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ORIGINAL PAPER

ADVANCING AGRIBUSINESS SUSTAINABILITY AND COMPETITIVENESS THROUGH LOGISTICS 4.0: A BIBLIOMETRIC AND SYSTEMATIC LITERATURE REVIEW

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ABSTRACT. Background: In the face of numerous sustainability challenges within global logistics operations, smart logistics, or Logistics 4.0, has emerged as a rapidly evolving field over the past decade. Situated within the broader context of Industry 4.0, Logistics 4.0 serves as a critical pillar for ensuring business sustainability by leveraging innovative and disruptive technological solutions. This study offers a novel and comprehensive analysis of the role of Logistics 4.0 in fostering business sustainability, with a particular focus on the agro-industrial sector.
Methods: Employing a bibliometric and content analysis approach, this research examines 56 publications from 2015 to 2021, sourced from Scopus, ScienceDirect, and Springer databases. The bibliometric research method incorporates joint keyword analysis using VOSviewer and is complemented by a content analysis of the selected articles. The bibliometric analysis uncovers a growing yet still nascent publication trend in this field.
Results: The study reveals that Logistics 4.0 plays a significant role in enhancing the sustainability of firms across various sectors, particularly within the agro-industrial sector. By harnessing digital technologies and innovative business models, Logistics 4.0 paves the way for creating competitive advantages for agro-industrial firms.
Conclusion: This research emphasizes the pivotal role of Logistics 4.0 in promoting sustainable and competitive growth in agribusiness, offering valuable insights for both academia and industry practitioners.

Keywords: logistics 4.0, agribusiness sustainability, agribusiness competitiveness, bibliometric analysis, systematic literature review.

INTRODUCTION

Logistics, as a concept, was initially related to military operations that included the transportation, supply, and maintenance of military equipment and personnel, with limited significance in the pre-1950s era. However, the scope of logistics expanded to include physical supply during the 1960s, giving rise to the term "business logistics" [Ballou, 2007]. Today, logistics pertains to the management of material and information flows within organizations, which involves overseeing the movement, storage, and related information of materials [Christopher, 2016]. The primary objective of logistics is to deliver finished products to customers with an appropriate level of service and quality at the lowest possible cost. Logistics has evolved into smart logistics or Logistics 4.0, which integrates technologies that automate logistics flows and enable real-time and near-

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real-time information availability [Winkelhaus and Grosse, 2020]. The benefits of Logistics 4.0 include timely delivery and supply, business agility, flexibility, responsiveness, and predictive analytics that can significantly reduce lead times, enhance quality, support environmental and social sustainability, and impact decision-making at different levels [Russell and Swanson, 2019; Tjahjono et al., 2021].

In the agribusiness sector, sustainability in agricultural production has become a critical issue for supply chains and their stakeholders [Satolo et al., 2020]. Agri-food supply chains encompass all productive and logistical measures from primary production to final product consumption and have become lengthier and more complex due to consistent international trade growth [Zupaniec et al., 2022; Frazzon et al., 2020]. Logistics activities' economic, environmental, and social impacts must be evaluated, and opportunities explored to make logistics productive and sustainable [Dey et al., 2011; Ahi and Searcy, 2013]. Logistics 4.0 has emerged as a solution to the sustainability challenges of firms in the agribusiness sector, with a focus on sustainable logistics solutions and addressing changing customer demands [Winkelhaus and Grosse, 2020]. This review aims to contribute to the existing knowledge on the role of Logistics 4.0 in agribusiness firms' performance, specifically within the context of Industry 4.0, focusing on sustainability and competitiveness concepts [Hardjomidjojo et al., 2022; Lin et al., 2018; Sharma et al., 2020]. It identifies key technologies, their applications, and effects on sustainability and competitiveness, highlighting the challenges and barriers agribusiness firms face when implementing Logistics 4.0 technologies [Bröring and Leker, J., 2021; Queiroz et al., 2020]. The review aims to promote a more comprehensive understanding of digital technologies' role in shaping a sustainable and resilient agri-food system for the future, including Logistics 4.0's potential impact on rural development, social equity, and environmental stewardship [Bronson and Knezevic, 2016; Frizzo-Barker et al., 2020]. The importance of empirical studies examining the real-world applications and impacts of Logistics 4.0 technologies in agribusiness settings is highlighted, including the influence of organizational culture, managerial practices, and the legal and regulatory environment on the adoption and diffusion of Logistics 4.0 technologies [Soto-Acosta and Cismaru, 2020; Raimundas et al., 2021]. Lastly, the review emphasizes the need to understand the potential implications of Logistics 4.0 adoption for small- and medium-sized enterprises (SMEs) in the agribusiness sector due to the distinct challenges they face [Gomes et al. 2018].

The expansion of logistics in the 1960s led to the emergence of the term "business logistics" to encompass physical supply and the management of material and information flows within organizations [Ballou, 2007; Christopher, 2016]. Today, logistics has evolved to address sustainability concerns and changing customer demands using emerging digital technologies, leading to the development of smart logistics or Logistics 4.0 [Winkelhaus and Grosse, 2020]. Logistics 4.0 integrates technologies that automate forward and reverse logistics flows, enabling real-time and near-real-time information availability and providing several benefits such as timely delivery and supply, agility, flexibility, responsiveness, and predictive analytics [Russell and Swanson, 2019].

Agri-food supply chains are considered critical for food safety, encompassing all logistical and productive measures from primary production to final product consumption [Codex Alimentarius Commission, 2016]. Due to the growth of international trade, agri-food supply chains have become more complex, involving intricate systems of numerous agents and interconnected processes [Bourlakis et al., 2014; Zupaniec et al., 2022]. Assessing the economic, environmental, and social impacts of logistics activities is crucial for ensuring supply chain sustainability [Dey et al., 2011; Ahi and Searcy, 2013]. Smart logistics, or Logistics 4.0, emerged in 2011 to address sustainability concerns and offer sustainable logistics solutions [Winkelhaus and Grosse, 2020].

Despite the potential benefits of Logistics 4.0 in agribusiness, there is a lack of literature regarding the influence of smart production

practices on performance [Hardjomidjojo et al., 2022; Lin et al., 2018; Sharma et al., 2020]. To address this gap, this review aims to provide an understanding of the role of Logistics 4.0 in agribusiness sustainability and competitiveness within the context of Industry 4.0. By conducting a systematic literature review, the paper identifies the key technologies, their applications, and their effects on sustainability and competitiveness, while also highlighting the challenges and barriers faced by agribusiness firms in implementing Logistics 4.0 technologies [Büyüközkan and Göçer, 2018; Queiroz et al., 2020].

This review aims to serve as a foundation for future research on Logistics 4.0 in agribusiness, providing insights for practitioners and policymakers to develop effective strategies for adopting and integrating these technologies into their operations to achieve sustainable and competitive growth [Kamble et al., 2018; Akhtar et al., 2019]. Additionally, the paper promotes a comprehensive understanding of the role of digital technologies in shaping a sustainable and resilient agri-food system for the future, including its impact on rural development, social equity, and environmental stewardship [Bronson and Knezevic, 2016; Frizzo-Barker et al., 2020]. The review also emphasizes the need for more empirical studies examining the real-world applications and impacts of Logistics 4.0 technologies in agribusiness settings, as well as the potential implications for small- and medium-sized enterprises (SMEs) in the agribusiness sector [Gomes et al., 2018; Heras-Saizarbitoria et al., 2021]. Additionally, the influence of organizational culture, managerial practices, and the legal and regulatory environment on the adoption and diffusion of Logistics 4.0 technologies in agribusiness settings should also be further investigated [Soto-Acosta and Cismaru, 2020; Raimundas et al., 2021].

METHODOLOGY

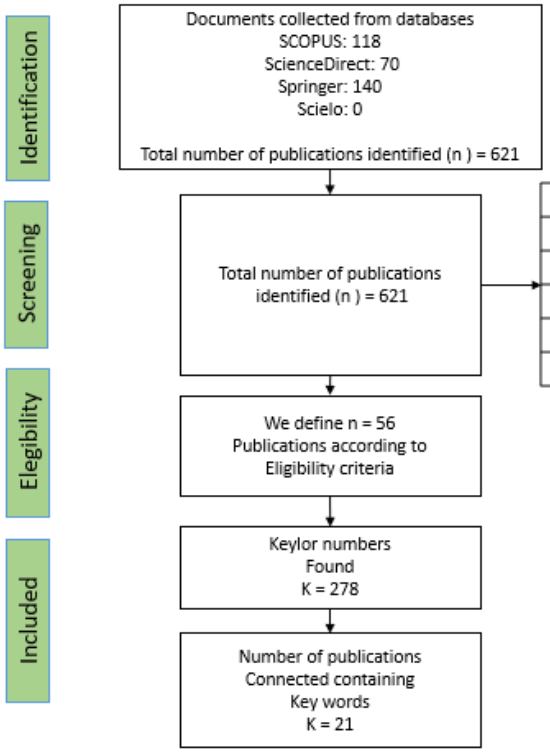
A systematic literature review was employed to analyze the role of Logistics 4.0 as a fundamental pillar of sustainability and business competitiveness in the agribusiness sector. The systematic review methodology was chosen due to its replicability, transparency, and scientific rigor compared to traditional narrative reviews [Linnenluecke et al., 2019]. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed to ensure the quality and transparency of the review process [Moher et al., 2009]. Asim and Sorooshian's [2019] research method was adopted to conduct the review

According to Asim and Asorooshian [2019], the descriptors, databases, eligibility criteria, and choice of documents were defined. This study used three databases as information sources: ScienceDirect, SCOPUS, and SpringerLink. The selection of ScienceDirect, SCOPUS, and SpringerLink databases for a systematic literature review of logistics 4.0 was likely based on their reputation and coverage of relevant academic journals and publications in the field. ScienceDirect is a well-known database that provides access to a large collection of academic journals, books, and conference proceedings in various fields of science, engineering, and technology. It is a part of the Elsevier publishing group and contains over 16 million articles from over 3,800 journals. SCOPUS is another highly regarded database that covers a wide range of scientific and technical disciplines, including the field of logistics. It is a product of Elsevier, and its content includes over 80 million records from over 25,000 journals, conference proceedings, and other sources. SpringerLink is a database that provides access to a vast collection of academic journals, books, and other publications in various fields of science, technology, and medicine. It is a part of the Springer Nature publishing group and contains over 13 million documents from over 8,000 journals. All three databases are well-established and widely used by researchers, and they have comprehensive coverage of relevant journals and publications in the field of logistics 4.0. By using these databases, researchers can access a large volume of peer-reviewed literature that is likely to be relevant to their research topic, and they can be confident that the sources are reputable and reliable. Additionally, these databases have advanced search functionalities that allow researchers to easily filter and identify

relevant articles based on specific criteria such as publication date, language, and type of publication.

The search for relevant literature related to logistics 4.0 and its role in business sustainability in agribusiness was conducted by consulting documents published between 2015 and 2021. The search terms used were "Logistics 4.0," "Business Sustainability," and "Agribusiness." The inclusion criteria were 1) The title, abstract, and keywords of the publications were considered; 2) Publications written in English were considered; 3) Original articles were considered; 4) Open access publications were preferred. The database records were exported as comma-separated value (CSV) files. The search results, which met the eligibility criteria, yielded a total of 56 records in CSV format. The resulting Excel data were converted back to CSV for analysis in VOSviewer, a software tool used for creating bibliometric maps. The type of analysis used in VOSviewer was the co-occurrence and complete count method. When "all keywords" were used, 278 keywords were produced. The latter was considered for the analysis. The results from VOSviewer indicated that only 21 records were connected. Overall, the search strategy and inclusion criteria were designed to ensure that the literature reviewed was relevant and met the specific objectives of this study. The use of VOSviewer allowed for a visual representation of the bibliographic data and provided insight into the research landscape of logistics 4.0 and its role in business sustainability in agribusiness.

In accordance with the PRISMA guidelines, this study employed a rigorous selection process to identify relevant articles for inclusion in the review. The search was conducted across multiple databases, including Scopus, ScienceDirect, and Springer, using a specific set of keywords related to logistics 4.0 and agribusiness sustainability. A total of 21 articles were identified as meeting the inclusion criteria and were read in their entirety to ensure their relevance to the research question. The articles were then systematically analyzed to provide a comprehensive understanding of the role of logistics 4.0 in agribusiness sustainability and competitiveness. By adhering to the PRISMA guidelines, this study ensures transparency, replicability, and scientific rigor in the reporting of its results.



Inclusion criteria	SCOPUS	ScienceDirect	Springer
Type of document (original article)	80	51	24
Years of publication (2015-2022)	80	45	17
Language (English - Spanish)	79	45	17
Open Access publications	21	23	12
Selected documents	21	23	12

Fig. 1. PRISMA flow chart.

In various fields of study, bibliometric analysis is a commonly used method to analyze the scientific literature dataset [Daly et al., 2007a; Daly et al., 2007b]. VOSviewer, a software tool for creating, visualizing, and exploring maps based on network data [Van Eck and Waltman, 2020], was used in this study to analyze articles based on authors, keywords, institutions, and location. The co-authorship of the studies and the keywords were interpreted in terms of the concurrence they may present, as well as the connection between terms that exist in the articles. Content analysis was employed as a method to analyze the documents, as it provides a suitable tool for systematically extracting, analyzing, and interpreting data on the topic being addressed. Depending on the research question, content analysis can use qualitative and/or quantitative methods [Hsieh and Shannon, 2005].

To ensure the quality of the research, the evaluation of the qualitative data in this study is based on four criteria: credibility, transferability, dependability, and confirmability [Lincoln and Guba, 1985]. The study explored the concepts and principles of Logistics 4.0 and its role in the sustainability of agribusiness enterprises. The bibliographic framework was developed by exploring relevant academic and scientific publications, and the results can be used as a reference for future studies. The study was conducted using the PRISMA guidelines, which makes the process systematic, exhaustive, rigorous, replicable, and impartial [Moher et al., 2009]. This research is dependable because the search strings and eligibility criteria used in data collection will produce similar results if applied by other researchers.

RESULTS

Fifty-six papers meeting the inclusion criteria of this study were identified, with 41% from ScienceDirect, 37.5% from SCOPUS, and 21.5% from Springer. Most publications were from the year 2021, with 15 articles (Figure 2), indicating a growing interest in research on Logistics 4.0 and its role in the sustainability of agribusiness enterprises. Notably, during the first four years of the publication period considered [2015-2018], only 19 articles were published on this topic. This highlights a recent surge in attention and research efforts towards the application of Logistics 4.0 in agribusiness supply chains, as scholars and practitioners recognize its potential to drive business sustainability and competitiveness.

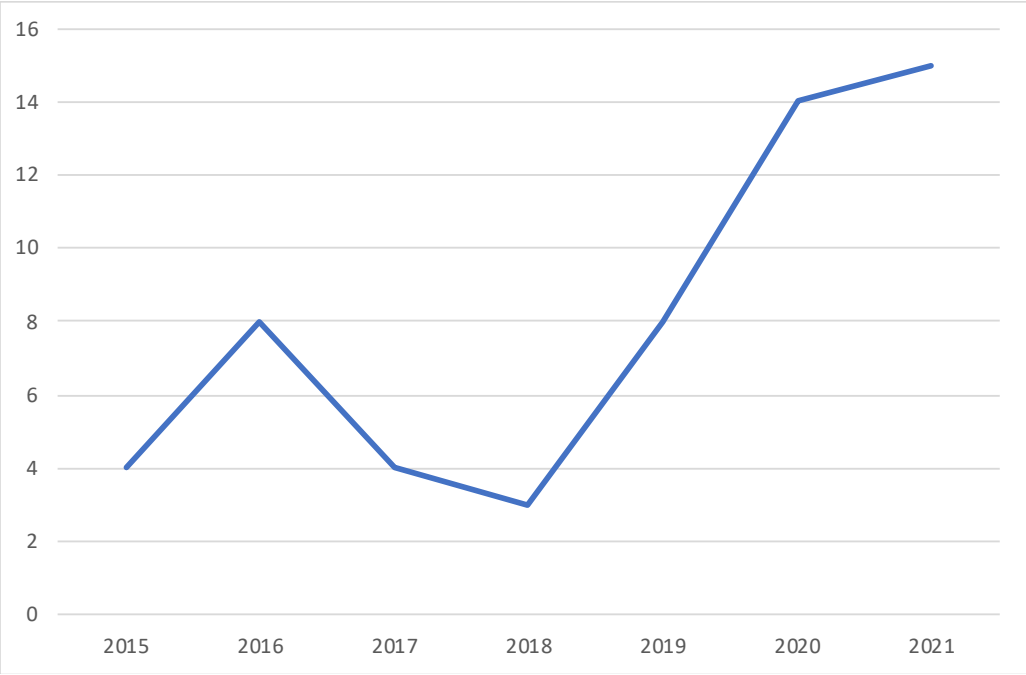


Fig. 2. *Publications by year.*

The analysis of the dataset revealed that Gunasekaran, Ivanov, and Liu were the most prolific authors, each with two publications. Among the journals, Sustainable (Switzerland) and Transportation Research Procedia had the highest number of publications, with five articles each. It was observed that the largest proportion of publications belong to the Business and Management field, accounting for 17.2%, followed by Engineering and Scientific Decisions, each with 14.1% of the publications. Overall, the results of the bibliometric analysis suggest that research on logistics 4.0 and its role in agribusiness sustainability is gaining attention in the academic community, as evidenced by the increasing number of publications in recent years. The analysis also reveals the main authors and journals contributing to this area of research, providing valuable insights for future studies.

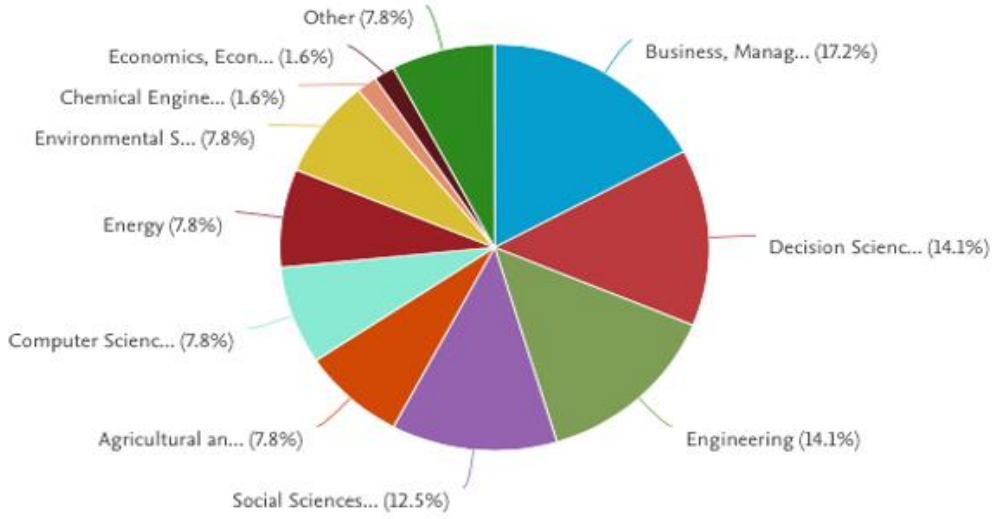


Fig 3. Publications by subject area.

A citation analysis was conducted to identify the most influential articles on the topic of logistics 4.0 and business sustainability in agribusiness. Out of the 56 articles included in this study, 7 were found to have a significant impact with a total of 539 citations. Supply chain and sustainability are critical areas of research, and several highly cited articles have contributed valuable insights to these fields. For instance, Ivanov et al. [2018] investigated the impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. This paper has received 269 citations since its publication, highlighting the relevance of digital technology in modern supply chain management. Another significant contribution is Ivanov's [2020] proposed viable supply chain model that integrates agility, resilience, and sustainability perspectives. The paper drew lessons from and offered insights beyond the COVID-19 pandemic, and it has been cited 105 times to date. Dubey et al. [2019] conducted an empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. This paper has received 77 citations since its publication, emphasizing the importance of data analytics in supply chain resilience. In a different study, Sharma et al. [2019] explored challenges and solutions for circular economy-driven sustainability practices in the food supply chain. The paper has been cited 32 times since its publication, highlighting the relevance of sustainability practices in the food industry. Todorovic et al. [2018] presented solutions for more sustainable distribution in short food supply chains, and the paper has received 24 citations since its publication. Sharma et al. [2020] analyzed agriculture supply chain risks and COVID-19 mitigation strategies, with implications for practitioners. This paper has been cited 16 times to date, demonstrating the relevance of the study during the COVID-19 pandemic. Lastly, Sun et al. [2020] studied the relationship between corporate social responsibility, co-creation, and green consumer

loyalty, focusing on the importance of green banking initiatives in an emerging economy. This paper has also been cited 16 times since its publication, highlighting the importance of sustainability practices in the financial sector. Overall, these highly cited articles provide valuable insights into various supply chain and sustainability topics, including the impact of digital technology, the integration of agility, resilience, and sustainability perspectives, data analytics capability, circular economy-driven sustainability practices, and mitigation strategies for agriculture supply chain risks during the COVID-19 pandemic.

Using Multidimensional Scaling (MDS) techniques, VOSviewer creates a map of texts based on the gap or distance between them in terms of their meaning or similarity [Van Eck and Waltman, 2020]. These texts are represented as nodes or clusters in the map, and the connections between them can be presented in different ways, such as through network visualization, overlay visualization, and density visualization. In this study, VOSviewer was used to analyze 278 keywords related to logistics 4.0 and business sustainability in agribusiness, and only 21 items were found to be significant. The network visualization of the data tags yielded 4 clusters, 21 links, and 54 strong links. This approach helps to identify the main research themes and the relationships between them, providing a useful tool for researchers to identify gaps and opportunities for future research [Jamwal et al., 2022; van Eck et al., 20201].

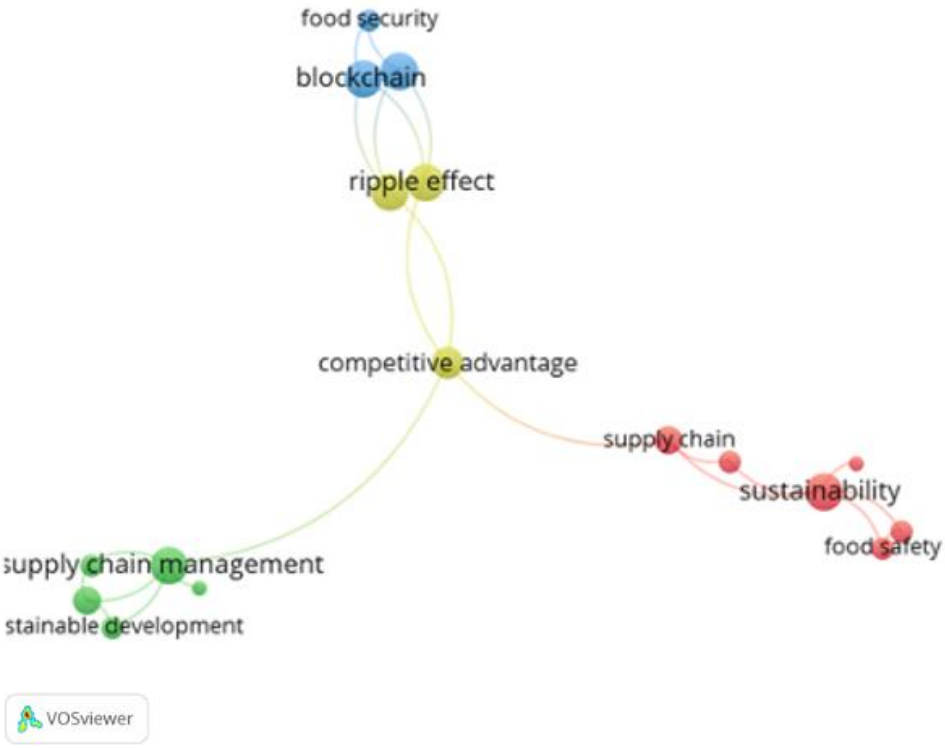


Fig. 4. *VOSviewer display network.*

Using VOSviewer, a cluster analysis of the 21 keywords revealed four distinct clusters, with 21 links and 54 strong links. The following analysis examines the keywords in each cluster with the highest number of occurrences and link strength: Cluster 1 (red) includes keywords related to the COVID-19 pandemic, food safety, quality, supply chain, and sustainability. The cluster reflects the growing interest in ensuring a safe and sustainable food supply chain during the pandemic, particularly in countries such as Greece. This cluster has 8 strong links, indicating a significant relationship between the keywords. Cluster 2 (green) includes keywords related to logistics, optimization, stakeholders, supply chain management, and sustainable development. This cluster highlights the

importance of effective supply chain management and sustainable development practices for optimizing logistics and engaging stakeholders. The cluster has 20 strong links, indicating a strong interconnection between the keywords. Cluster 3 (blue) includes keywords related to blockchain, food security, and industry 4.0. This cluster reflects the growing interest in using blockchain and Industry 4.0 technologies to ensure food security and traceability. This cluster has 9 strong links, indicating a significant relationship between the keywords. Cluster 4 (yellow) includes keywords related to competitive advantage, ripple effect, and supply chain resilience. This cluster highlights the importance of supply chain resilience for achieving a competitive advantage and minimizing the ripple effect of disruptions. The cluster has 17 strong links, indicating a strong relationship between the keywords. Overall, the cluster analysis provides valuable insights into the research landscape of logistics 4.0 and its role in business sustainability in agribusiness. The identified clusters reflect the diverse interests and concerns of researchers in this field, including the impact of COVID-19 on the food supply chain, the importance of sustainable development practices and supply chain resilience, and the potential of blockchain and Industry 4.0 technologies.

In the visualization, the size of a label and circle of an item is determined by its frequency of occurrence. The higher the frequency of occurrence, the larger the label and circle of the item. In addition, the color of an item is determined by the cluster to which it belongs. The text elements or labels in the VOSviewer visualization represent the keywords that have multiple occurrences in the publications extracted from the review. A total of 21 keywords were found to have an occurrence greater than 2 times. Although the presence of COVID-19 as a keyword is notable due to the pandemic situation, it is worth noting that other keywords are relevant to the topic of study. For instance, the term "Industry 4.0" is found, which has led to the development of logistics 4.0. Additionally, the terms "sustainable development" and "supply chain management" are also present. In terms of the agro-industrial sector, words related to "food safety" and "circular economy" are found, indicating that there is still room for further research on these topics in relation to logistics 4.0 and business sustainability in agribusiness.

DISCUSSION

In a content analysis of 56 publications related to sustainable development and agribusiness, digital technologies and mathematical models such as data analytics, blockchain, IoT, robust optimization, and mixed linear programming were found to be increasingly utilized to improve supply chain resilience, transparency, and sustainability [Dubey et al., 2019; Kayikci et al., 2020; Sundarakani et al., 2020; Yadav et al., 2020]. Co-creation and AgriFood-Tech were also identified as emerging trends that are contributing to the growth and sustainability of the agribusiness sector [Heberli et al., 2019; Vlachopolou et al., 2021]. The Supply Chain Management Dashboard was shown to be an effective tool in facilitating collaboration and improving decision-making in supply chain management [Sithole et al., 2016].

Logistics 4.0 presents an opportunity for improving the distribution of short food supply chains and aligning with contemporary logistics trends, sustainability, and the new digital era [Todorovic et al., 2018]. However, to achieve the full potential of Logistics 4.0, optimized planning, incentive alignment, and cross-company collaboration are needed [Lee and Shen, 2020]. The Belt and Road Initiative (BRI) offers significant opportunities for improving supply chain logistics, but requires new work processes and technologies, incentive alignment, cross-company collaboration, and optimized planning [Lee and Shen, 2020]. Linn and Maenhout [2019] emphasize the importance of including Logistics 4.0 in strengthening business models in agro-industrial sectors such as rice, which exhibit low technical efficiency and very low chain performance.

To mitigate the various risks that agribusiness supply chains face, Industry 4.0 technologies, supply chain collaboration, and shared responsibility have been suggested

[Sharma et al., 2020; Jamwal et al., 2021, 2022]. Decentralized production presents challenges to the cold supply chain, but short-distance transportation and modern marketing methods offer potential solutions [Almena et al., 2020; Zhou et al., 2020]. To increase farmers' income and social capital, strengthening the supply chain and competitive advantage have been recommended [Karim et al., 2020; Jamwal et al., 2021].

In terms of supply chain viability, sustainability should encompass environmental soundness, social equity, and economic viability [Borsellino et al., 2016]. Value Co-creation, AgriFood-Tech, Supply Chain Management Dashboard, and Routination are models that have been applied to enhance supply chain viability [Ivanov, 2020; Jamwal et al., 2022]. Value co-creation enables active participation, mutual learning, and direct influence through a dialogic process between the company and the customer [Heberli et al., 2019]. AgriFood-Tech business models contribute to the growth and sustainability of the agribusiness sector by fostering innovation, accelerating structural change, enhancing productivity, and introducing new products and services to the market through the implementation of digital environments [Vlachopoulou et al., 2021]. The Supply Chain Management Dashboard promotes integrated supply chain management by facilitating collaboration and supporting executive decision-making, thereby increasing transparency, operational efficiency, cost-effectiveness, and food assistance delivery to vulnerable populations [Sithole et al., 2016]. Routinization enables firms to reconfigure their knowledge base, providing insight into the impact on internal and farm operations performance [Heberli et al., 2019].

Digital technologies such as Industry 4.0 enhance demand responsiveness, capacity flexibility waste, enhancing traceability, and increasing transparency and accountability, as emphasized by Kayikci et al. [2020]. Big Data analytics can help firms identify trends, predict demand, and optimize supply chain operations, as highlighted by Dubey et al. [2019]. Simulation models can help in evaluating alternative scenarios, identifying bottlenecks and optimizing resource utilization, as noted by Jamwal et al. [2022].

Development in agribusiness requires the application of innovative technologies and practices that enhance transparency, supply chain resilience, and economic, social, and environmental sustainability. The literature review highlights the potential of digital technologies such as Industry 4.0, IoT, Big Data, and Blockchain, and mathematical models such as robust optimization and mixed linear programming in enhancing supply chain sustainability. Additionally, co-creation and AgriFood-Tech are emerging trends that contribute to the growth and sustainability of the agribusiness sector. The Belt and Road Initiative presents opportunities for improving supply chain logistics, but requires new work processes and technologies, incentive alignment, cross-company collaboration, and optimized planning to realize its full potential. Finally, Logistics 4.0 offers significant opportunities for improving the distribution of short food supply chains and strengthening business models in the agro-industrial sector, but corresponding solutions are needed to enable firms to improve their operational performance and create economic value while considering factors such as optimized planning, incentive alignment, and cross-company collaboration.

CONCLUSIONS

Logistics 4.0 represents a paradigm shift in supply chain management, driven by the integration of material, information, and financial flows through automation and digital technologies. This evolution enables supply chains to become faster, more accurate, and more efficient in areas such as information exchange, physical flow, planning activities, performance, order management, inventory control, and cost reduction. The transition to Logistics 4.0 requires a progressive transformation process that incorporates environmental, social, and societal dimensions. This shift plays a crucial role in enhancing the sustainability of firms in general and is particularly impactful in the agribusiness sector.

The adoption of digital technologies and innovative business models through Logistics 4.0 creates a significant competitive advantage for agribusiness firms. Key components of Logistics 4.0 include data analysis capabilities, blockchain, robust optimization and mixed linear programming, the Internet of Things, AgriFood-Tech, and routination, which serve to improve logistical processes. Additionally, digital technologies can be utilized to assess and mitigate various risks in agri-food production. This research provides valuable insights for organizations and practitioners, enhancing their understanding of Logistics 4.0 and its implications for business sustainability in the agribusiness sector. To the best of our knowledge, this is the first publication to examine the role of Logistics 4.0 in fostering sustainable business development, specifically within the agribusiness sector.

As an emerging research area, Logistics 4.0 has the potential to be applied across various industries and sectors. Future studies should focus on empirical research that demonstrates the positive outcomes of implementing digital technologies in the supply chains of diverse agribusiness firms. Additionally, qualitative studies engaging organizational leaders can be used to investigate the extent of technology development in logistical processes. It is also important to measure the adaptability and progress of firms in adopting digital technologies within the framework of Logistics 4.0.

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