Región Científica

e-ISSN: 2954-6168
Región Científica. 2024. 3(2), 2024315
doi: 10.58763/rc2024315

Implementation of circular economy in supply chain management: a bibliometric analysis

Implementación de la economía circular en la gestión de la cadena de suministro: un análisis bibliométrico

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ABSTRACT

Supply chains have a high environmental impact; while the circular economy generates sustainable benefits through the reuse of resources, in this sense, circular supply chains integrate the sustainability of supply chains. The objective is to analyze the implementation of circular economy in supply chain management during the period 2021 - 2023. The research is of a descriptive quantitative type, based on a bibliometric analysis, it was developed in the Scopus database and only research articles found in open access in the areas of engineering, business, management and accounting sciences were taken into account. A total of 293 research papers were identified, the largest number of papers were published in 2022 with 114. The most representative author was Kazancoglu with eight publications. The institution that contributed the most articles was Yaşar Universitesi with 10 researches. The country that published the most was United Kingdom with 76 researches. The researches were published in 83 scientific journals, the most published was Journal of Cleaner Production (n=39), and in turn the most cited with 1138 citations, the one with the highest impact in Scopus was International Journal of Production Economics (IF=11,849).

Keywords: bibliometric analysis, circular economy, reverse logistics, supply chain.

JEL Classification: L81, Q01, Q56

RESUMEN

Las cadenas de suministro desprenden un gran impacto ambiental; mientras que la economía circular genera beneficios sostenibles mediante la reutilización de recursos, las cadenas de suministro circulares integran la sostenibilidad de aquellas. El objetivo trazado fue analizar la implementación de la economía circular en la gestión de la cadena de suministro durante el período 2021 – 2023; bajo una investigación de tipo cuantitativa descriptiva, y a partir de un análisis bibliométrico, se desarrolló en la base de datos Scopus y solo se tuvieron en cuenta los artículos de investigación de acceso abierto en las áreas de ingeniería, negocio, administración y ciencias contables. Se identificaron 293 investigaciones, mayoritariamente publicadas en el año 2022 con 114. El autor más representativo fue Kazancoglu, con ocho publicaciones. La institución que más aportó artículos fue Yaşar Universitesi, con 10 investigaciones y el país que más se publicó fue Reino Unido, con 76 investigaciones. Las investigaciones se publicaron en 83 revistas científicas, la que más publicó fue Journal of Cleaner Production (n=39); la más citada, tuvo 1138 citas y la de mayor impacto en Scopus fue International Journal of Production Economics (IF=11,849).

Palabras clave: análisis bibliométrico, cadena de suministro, economía circular, logística inversa.

Clasificación JEL: L81, Q01, Q56

Received: 11-03-2024 **Revised:** 26-05-2024 **Accepted:** 15-06-2024 **Published:** 01-07-2024

Editor: Carlos Alberto Gómez Cano

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Cite as: Leyva, S. y Pancorbo, J. (2024). Implementación de la economía circular en la gestión de la cadena de suministro: un análisis bibliométrico. Región Científica, 3(2), 2024315. https://doi.org/10.58763/rc2024315

INTRODUCTION

Today's environments are increasingly competitive, influenced by globalization and scientific and technological advances, and institutions are constantly seeking alternatives to address the various challenges facing the sector in the area of logistics and supply chains (Sánchez et al., 2021). In this context, institutions need to be flexible and adapt their processes and structures to market demands, ensuring that internal and external factors are interrelated and fostering the exchange of information for management, from suppliers to production and the marketing of products and goods (Marqués, 2013).

In this scenario, supply chains (SCs) emerge as an opportunity. They reached their peak in 1990, following the evolution of logistics subsystems toward business logistics and, subsequently, the integration and interrelation of these systems through collaborations to offer a service or product (Acevedo, 2008). Chopra and Meindl (2008) define SC as the set of parties directly or indirectly involved in satisfying a customer; it includes the supplier, manufacturer, transporters, warehouses, marketers, and customers. Aguilar et al. (2012), for their part, identify three main stages of SC: provisioning, production, and distribution.

Supply Chain Management (SCM) is an evolving concept, as there is no evidence of a homogeneous origin in its study and conception, but rather it adapts to approaches and perspectives based on the characteristics of institutions. SCM encompasses the processes of planning, organization, coordination, and control of supply, transformation, and logistics management activities. Currently, the integration of SC and collaboration among its stakeholders are essential, based on a coherent and solid management model that allows for improved performance and quality of products and services.

Acevedo (2013) identifies a set of problems that affect the correct functioning of the SCM:

- Poor collaborative planning.
- Poor integration of logistics flows: monetary-financial, materials, and information.
- Poor understanding of the concept and scope of logistics and its use in identifying management indicators.
- Poor inventory management caused by poor production planning.
- Poor integration of CS.
- Poor integration of digital technologies for management.

The circular economy proposal

The circular economy (CE) approach emerges as a new paradigm for optimizing resource use and promoting sustainable and economic development (Sánchez Suárez et al., 2023). It represents an alternative to linear management models, utilizing sustainable practices related to energy savings and waste reuse for environmental preservation (Ridaura, 2020).

The objective of the CE is to generate economic development by minimizing environmental impacts based on compliance with the 2023 Agenda for Sustainable Development (Prieto Sandoval et al., 2017). Furthermore, it proposes a new production management model based on the reuse of materials and eco-design (Almeida-Guzmán & Díaz-Guevara, 2020).

As a concept, it increases business competitiveness and reduces environmental pollution (Fadeeva & Van Berkel, 2021). It proposes a change in the management model based on the achievement of industrial symbiosis, reuse, and remanufacturing (Geywitz, 2020). It seeks not only sustainable manufacturing (Ruggerio, 2021) but also responsible marketing and consumption (García, 2018).

Circular supply chains

Supply chains have a significant environmental impact; while the circular economy generates sustainable benefits through the reuse of resources, circular supply chains integrate sustainability.

Circular supply chain management (CSCM) considers two main elements: sustainable development and the implementation of environmental management policies. Geissdoerfer et al. (2019) defines CSCM as the integration of circular economy thinking and SCM in industrial and natural environments, from waste reduction—through business model redesign and breakthrough innovations—and from product or service design to waste management.

With this in mind, this research aims to analyze the implementation of the circular economy in supply chain management during the 2021-2023 period.

METHODOLOGY

Descriptive quantitative research was developed (Kotronoulas & Papadopoulou, 2023) based on a bibliometric analysis (Yu et al., 2023) to explore the scientific production related to the implementation of the circular economy in supply chain management. The precepts of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology (Helbach et al., 2023; Kamaraj et al., 2021) were considered. This methodology was developed in the Scopus database for the period 2021–2023.

The search strategy was: TITLE-ABS-KEY ("circular economy" OR "circular economies" AND "supply chain" OR "supply chain management") AND PUBLICATION > 2020 AND PUBLICATION < 2024 AND (LIMIT-TO (SUBJAREA, "ENGI") OR LIMIT-TO (SUBJAREA, "BUSI")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (OA, "all")). Only open-access research articles in engineering, business, administration, and accounting were considered. The search was conducted on November 4, 2023, and 293 results were obtained. The initial review was conducted by one of the researchers, who reviewed the title, abstract, and the entire document.

Bibliometric indicators analyzed

Indicators were studied to analyze scientific production in the period:

- Trend indicator, to analyze the number of research projects for each year.
- Analysis of knowledge areas, to study the main areas of knowledge where research was conducted based on their number of projects.

Impact indicators were analyzed in the period:

- Analysis of author contributions, based on the number of research papers published during the period.
- Institutional affiliation, to measure the impact of the institutions that contribute the most research in the area of knowledge.
- Analysis of contributions by country, to measure the amount of research conducted by each country.
- Scientific journals, where the number of citations received, the impact factor in the Web of Science Group (IF-WoS), Scopus (IF-Sc), h-index, and the SCImago SJR Rank (SJR indicator) were analyzed.

Additionally, bibliometric maps were constructed for the analysis of co-occurrence of words and for the identification of lines of research.

Source of information

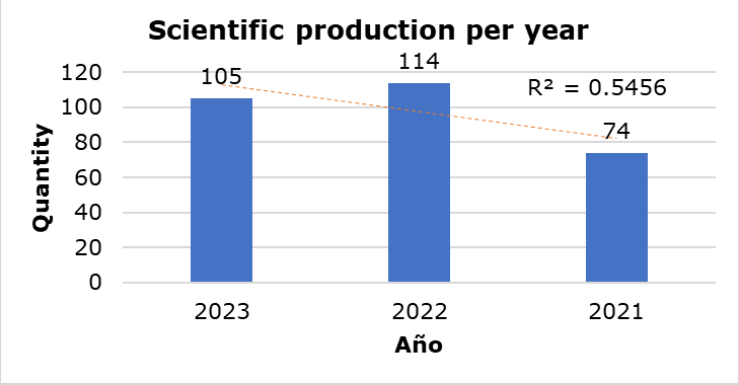
For the quantitative analysis of the indicators, the .CSV format files were downloaded from the Scopus database (https://www.scopus.com/), while the elements related to the impact and affiliation of the journals were obtained from SCImago Journal Rank, Sci Journal (https://www.scijournal.org/).

RESULTS AND DISCUSSION

The research trend (Figure 1) showed an upward trend in 2021 and 2022, while in 2023, it decreased by nine investigations, a year characterized by a linear function with a confidence level of 54.56%. The largest number of investigations were published in 2022, with a total of 114, representing 38.91% of the total (293), where 100% covered research articles. The research addressed 16 areas of knowledge, but the present research was only restricted to those that addressed engineering (n = 240) and business, administration, and accounting (n = 180) topics.

Figure 1.

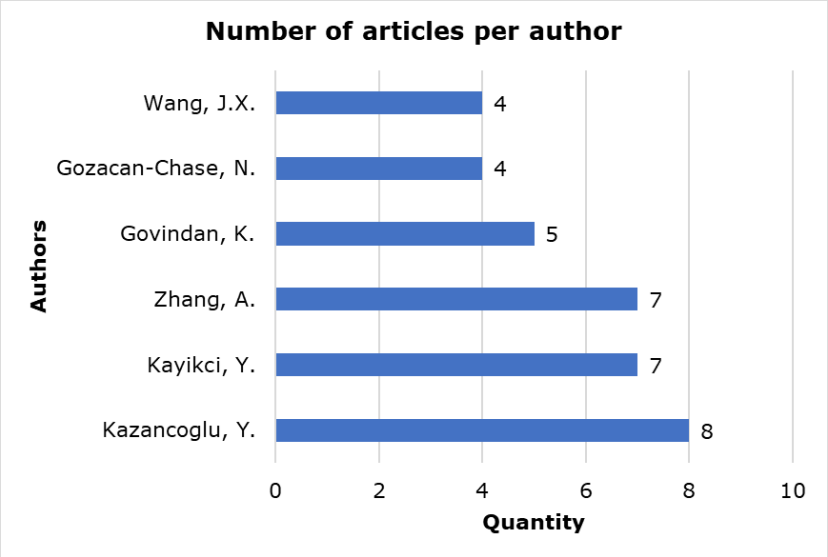
Scientific production per year



Source: own elaboration

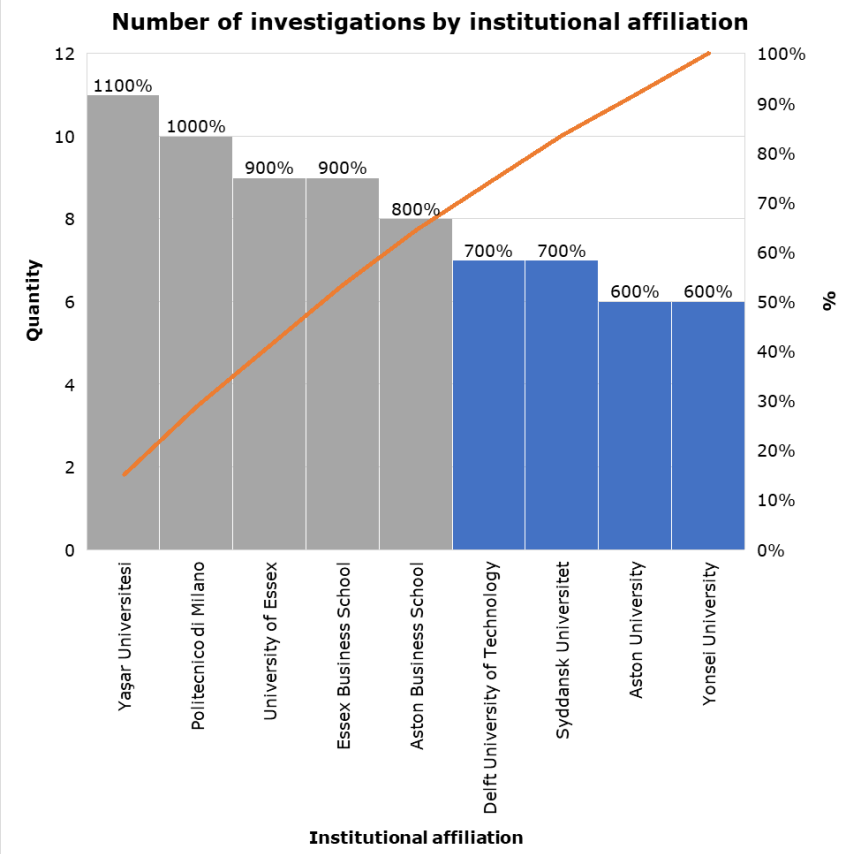
From an analysis of the number of articles published per author (Figure 2), 159 authors were identified who have published in the period. Of this group, an analysis of those who have published more than three articles in the period showed that the most representative authors were Kazancoglu, Y. (n = 8), Kayikci, Y. (n = 7), and Zhang, A. (n = 7). It is worth highlighting that, of the total number of authors per research, 9.43% have published more than three investigations during the period, and 51.57% have at least two investigations.

Figure 2.
Number of articles per author



Source: own elaboration

Figure 3.
Number of investigations by institutional affiliation

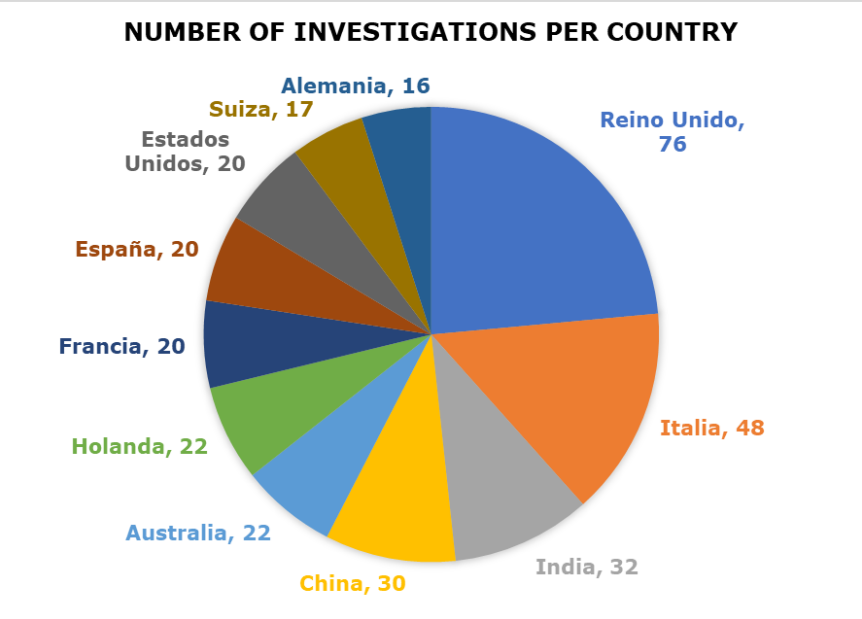


Source: own elaboration

The research was published in 159 research and higher education centers. A Pareto analysis of institutional affiliation with more than six articles published during the period (Figure 3) showed that 70% of the research out of the total (73) – representing 24.91% of the 293 articles initially obtained – has as institutional affiliation Yaşar Universitesi (n = 11), Politecnico di Milano (n = 10), University of Essex (n = 9), Essex Business School (n = 9) and Aston Business School (n = 8), which are represented in grey in the graph.

The research, according to the author's country of origin (Figure 4), originated in 69 countries; an analysis of the countries with more than 16 research studies revealed that the most representative was the United Kingdom, with 76 research studies, representing 23.53% of the total, followed by Italy, India, and China with 48, 32 and 32 research studies, respectively.

Figure 4.
Number of investigations per country



Source: own elaboration

The research was published in 83 scientific journals; the most cited were the Journal of Cleaner Production (n = 39), Sustainability (n = 36), Business Strategy and the Environment (n = 22), and Sustainable Production and Consumption (n = 17). An analysis of the journals that received more than 100 citations during the selected period (Table 1) showed that the most cited article was: "Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence, sustainable manufacturing practices and circular economy capabilities," with 271 citations by the author, Bag, S., published in the journal Technological Forecasting and Social Change.

The most cited journal (with 1,138) was the Journal of Cleaner Production, followed by Business Strategy and the Environment (with 536); according to the Scopus impact factor, the most representative was the International Journal of Production Economics with an IF = 11.849, while, according to the Web of Science impact factor, the most representative was Business Strategy and the Environment, with an IF = 10.302. On the other hand, when analyzing the h-index indicator, the one that obtained the highest value was the Journal of Cleaner Production, with an h-index value of 232.

Table 1.
Analysis of journals with more than 100 citations

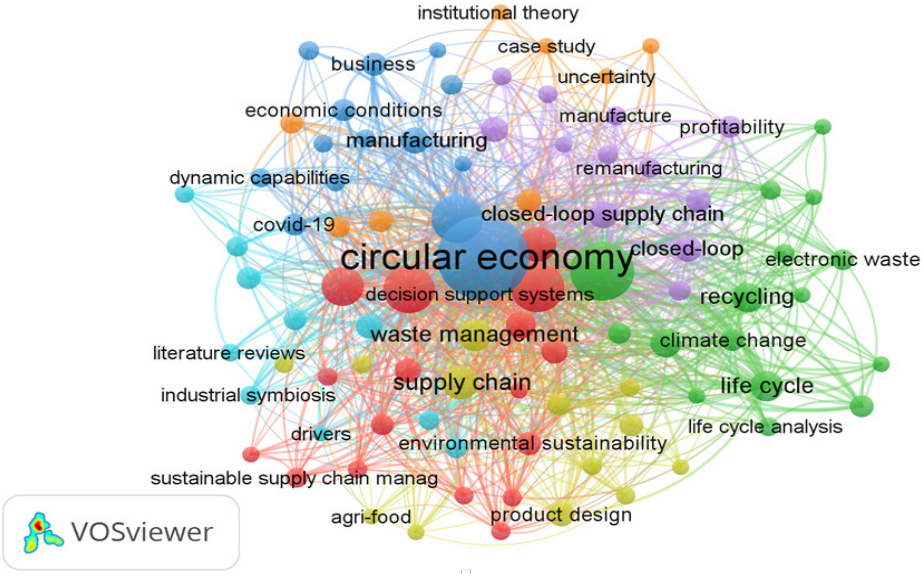
Journal	Citations	IF-WoS	IF-Sc	h-index	SJR
Journal of Cleaner Production	1138	9.297	10.956	232	1.937
Business Strategy and the Environment	536	10.302	11.283	115	2.123
Technological Forecasting and Social Change	345	8.593	11.146	134	2.226
Sustainability	325	3.251	4.166	109	0.612

Sustainable Production and Consumption	243	5.032	9.059	38	-
International Journal of Production Economics	205	7.885	11.849	197	2.406
Operations Management Research	165	2.706	6.833	31	0.703
Cleaner Logistics and Supply Chain	128	-	-	-	-
International Journal of Logistics Research and Applications	126	3.821	6.078	38	0.802
Journal of Business Research	122	7.55	11.063	217	2.049
Industrial Marketing Management	114	6.96	8.24	147	2.022
Transportation Research Part E: Logistics and Transportation Review	112	6.875	10.745	122	2.042
Production Planning and Control	107	7.044	6.441	85	1.331

Source: own elaboration

The bibliometric network map (Figure 5) was constructed with the aim of analyzing the co-occurrence of keywords, starting from the level (n = 5); 91 items grouped into seven clusters were identified.

Figure 5.
Keyword co-occurrence network map



Source: own elaboration

Table 2.
Cluster analysis of the most frequently occurring keywords

Clusters	Ítems	Color	Keywords
1	17	Red	Blockchain, circular economy, circular supply chain, circular supply chain management, construction industry, decision making, green supply chain management, industrial economics, industry 4.0, supply chain management, sustainable supply chain management, sustainable supply chain.
2	16	Green	Automotive industry, climate change, economic and social effects, electronic waste, environmental impact, environmental management, environmental regulations, integer programming, life cycle, recycling, supply chain.
3	14	Blue	Blockchain technology, business, circular economy, covid-19, dynamic capabilities, economic conditions, innovation, manufacturing, stakeholder, strategic approach, sustainability, sustainable development, supply chain management.
4	13	Yelow	Agri-food, business model, digitalization, environmental economics, environmental technology, logistics, optimization, product design, supply chain, textiles, textile industry, waste management.

5	12	Purple	Carbon footprint, closed-loop, closed-loop supply chain, commerce, costs, decisions makings, manufacture, profitability, remanufacturing, reverse logistics, sales, sustainable consumption.
6	10	Sky blue	Current, barrier, circular supply chain, drivers, industrial research, industrial symbiosis, literature review.
7	9	Orange	Case study, decision support systems, developing countries, food supply, food supply chain, food waste, institutional theory, uncertainty.
Total	91		

Source: own elaboration

Analysis of results

A bibliometric analysis was presented to analyze scientific production related to the implementation of the circular economy in supply chain management, which included the areas of engineering, business, administration, and accounting, during the period 2021–2023. Research and reviews can be seen in which this circular economy is implemented in the agri-food sector (Mehmood et al., 2021; Viscardi et al., 2022).

The generation of knowledge to support the resolution of social and economic problems in society is considered an international priority. In this context, universities are among the most important centers due to their capacity as sources of this important intangible asset. The universities that contributed the most research were Yaşar Universitesi (in Turkey), Politecnico di Milano (in Italy), and the University of Essex (in the United Kingdom).

This result is consistent with the findings of Dextre-Vilchez et al. (2023) regarding the top-producing countries according to the origin declared by the author. In contrast, Pericàs et al. (2020) identify American universities among the top-producing ones and support their approach based on what was stated by Jaffe et al. (2020), who recognizes the United States as the main producer of scientific articles worldwide. Furthermore, the largest amount of published research was found in the United Kingdom, which aligns with the research results that identify this country as one of the largest producers internationally (Pericàs et al., 2020).

A broad development of the subject matter and the socialization of research were evident in high-impact open-access journals (De Felice & Polimeni, 2020; ElHawary et al., 2020). In this regard, the Open Access regime influenced the average number of citations among the journals with the highest number of them (≥ 100 citations), which was 282. Regarding the impact of the journals in WoS 12, an IF ≥ 2,706 was obtained, and one did not have an IF, while in Scopus, an IF ≥ 4,166 was obtained, located in the most representative quartiles in the areas of engineering and administration (Q1 - Q2). These data are analogous to those expressed by Dextre-Vilchez et al. (2023) and Muñoz-Estrada et al. (2022) in their reports. Analyzing the h-index as an impact indicator in Google Scholar, it was evident that the journals had a score above 31 and a maximum of 232.

Seven main lines of research related to the implementation of the circular economy in supply chain management were identified from the cluster analysis. These were:

1. The adoption of construction supply chain management tools (Adabre et al., 2023; Gunaratne et al., 2022) through the adoption of sustainable management practices (Allen et al., 2021; de Mattos et al., 2023; Liu et al., 2023), which has led to the adoption of these good practices in the industry (Luu et al., 2023) and the consolidation of supply chain circularity (Haber & Fargnoli, 2022; Romagnoli et al., 2023).
2. This line of research focuses on the adoption of sustainable practices, such as recycling based on product lifecycle analyses in the supply chain (Aviso et al., 2023; Wójcik-Karpacz et al., 2023), by analyzing the environmental impact through the study of regulations for environmental management of the supply chain (Kazancoglu et al., 2021) and their effects on the economy and society (Rodríguez-Espíndola et al., 2022).
3. They focus on the innovation of supply chain management strategies (Fernando et al., 2023) and the use of blockchain technology based on the consolidation of sustainable development practices (Upadhyay et al., 2021; Zarbakhshnia et al., 2023).
4. They focused on exploring best practices, case studies, business models (Dragomir & Dumitru, 2022), and process digitalization (Rasool et al., 2023) in the agri-food and textile industries based on optimization (McDougall et al., 2022; Silobrit & Jureviciene, 2023).
5. They focused on studies of closed supply chains, utilizing reverse logistics (Nanayakkara et al., 2022) and remanufacturing tools to reduce costs and support the decision-making process (Zhang et al., 2022).

6. They were represented by literature reviews on supply chain circularity and its implementation in industry research (Schultz et al., 2021; Zhang et al., 2021).
7. They focused on the management of food supply chains (food chains) through practical case studies (Kumar et al., 2023) and support systems for decision-making and development of countries (Okorie et al., 2022).

One of the study's limitations was its restriction to a single database (SCOPUS). It could be generalized to other impact databases, in addition to considering other indicators of interest, including: journal quartile and country; collaboration networks among authors; average citations per year; and collaboration networks between institutions and countries. Likewise, authors' self-citations were not taken into account in the total citation count per journal.

CONCLUSIONS

The publication trend during the period was mixed: consistent in 2021-2022, with a peak of 114 scientific articles; this number decreased in 2023. On the other hand, 159 research and higher education centers were identified; the most representative were Yaşar Universitesi and Politecnico di (belonging to Turkey and the United Kingdom, respectively, with 21 articles between them); this figure is in line with the top producing countries, according to the origin of the main author, which are: the United Kingdom, Italy, India, and China.

The research was published in 83 scientific journals, and the one with the most articles was the Journal of Cleaner Production (n = 39), which was also the most cited with 1,138 citations. The journal with the highest impact on Scopus was the International Journal of Production Economics, with an impact factor of 11.849, and the Web of Science journal was Business Strategy and the Environment, with an impact factor of 10.302.

The analysis of keyword co-occurrence based on the bibliometric network map identified seven lines of research centered on the circular economy as the most frequently occurring keyword and its implications for supply chain management based on the adoption of new models from a sustainable perspective, the implementation of process digitalization, and blockchain technologies. All of this focuses on the impact of adopting this version on sustainable development, cost optimization, and the reuse of resources that allow for improved management processes from the supplier to the customer.

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FINANCING
The authors did not receive funding for the development of this research.

CONFLICT OF INTEREST STATEMENT
The authors declare that there is no conflict of interest.

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