INTERNATIONAL JOURNAL OF PRODUCTION ECONOMICS	7	2.45%
JOURNAL OF INTELLIGENT FUZZY SYSTEMS	7	2.45%
INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH	6	2.10%
PROCESSES	6	2.10%
APPLIED SOFT COMPUTING	5	1.75%
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	5	1.75%
INFORMATION SCIENCES	5	1.75%
INTERNATIONAL JOURNAL OF SUSTAINABLE ENGINEERING	5	1.75%
KYBERNETES	5	1.75%
MATHEMATICS	5	1.75%
SOFT COMPUTING	5	1.75%

III.II.VII. Leading Countries in the Field

Table V. Leading Countries in the Field

Countries	Publication No	Distribution
PEOPLES R CHINA	100	34.97%
IRAN	55	19.23%
INDIA	40	13.99%
USA	25	8.74%
TURKEY	21	7.34%
TAIWAN	20	6.99%
ENGLAND	18	6.29%
GERMANY	15	5.25%
MALAYSIA	14	4.90%
PAKISTAN	12	4.20%
DENMARK	10	3.50%
SERBIA	10	3.50%
VIETNAM	10	3.50%

The countries making the most significant contributions to the field, with publication counts of at least 10 or more, are shown in Table V. Upon examining the table, it can be observed that out of the 302 included publications, China ranks first with a percentage of 34.97%. Following China, Iran, India, the USA, and Turkey are the countries with the highest activity in this area.

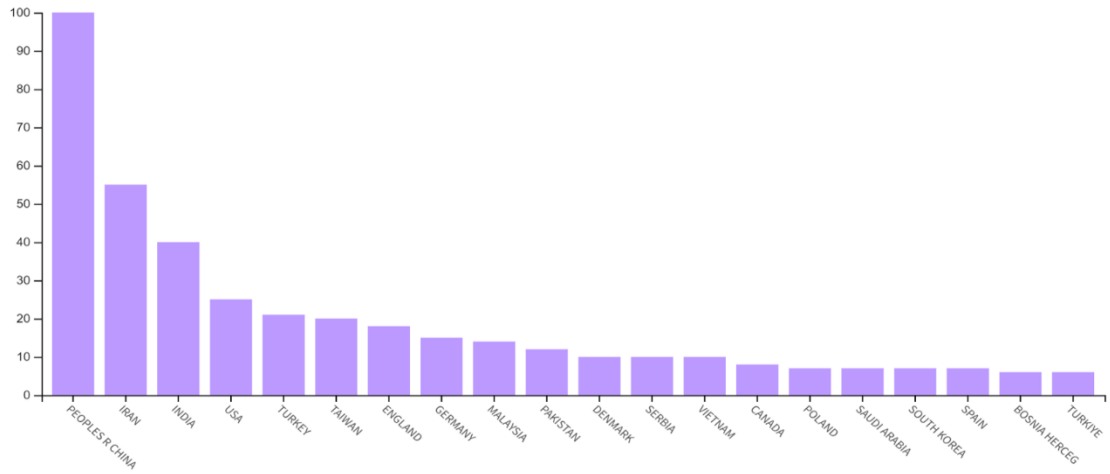

Figure III. Leading Countries in the Field

In Figure III, the distribution of these countries is graphically represented. As seen in the figure, these countries, with China leading, comprise 95.11%, primarily consisting of Asian countries. The increase in research and studies related to sustainability from China and other Asian countries can be attributed primarily to rapid economic growth and

industrialization. Environmental problems have also increased under the influence of rapid economic growth and industrialization in many Asian countries in the last few decades. Problems such as air pollution, water pollution, and waste management have encouraged research in sustainability. Researchers have been directed towards finding solutions to these issues. Several countries in Asia are facing urgent situations requiring immediate action to address environmental problems due to rapid urbanization, population growth, industrialization, depletion of natural resources, and environmental degradation. This situation has increased the importance of sustainability research and focused more attention on these issues. Another reason is government policies and incentives. Asian countries have developed policies and incentives to promote sustainable development. For example, China's "Green Development" strategy, 13th Five-Year Plan, and initiatives such as "Made in China 2025," India's "Smart Cities" initiative, and Japan's incentives for eco-friendly technologies have encouraged researchers to work on sustainability issues. These policies have contributed to the increase in academic and industrial research. China has significantly increased its research and development (R&D) capacity in recent years. Universities and research institutions provide more resources and support in the fields of sustainability and environmental science, encouraging more academics and researchers to work on sustainability issues. Chinese researchers are increasingly participating in international collaborations. These collaborations promote knowledge sharing in sustainability and the development of innovative solutions. International projects and partnerships increase the number and quality of research coming from China. The United Nations' Sustainable Development Goals (SDGs) adopted in 2015 have guided global research on sustainability. China is making intensive efforts to achieve these goals, which is reflected in academic research. In conclusion, the main reasons for the increase in sustainability research in Asian countries, particularly China, include rapid economic growth and industrialization, government policies and incentives, increased R&D capacity, international collaborations, global sustainability goals, and increased environmental awareness. These factors encourage researchers in this region to conduct intensive studies on sustainability.

III.II.VIII. Leading Universities in the Field

The universities contributing to the development of the field with at least 5 or more publications are shown in Table VI .

Table VI. Leading Universities in the Field

Universities	Publication No	Distribution
ISLAMIC AZAD UNIVERSITY	16	5.59%
UNIVERSITY OF TEHRAN	16	5.59%
SICHUAN UNIVERSITY	10	3.50%
UNIVERSITI TEKNOLOGI MALAYSIA	10	3.50%
UNIVERSITY OF SOUTHERN DENMARK	10	3.50%
NATIONAL INSTITUTE OF TECHNOLOGY NIT SYSTEM	9	3.15%
IRAN UNIVERSITY SCIENCE TECHNOLOGY	8	2.80%
NATIONAL KAOHSIUNG UNIVERSITY OF SCIENCE TECHNOLOGY	7	2.45%
XIAMEN UNIVERSITY	7	2.45%
INDIAN INSTITUTE OF TECHNOLOGY SYSTEM IIT SYSTEM	6	2.10%
LA SALLE UNIVERSITY	6	2.10%
UNIV DEF BELGRADE	6	2.10%
UNIVERSITY OF PADERBORN	6	2.10%
UNIVERSITY OF EAST SARAJEVO	5	1.75%
UNIVERSITY OF ELECTRONIC SCIENCE TECHNOLOGY OF CHINA	5	1.75%
UNIVERSITY OF WESTMINSTER	5	1.75%

Four of the universities in Table VI are located in China, three in Iran, and two in India. Economic growth and industrialization have increased in China and India over the past decade. This rapid growth, along with dense population and rapid urbanization, has led to environmental degradation and depletion of natural resources. Iran faces environmental pressures such as water scarcity, soil erosion, and air pollution due to industrialization and the energy sector. This situation has increased the number of environmental sustainability research. In conclusion, common reasons for the increase in sustainability research in China, India, and Iran include rapid economic growth and industrialization, the need to address environmental issues, government policies and incentives, increased R&D capacity, international collaborations, global sustainability goals, and high population density and urbanization. These factors encourage researchers in these countries to conduct intensive studies in the field of sustainability.

III.II.IX. Science Mapping

Science mapping is a method aimed at visualizing the structure, dynamics, and development of a specific research area through the analysis of scientific research and literature. This process systematically organizes scientific knowledge using various data

collection and analysis techniques and presents this information in the form of visual maps. These maps are used to understand the structural and conceptual framework of a particular topic, illustrate research relationships, uncover scientific communication networks, and develop research strategies

III.II.X. Citation Density Analysis

Citation density analysis is an important bibliometric method used to evaluate the impact and connections of scientific articles. This analysis helps determine which studies and researchers have the most impact by examining how often and by whom articles in a specific topic or research area are cited. It conducts impact assessments to identify which articles, authors, or journals have the most influence in a given field. It performs trend analysis to examine research trends in a particular field and their changes over time. It elucidates collaborations among researchers and the scientific impact of these collaborations. It helps identify studies that are widely acknowledged and frequently cited as foundational in the field. Citation density analysis is a critical method for understanding the impact and development of scientific research. It enables researchers, institutions, and policymakers to objectively assess the value and significance of scientific studies. Additionally, it can provide guidance for future research by identifying important studies and research gaps in a specific field.

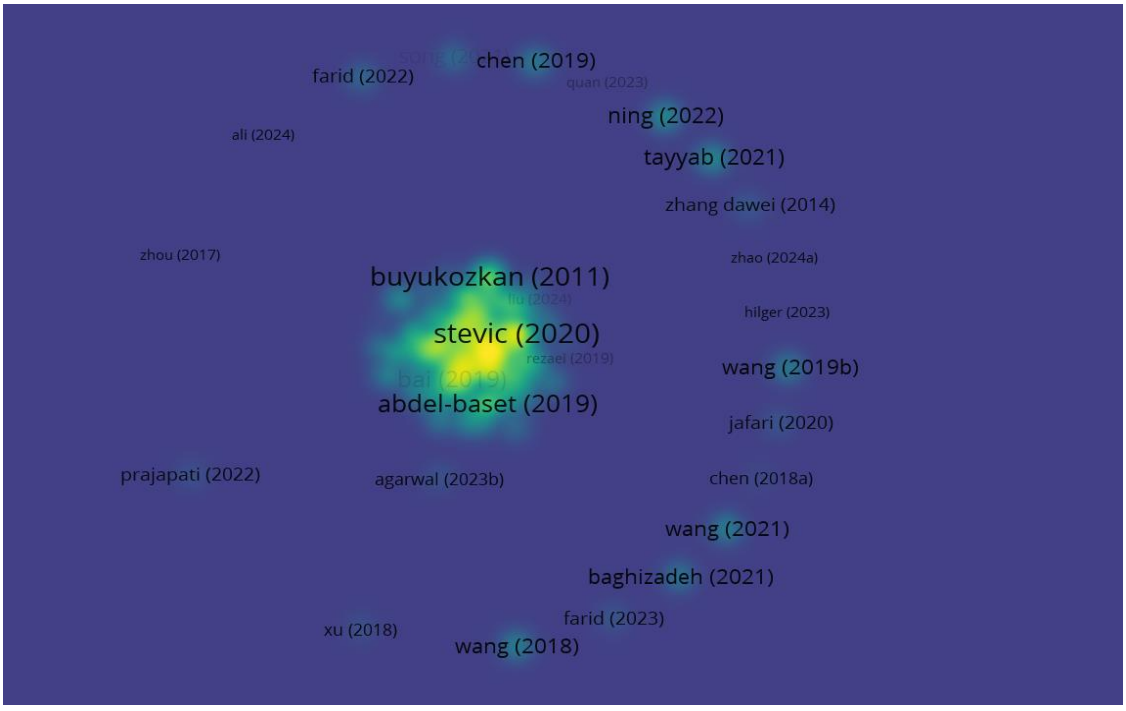

Figure IV. Citation Analysis Density Map

The visualization of the connections between the 302 articles examined in the analysis and the density map of the strongest citation connections identified by the VOSviewer algorithm among the 45 studies meeting the criterion of at least 100 citations are presented in Figure V. The most cited articles are detailed below:

Pamucar et al., 2024, developed a new Measurement and Ranking of Alternatives according to the Compromise Solution (MARCOS) method for sustainable supplier selection at a polyclinic in Bosnia and Herzegovina. The example describes how the MARCOS method can be used to select sustainable suppliers in the private healthcare sector. It involves ranking eight alternatives based on 21 criteria for all aspects of sustainability. The results of the new method and its validation are conducted through comprehensive sensitivity analysis. Twenty-one scenarios were created where the weight values of the criteria were changed, the measurement scale from 1 to 9 was changed to 1-5, comparisons were made with six other methods, and validated under dynamic conditions implying changes in the criteria. All stages of sensitivity analysis have demonstrated the validity of the MARCOS method.

Kannan et al., (2018) propose a framework for evaluating sustainable supplier selection using an integrated Analytic Hierarchy Process (AHP), ViseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR), a multi-criteria optimization, and compromise solution approach. A supplier selection was made based on data from an automotive company in India. According to the findings, 'Environmental costs', 'Product quality', 'Product price', 'Occupational health and safety systems', and 'Environmental competencies' ranked among the top five criteria for sustainable supplier selection. Additionally, among the five sustainable supplier alternatives, the 'third' supplier ranked highest. The study presented in this article can assist managers and business professionals not only in distinguishing important supplier selection criteria but also in evaluating the most efficient supplier in the supply chain for sustainability while remaining competitive in the market.

Amindoust et al., 2012, identified sustainable supplier selection criteria and sub-criteria, and proposed a methodology for evaluating and ranking a specific supplier group based on these criteria and sub-criteria. Fuzzy logic was applied to address the subjectivity of decision-makers' evaluations, and a new ranking method based on fuzzy inference systems (FIS) for supplier selection problems was proposed. Finally, an illustrative example was used to demonstrate the applicability of the proposed method.

Büyüközkan and Çiftçi, 2011, examine the problem of determining an effective model based on sustainability principles for supplier selection operations in supply chains. The approach should also take into account time pressure, lack of expertise in the relevant field, etc., that decision-makers may encounter during the evaluation process. The article develops a new approach based on a fuzzy analytic network process under incomplete preference relations within a multi-person decision-making scheme. The method not only enables adequate evaluations using the provided preference information but also maintains the consistency level of the evaluations. Finally, the article analyzes the sustainability of some suppliers in a real-life problem to demonstrate the validity of the proposed evaluation model.

In conclusion, supplier selection based on sustainability principles is an important strategic tool for businesses to fulfill their environmental, social, and economic responsibilities. This selection not only ensures legal compliance and cost savings but also enhances brand reputation and establishes a solid foundation for long-term business success. Therefore, sustainable supplier selection has become an indispensable practice for modern businesses.

III.II.XI. Co-citation Analysis

Co-citation analysis is a bibliometric analysis method used to examine relationships and connections in scientific literature. This analysis identifies whether two or more studies cite the same third study, thereby revealing the relationship between these studies and common areas of interest. Co-citation analysis is a useful tool not only for discovering related or interconnected publications but also for determining thematic clusters (Donthu et al., 2021). It helps identify common themes, concepts, or theories, uncover connections between researchers or research groups, understand trends and their evolution over time, and identify pioneering and influential studies. Thus, it promotes scientific communication and collaboration.

Figure V shows the density map related to co-citation analysis. Four different clustering patterns are identified based on co-citations.

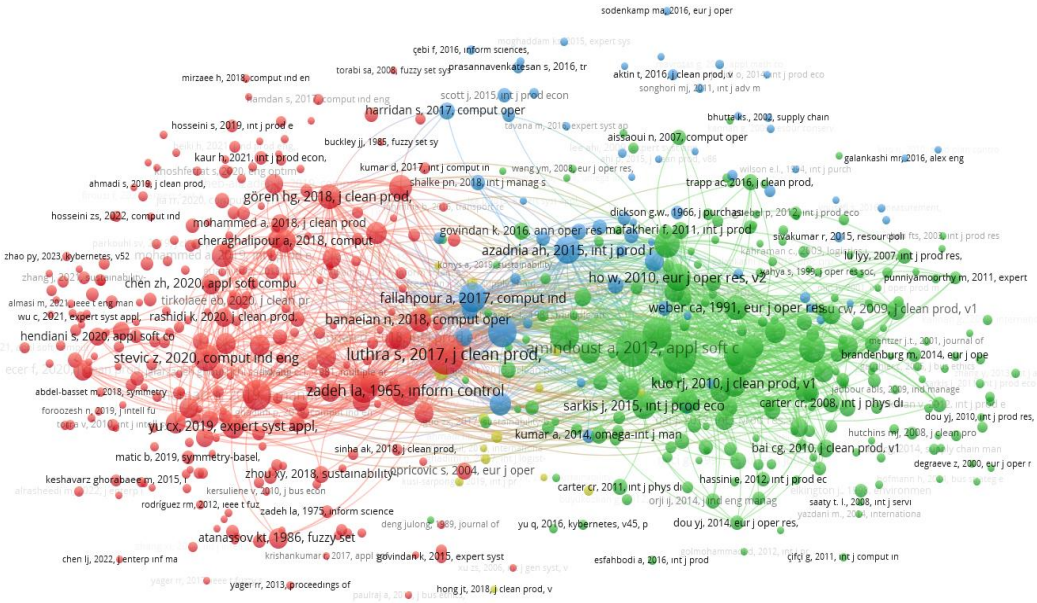

Figure V. Connection Map for Co-Citation Analysis

IV. CONCLUSION AND RECOMMENDATIONS

Sustainable supplier selection is crucial for businesses' long-term success and societal responsibilities, impacting environmental, social, and economic dimensions. This process involves a diverse set of evaluation criteria, from resource preservation and carbon footprint reduction for environmental impact, to cost savings, efficiency, and risk management for economic benefits. Socially, it includes criteria such as ethical practices, employee rights, and safety, all of which collectively support brand reputation and competitive advantage. Moreover, compliance with international standards (e.g., ISO 14001 and ISO 45001) further strengthens a business's position in global markets by enhancing consumer trust and fulfilling regulatory expectations.

While sustainable supplier selection supports businesses in achieving their economic and social goals, it also presents notable challenges. Balancing multiple, often conflicting criteria (environmental, social, and economic) can complicate the decision-making process. For instance, the most environmentally sustainable supplier may not meet economic viability requirements. Additionally, the process can be resource-intensive, requiring robust data collection and analysis, which may not always yield reliable and up-to-date information. Furthermore, as sustainability criteria evolve, businesses may struggle to keep pace with

emerging standards and technologies, creating a need for constant adaptation and reassessment.

This study provides a bibliometric analysis of sustainable supplier selection research, analyzing key publications, authors, journals, and trends in the field. The findings offer insights into the development and focus areas of the literature, with notable contributions identified from prolific authors and leading countries.

Limitations and Future Research Directions:

The study is limited by its reliance on the WoS database, excluding other major databases like Scopus, Google Scholar, and Microsoft Academic. Including these sources in future research could expand the literature scope, enabling a more comprehensive analysis. Additionally, this study focuses only on English publications, potentially overlooking significant contributions in other languages. Future research could address this by incorporating non-English sources for a broader, more diverse perspective.

By recognizing these limitations and exploring additional databases and languages, future studies can build a more detailed understanding of sustainable supplier selection, offering insights that support both academic and practical advancements in the field.In the literature review, selection criteria to be considered while making supplier selection within the scope of sustainability have been determined. Drawing on studies conducted on selection criteria, Coskun, Yıldız, and Bayraktar (2022) ranked the factors they obtained environmentally, economically, and socially, and listed these criteria in Table VII.

Table VII. Selection Criteria for Sustainable Supplier Selection

S	A. ENVIRONMENTAL CRITERIA	STUDIES DONE
1	Waste Management	Govindan vd. (2013); Azadnia vd. (2012); Amindoust vd. (2012)
2	Environmental Protection Policies	Awasthi vd. (2010)
3	Environmental Management System	Çiçek vd. (2020); Bai & Sarkis (2010); Dou & Sarkis (2010)
4	Emissions	Amindoust vd. (2012)
5	Energy consumption	Gold & Awasthi (2015)
6	Recycling Activities	Memari vd. (2019); Su vd. (2016)
7	Resource Consumption	Çiçek vd. (2020); Govindan vd. (2013);Bai & Sarkis, (2010)
8	Pollution Prevention Measures	Govindan vd. (2019); Bai & Sarkis (2010)
9	Pollution Control	Govindan vd. (2019); Dou & Sarkis (2010)
10	Certification	Fallahpour vd. (2017); Su vd. (2016)
11	Participation in Green Activities	Amindoust vd. (2012)
12	Green Transportation and Distribution Strategies	Colicchia vd. (2013)
13	Green Supply Chain	Azadnia vd. (2013); Amindoust vd. (2012)
S	**A. ECONOMIC CRITERIAS**	**STUDIES DONE**
1	Price	Awasthi vd.(2018);Luthra vd. (2017); Amindoust vd. (2012)
2	Company Infrastructure	Yayla vd. (2015)
3	Profitability	Govindan vd. (2019)
4	Environmental Costs	Ahi & Searcy (2015)
5	Market share	Govindan vd. (2019); Ahi & Searcy (2015)
6	Operational Costs	Govindan vd. (2019);Arabsheybani vd. (2018)
7	Service Skill	Chang vd. (2011); Dou & Sarkis (2010)
8	Service Performance	Memari vd. (2019); Luthra vd. (2017)
9	Communication and Information Technology	Govindan vd. (2019); Liu & Wang (2009)
10	Quality	Memari vd. (2019); Amindoust vd. (2012); Bai & Sarkis (2010)
11	Delivery time	Fallahpour vd. (2017); Govindan vd. (2013); Chen vd. (2010)
12	Customer happiness	Ahi & Searcy (2015)
13	Strategic Alignment	Dou & Sarkis (2010)
14	Risk Sharing	Tavana vd. (2016)
15	Product / Service Quality	Govindan vd. (2019)
16	Supply Cost	Govindan vd. (2019); Memari vd. (2019); Ghadimi & Heavey (2014)
18	Technology Expertise/Capacity	Bai & Sarkis (2010); Aktas vd. (2011)
19	Reverse Logistics Investments	Aguezzoul (2014)

The total of 18 economic, 13 environmental, and 12 social criteria have been identified. These criteria are significant in achieving sustainability goals, minimizing environmental impacts, fulfilling social responsibilities, and generating long-term economic

benefits. Each criterion should be selected and evaluated to contribute to the environmental, social, and economic sustainability of your supply chain. This will provide guidance to business professionals and academics aiming to conduct Sustainable Supplier Selection.

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