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The Role of Logistics 4.0 in Agribusiness Sustainability and Competitiveness, A Bibliometric and Systematic Literature Review

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ABSTRACT

Firms face several challenges related to sustainability in global logistics operations. In response to this new dynamic, logistics has evolved into what is now known as smart logistics or Logistics 4.0, which has been in constant change for the past 10 years. This evolution has occurred within the framework of Industry 4.0 and has been called to be the pillar

that guarantees sustainability in firms through the development and implementation of innovative and disruptive technological solutions. A systematic analysis of the literature related to the role of logistics 4.0 in business sustainability in the agro-industrial sector was carried out. A bibliometric and content analysis was performed on the 56 publications identified from 2015 to 2021 in the Scopus, ScienceDirect and Springer databases. The bibliometric research method used was the joint analysis of keywords using VOSviewer, followed by a content analysis of the selected articles. The bibliometric analysis made it possible to identify that publication in this field is low and growing. Logistics 4.0 contributes considerably to the sustainability of firms in general, and even more to the agro-industrial sector through digital technologies and new business models, allowing the creation of competitive advantages in agro-industrial firms.

Keywords: *agribusiness, business sustainability, logistics 4.0, systematic literature review, VOSviewer*

1. INTRODUCTION

Prior to the 1950s, logistics was a popular military term that involved supply, vehicle maintenance, and the transportation of military supplies and troops from one place to another. At that time, logistics was not very important; in the 1960s, the scope of product distribution was expanded to include physical supply and was called business logistics (Ballou, 2007). Logistics refers to the management of material and information flows in firms (Christopher, 2016). More specifically, it encompasses the management of the movement and storage of materials and related information. Logistic aim is to deliver finished products to the final customer with an adequate level of service and quality at the lowest possible cost. Today, logistics is under pressure to help meet the global challenge of sustainability (Montreuil, 2011). Due to the increased supply chain complexity, higher customer expectations, shorter product and technology life cycles, and unstable environment, supply chain uncertainty and risk have become major obstacles to achieving on time delivery, increasing customer satisfaction, improving the efficiency, and reducing costs (Wang *et al.*, 2018).

In this dynamic business world, firms are facing several challenges related to sustainability in global logistics operations and emerging digital technologies can provide a solution to such problems (Strandhagen, 2017). In response to these new dynamics, logistics has evolved to what is now known as smart logistics or Logistics 4.0, which aims to meet changing customer requirements and provide sustainable logistics solutions (Winkelhaus and Grosse, 2020). Logistics 4.0 is a combination of technologies that help automate the forward and reverse logistics flow with real-time and near real-time information availability (Winkelhaus and Grosse, 2020). Its benefits include ensuring timely delivery and supply, ability to develop business agility, flexibility and responsiveness in the supply chain, and ability to apply predictive analytics (Russell and Swanson, 2019). These capabilities can significantly reduce lead times to customers, significantly improve quality parameters, support environmental and social sustainability, and can affect reverse decision making at strategic, operational, and tactical levels (Winkelhaus and Grosse, 2020).

Logistics processes have a wide range of problems and issues that affect the sustainability performance of firms. In attempting to build sustainable supply chains, increasing logistics costs in a company can reduce total supply chain costs (Govindan *et al.*, 2020). Sustainable development requires firms to change their way of thinking. Therefore, the current global dynamics encourage firms to implement new techniques, methodologies, and administrative and productive approaches, such as logistics 4.0, a product of I4.0. These new approaches are expected to cause disruptive changes for the industry and significant changes in organizational structures, business processes and business models (Brundtland and Mansour, 1987; Chopra and Meindl, 2002; OECD, 2017).

Sustainability in agricultural production has become an essential issue for the chain and its agents (Satolo *et al.*, 2020). Therefore, agri-food supply chains are identified as one of the most critical issues of today's food safety (Codex Alimentarius Commission, 2016). Agri- food supply chains comprise all productive and logistical measures from primary production to consumption of the final product, due to the constant growth of international trade in the last decades and the resulting increased geographical segregation of food production, processing, and consumption, agri-food supply chains have become longer and more complex (Zupaniec *et al.*, 2022). The tendency of food items to be produced in a complex system composed of several agents and with processes connected to supply chains (Bourlakis *et al.*, 2014). The supply chain is complex, especially when it sees logistic aspects linked to the collection, storage, and distribution of the products and its derivatives. The assessment of the economic, environmental, and social impacts of logistics activities is relevant, with the need to explore opportunities that make logistics productively efficient and sustainable (Dey *et al.*, 2011).

Smart logistics or Logistics 4.0 has evolved around 2011 with the aim of meeting changing customer demands and providing sustainable logistics solutions (Winkelhaus and Grosse, 2020). Despite the potential benefits of Industry 4.0 in supply chain management, there is a deficiency of literature in terms of smart production practices and their influences on performance, especially in agribusiness (Hardjomidjojo *et al.*, 2022; Lin *et al.*, 2018). This review provides an understanding of the role of logistics 4.0 in the performance of firms in the agribusiness sector, an analysis that will be directed towards the concepts of sustainability and competitiveness in the framework of industry 4.0. This paper reports the results of a systematic literature review on the role of logistics 4.0 as a fundamental pillar of business sustainability and competitiveness.

2. LITERATURE REVIEW

2.1 Logistics 4.0

Logistics 4.0 marks the specific application of Industry 4.0 in logistics. Industry 4.0 (I4.0) is used for recent advances in industrial production, especially advances in digital technologies that enable new and more efficient processes, new products, and new and more efficient services (OECD, 2017). The I4.0 concept originated from the German industry strategic initiatives platform that was initiated to secure the future of German manufacturing; recently, several other governments have launched strategic initiatives to strengthen industrial production making the fourth industrial revolution global (OECD, 2017). Hermann *et al.* (2016) have identified three components of Industry 4.0: Smart factory, with manufacturing fully equipped with sensors and actuators, and composed of autonomous systems; Cyber-physical systems (CPS), merging the physical and digital level by integrating computers and physical processes; and, Internet of Things (IoT), where all objects (products, machines, equipment, humans) are interconnected and networked. I4.0 includes a range of different technological advances and new concepts. The i4.0 concept is still in the developmental stage, both in the business environment and the scientific community, for logistics application the multidisciplinary approach required for digital transformation initiatives in different economic segments makes the interpretation of i4.0 even more complex (Sordan *et al.*, 2022).

A new development in Logistics 4.0 is often induced by a new technology and its application in a specific area (Winkelhaus and Grosse, 2020). Logistics 4.0 aims to eliminate inaccuracy and further improve the speed of the process based on near real-time information (Barreto *et al.*, 2017). The three main characteristics of Logistics 4.0 are vertical integration (integration of different IT systems at various levels within a plant), horizontal integration (inter-corporate collaboration) and end-to-end engineering integration (cross-linking of stakeholders, products, and machines) (Strandhagen *et al.*, 2017). Logistics 4.0 involves systems-based planning and control of the physical movement of goods and their associated information flow from origin to destination. Logistics 4.0 uses back-end and front-end technologies and provides logistics solutions to customers by meeting their demands without increasing costs (Frank *et al.*, 2019). Based on these technologies, various advanced systems are operated, such as warehouse management systems, intelligent transportation systems, smart transportation systems, information security, and autonomous order processing through blockchain technology and smart contracts (Barreto *et al.*, 2017). The development of logistics 4.0 capabilities requires the development of dynamic capabilities, such as technological capabilities and environmental capabilities, to enable digital technologies and execute plans (Winkelhaus and Grosse, 2020).

2.2 Business Sustainability and Logistics 4.0

Sustainability is a concept consisting of three pillars: environmental, social, and economic (Chopra and Meindl, 2002). To achieve this sustainability, logistics 4.0 can take advantage of its capabilities, which are focused on technological capabilities necessary for the enablement of Logistics 4.0 (Nour, 2022). Firms must focus more on their ability to generate, manage, and use information. For this, Data generated from IoT devices can be considered as key capability to generate information (Winkelhaus and Grosse, 2020). Information management can be performed centrally through cloud computing and decentralized in autonomous systems (Winkelhaus and Grosse, 2020). Big data analytics can be used as a basic approach to improve the level of logistics services.

The development of organizational capabilities is important to develop Logistics 4.0 capabilities. Human resource capacity, management capacity, and the ability of employees to conduct digital transactions are a fundamental requirement for developing Logistics 4.0 capabilities (Bag *et al.*, 2020). Training and development of human workers are essential to upgrade and adapt them to the logistics 4.0 environment (Schmidtke *et al.*, 2018). Environmental capabilities provide the ability to capture data from customers, the market, and the business environment. The development of environmental capabilities should be realized using information and communication technologies and further develop Logistics 4.0 capabilities (Winkelhaus and Grosse, 2020).

3. METHODOLOGY

A systematic literature review was conducted to analyse the role of logistics 4.0 as a fundamental pillar of sustainability and business competitiveness in the agribusiness sector. The systematic review provides a methodology to conduct reviews in a replicable, transparent, and scientific manner compared to narrative reviews; likewise, they can be author-centred or topic-centred (Linnenluecke *et al.*, 2019). Compared to the traditional narrative review, the systematic review is an evidence-based approach that minimizes bias through comprehensive literature searches of published studies. The use of systematic review offers the opportunity to produce knowledge that is theoretically sound, methodologically rigorous, context-sensitive, and relevant to the community of practitioners (Tranfield *et al.*, 2003). An approach like Asim and Sorooshian's (2019) research method was used, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al.*, 2009). The steps followed for data collection are presented in the **Figure 1**:

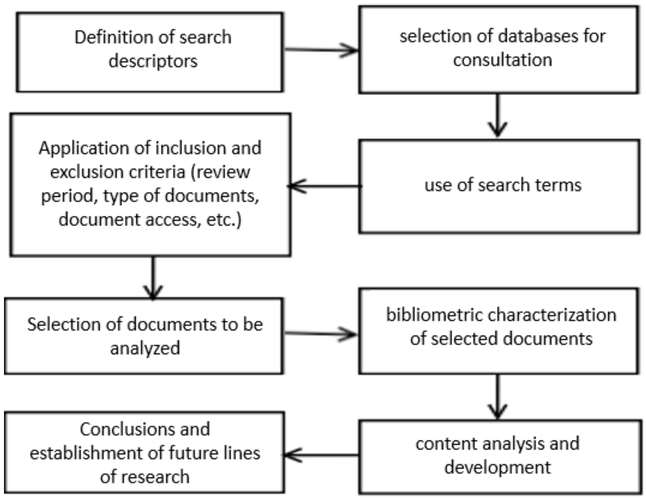

Figure 1 Stages of data collection

3.1 Data Collection

According to Asim and Asorooshian (2019), the descriptors, databases, eligibility criteria, and choice of documents were defined. the details are presented in **Table 1** below.

Table 1 PRISMA Research Checklist

Item PRISMA	Description
Information sources (databases)	ScienceDirect, SCOPUS and SpringerLink
Search - Eligibility criteria	Literature related to logistics 4.0 and its role with business sustainability in agribusiness was chosen by consulting documents published between 2015 and 2021. The descriptors used were: ("Logistics 4.0" AND "Business Sustainability" AND "Agribusiness"). The inclusion criteria used in the database search were: 1. The Title, Abstract and Keywords of the publications were considered. 2. Publications in English was considered. 3. Original articles were considered. 4. Open access publications.
Study selection, data collection and analysis	The database records were exported as comma-separated value (CSV) files. The search results (delimited with eligibility criteria) yielded a total of 56 records in CSV format. The resulting Excel data were converted back to CSV for analysis in VOSviewer, where maps were created based on the bibliographic data. 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. VOSviewer shows that only 21 records are connected.

For the reporting of the results, the PRISMA guide was followed, which establishes guidelines and defines the components that should be considered for the flowchart of the article review. Based on a selection process in the identified databases, a total of 21 articles were filtered and read in their entirety to subsequently design and present the results of the research.

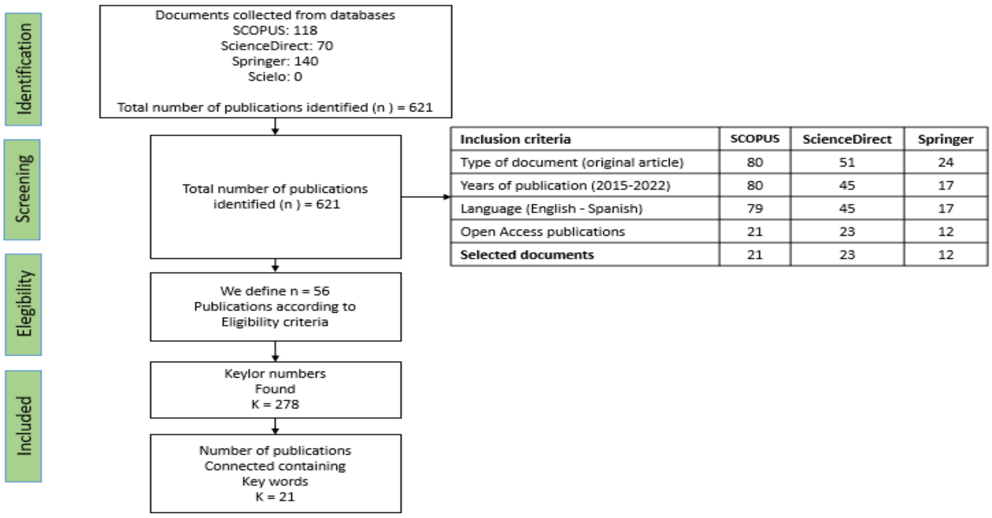

Figure 2 PRISMA flow chart

3.2 *Data Analysis*

3.2.1 Bibliometric Analysis

This analysis is used to analyse the dataset of scientific literature qualitatively and quantitatively from research databases in various fields of study (Daly *et al.*, 2007). VOSviewer, a software tool for creating, visualizing, and exploring maps based on network data, was used. In identifying and selecting terms in the text data, VOSviewer uses Natural Language Processing (NLP) algorithms in the Apache OpenNLP library for phrase detection and part-of-speech tagging (Van Eck and Waltman, 2020). The articles were analysed from the authors, keywords, institutions, and location, to interpret the co-authorship of the studies and the keywords in terms of the concurrence that they may present, in addition to the concurrence that evidences the connection between terms that exists in the articles.

3.2.2 Content Analysis

Content analysis is the method with which the documents were analysed, as it provides a suitable tool for extracting, analysing and interpreting data on the topic addressed. Content analysis systematically analyses data from multiple sources and, depending on the research question, qualitative and/or quantitative methods can be used.

3.3 *Quality of Research*

The evaluation of the quality of the qualitative data in this thesis is based on 4 criteria: credibility, transferability, and reliability. The concepts and principles of Logistics 4.0 and its role in the sustainability of agribusiness enterprises have been explored. The bibliographic framework has been developed by exploring relevant academic and scientific publications. The development of this document can be used as a reference for future studies. The review was conducted using the PRISMA guide, which makes the process systematic, exhaustive, rigorous, replicable, and impartial. This research is reliable because the search strings and eligibility criteria used in data collection will produce similar results if applied by other researchers.

4. RESULTS

4.1 Characterization of the Publications Found

Fifty-six papers were found that met the inclusion criteria of the study, comprising 41% from ScienceDirect, 37.5% from SCOPUS and 21.5% from Springer. From the publication period considered (2015-2021), it could be observed that the highest number of publications was in the year 2021 with 15, **Figure 3**. Research in logistics 4.0 with respect to business sustainability in agribusiness is gaining ground, since the first 4 years only 19 articles were published.

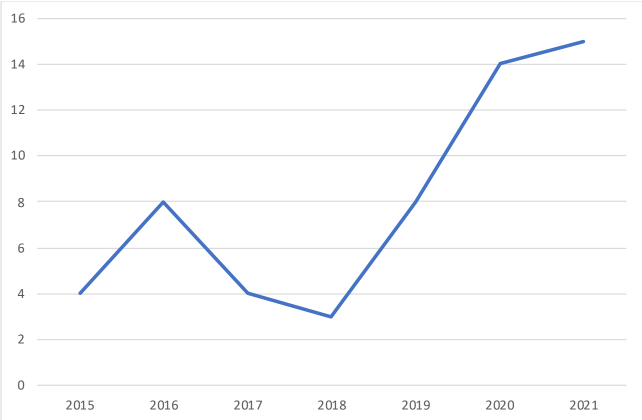

Figure 3 Publications by year

The United Kingdom is the country with the highest number of publications (7 publications), followed by India (5 publications). The following figure shows the distribution of the countries with the highest number of publications:

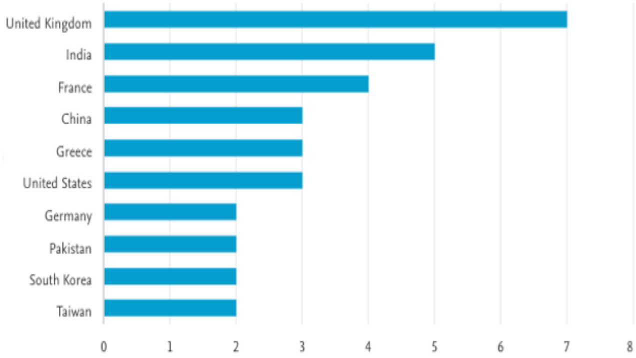

Figure 4 Publications by country

Gunasekaran, Ivanov and Liu were the authors with the highest number of publications with 2 each. The journals where the largest number of papers were published were Sustainable (Switzerland) and Transportation Residual Procedia with 5 articles each. The following figure shows the distribution of publications by main journals.

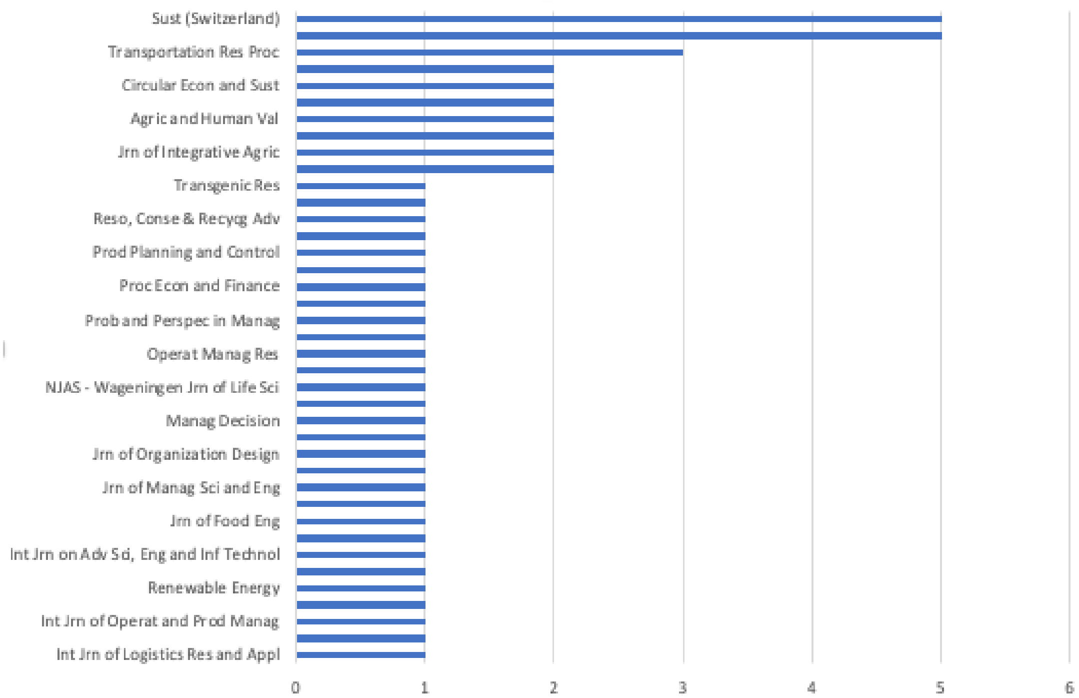

Figure 5 Publications by journal

It was found that the area to which the largest number of publications belong is Business and Management (17.2%), followed by Engineering and Scientific Decisions with 14.1% each, see **Figure 6**.

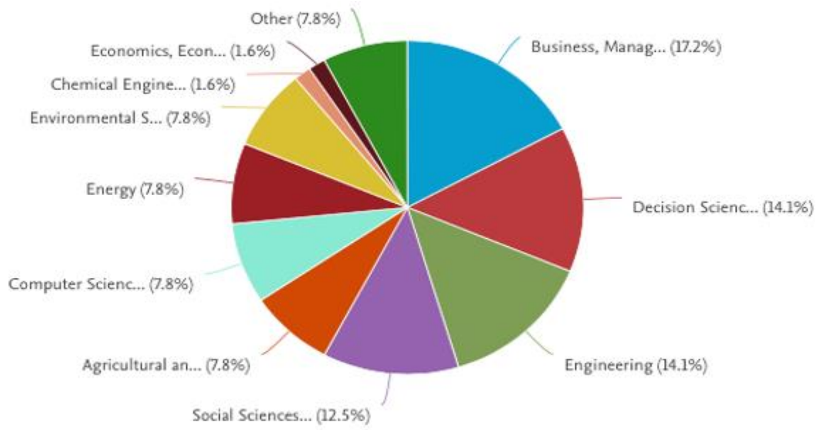

Figure 6 Publications by subject area

Finally, 7 articles were found to have 539 citations, while only one article had 269. The following table shows the 7 articles with the highest number of citations.

4.2 Bibliometric Analysis

Visualization and presentation of some of the patterns observed in the data, VOSviewer version 1.6.16 was used. The guidelines in the Van Eck and Waltman (2020) manual for the tool were used to create, query, and process the extracted bibliographic data in CSV format.

Table 2 Citation of Articles

Title	Year	Citations
The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics	2019	269
Viable supply chain model: integrating agility, resilience, and sustainability perspectives—lessons from and thinking beyond the COVID-19 pandemic	2020	105
Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience	2021	77
When challenges impede the process: For circular economy-driven sustainability practices in food supply chain	2019	32
Solutions for more sustainable distribution in the short food supply chains	2018	24
Agriculture supply chain risks and COVID-19: mitigation strategies and implications for the practitioners	2020	16
Csr, co-creation and green consumer loyalty: Are green banking initiatives important? A moderated mediation approach from an emerging economy	2020	16

4.2.1 Network Visualization

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. These texts are the most important keywords of the processed data and the connections between them can be presented in 3 visualizations in VOSviewer - Network Visualization, Overlay Visualization and Density Visualization. For 278 analysed keywords, only 21 items were found. The network visualization of the data tags yielded 4 clusters, 21 links and 54 strong links.

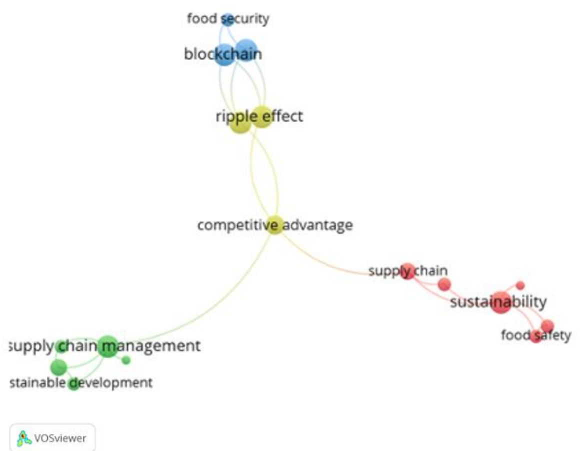

Figure 7 VOSviewer display network

In visualization, the size of an item's label and circle is determined by its weight. The larger the weight of an item, the larger the label and circle of the item. In addition, the colour of an item is determined by the cluster to which it belongs.

4.2.2 Keyword Analysis

The text elements or labels in the VOSviewer visualization represent the keywords that have several occurrences in the publications extracted from the review. There are 21 keywords with an occurrence greater than 2 times. All keywords considered are presented below:

Table 3 Cave words with occurrence greater than 2

id	Keyword	Occurrence	Strong links
26	blockchain	2	5
34	case study	2	0
35	certification	2	0
39	circular economy	2	0
46	competitive advantage	3	4
55	covid-19	4	2
113	food safety	2	2
115	food security	3	2
128	greece	2	2
146	industry 4.0	2	5
164	logistics	2	1
181	optimization	2	2
197	performance	2	0
206	quality	2	1
220	ripple effect	2	5
239	stakeholders	2	3
245	supply chain	2	3
250	supply chain management	4	5
251	supply chain resilience	2	5
254	sustainability	5	5
256	sustainable development	2	2

This information may not be considerable, but the presence of keywords such as COVID19 is evident, due to the pandemic situation that society has experienced this past year. Despite this, the other keywords are related to the topic of study. The presence of "Industry 4.0" is found, which has allowed the rise of logistics 4.0; also, the terms "sustainable development" and "supply chain management". As for the agro-industrial sector, words related to "food safety" and "circular economy" are found, which shows little research development on this topic.

4.2.3 Cluster Analysis

The 21 keywords analysed with VOSviewer resulted in 4 clusters, 21 links and 54 strong links. The keywords in each cluster with the highest number of occurrences and link strength are analysed and presented in the following table.

Table 4 Cave words with occurrence greater than 2

Cluster	Keywords with more than 2 occurrences
Cluster 1 (red)	Covid-19, food safety, Greece, quality, supply chain, sustainability
Cluster 2 (green)	Logistics, optimization, stakeholders, supply chain management, sustainable development
Cluster 3 (blue)	Block chain, food security, industry 4.0
Cluster 4 (yellow)	Competitive advantage, ripple effect, supply chain resilience

4.2.4 Principal Findings

This section presents the main findings of the systematic review of the literature according to the PRISMA guideline. The content analysis of the title, keywords, abstract and part of the content of the 56 publications was reviewed. The focus was on publications that were related to sustainable development and agribusiness.

Table 5 Principal Findings

No.	Finding	Description	Authors
1	Sustainability	This concept implies environmental soundness, social equity and economic viability. It is difficult to define it, as not only each country but also each entrepreneur has a different understanding of its meaning. It is necessary to include the variety and diversity of the different territories.	Borsellino *et al.* (2016)
2	Data analysis capabilities	Data analytics capability is linked to and complements organizational flexibility, supply chain resilience and competitive advantage during supply chain disruptions. data analytics capability under the moderating effect of organizational flexibility improves supply chain resilience and competitive advantage.	Dubey *et al.* (2019)
3	Block chain	Blockchain technology can solve major challenges such as traceability, trust and accountability in the food industry.	Kayikci *et al.* (2020)
4	Risks in agricultural supply chains	Supply, demand, financial, logistical and infrastructure, management and operational, political and regulatory, biological and environmental risks have a significant impact on ASC depending on the scope and scale of organizations. The adoption of Industry 4.0 technologies, supply chain collaboration and shared responsibility offers a solution to this problem. Decentralization of production affects the entire cold supply chain: complexities such as refrigerated transportation and storage costs, as well as product mixes (i.e., variants) and optimal production scheduling. Facilities and labor affect sustainability in the context of markets with uncertainty affected by COVID-19. The role of short-distance transportation and modern marketing methods are strategies that enable sustainability of the agricultural supply chain.	Sharma *et al.* (2020) Almena *et al.* (2020) Zhou *et al.* (2020)
5	Challenges for the sustainability of the agricultural supply chain	Poor government policies, lack of technology and techniques, and lack of farmer knowledge and awareness are the main challenges. Supply chain and competitive advantage are important factors to increase maize farmers' income, social capital needs the support of supply chain and competitive advantage as intervention variables. Supply chain and competitive advantage are important factors to increase maize farmers' income, social capital needs the support of supply chain and competitive advantage as intervention variables.	Sharma *et al.*, (2019) Karim *et al.* (2020) Karim *et al.* (2020)
6	Robust Optimization and Mixed Linear Programming	This model links social constraints with modern supply chain constraints in possibility and probability situations. It allows testing cost-benefit trade-offs with respect to green facility location and supply chain cost decisions when operating under uncertainty.	Sundarakani *et al.* (2020)
7	Internet of things	An IoT-based coordination system for the agricultural supply chain allows for increased competitiveness as a technical and support resource in the face of market uncertainties.	Yadav *et al.* (2020)
8	Co-creation	Co-creation takes place through the interaction between a supplier and a customer. It can occur in a set of different business relationships.	Handayati et a. (2015)
9	Logistics 4.0 opportunities	Short food supply chains require corresponding solutions in distribution that are aligned with contemporary logistics trends, sustainability and aspects of the new digital era. These innovations can enable firms to improve their operational performance and create economic value. At the same time, to realize the full potential of BRI, new work processes and technologies, incentive alignment, cross-company collaboration and optimized planning are needed. Some agro-industrial sectors such as rice show low technical efficiency and very low chain performance, which is because most firms are too small and need to expand their operational size. In addition to the fact that the actors need to organize themselves, it is necessary to include logistics 4.0 to strengthen their business models.	Todorovic *et al.* (2018) Lee y Shen (2020) Linn y Maenhout (2019)
10	AgriFood-Tech	These business models contribute to the growth and sustainability of the agribusiness sector by implementing a digital environment, fostering innovation, accelerating institutional and structural change, improving productivity and introducing new products and services to the market.	Vlachopolou *et al.* (2021)
11	Supply Chain Management Dashboard	It promotes integrated supply chain management by facilitating collaboration between different business units and supporting more informed executive management decision making. This tool increases transparency and operational efficiency, cost-effectiveness of funds and ultimately supports the delivery of critical food assistance to millions of vulnerable families.	Sithole *et al.* (2016)

Table 5 Principal Findings (Con't)

No.	Finding	Description	Authors
12	Routination	Routinization moderates only the relationship between the impact on internal operations and the impact on the performance of farming operations.	Haberli *et al.* (2019)
13	Supply chain viability	is the ability of a supply chain to sustain and survive in a changing environment by redesigning structures and replanning performance with long-term impacts. It encompasses three perspectives: agility, resilience and sustainability.	Ivanov (2020)
14	Digital technologies, Industry4.0, in the supply chain	Digital technologies increase demand responsiveness and capacity flexibility. By reducing inventory, lead times due to additive manufacturing	Ivanov *et al.* (2018), Phillips *et al.* (2019)

5. DISCUSSION

5.1 Risks of Agro-industrial Supply Chains

Based on the current literature review it was found that risks not only hinder the productivity of supply chains, but also deteriorate their performance. Supply, demand, financial, logistical and infrastructure, managerial and operational, political, and regulatory, biological, and environmental risks have a significant impact on agribusiness supply chains. The adoption of Industry 4.0 technologies, supply chain collaboration and shared responsibility offers solution in the face of this problem (Sharma *et al.*, 2020). Additionally, decentralization of production affects the entire cold supply chain: complexities such as refrigerated transportation and storage costs, as well as product mixes (i.e., variants) and optimal production scheduling (Almena *et al.*, 2020). Finally, facilities and labour were found to affect sustainability in the context of markets with uncertainty affected by COVID-19. The role of short-distance transportation and modern marketing methods are strategies that enable sustainability of the agricultural supply chain (Zhou *et al.*, 2020).

5.2 Agribusiness Supply Chain Challenges

Some challenges that agribusiness enterprises face was identified. Poor government policies, lack of technology and techniques, and lack of knowledge and awareness of farmers are the main challenges (Sharma *et al.*, 2019). Likewise, these enterprises need to strengthen supply chain and competitive advantage; as they are important factors to increase maize farmers' income, social capital needs supply chain support and competitive advantage as intervention variables (Karim *et al.*, 2020).

5.3 Strategies for Agribusiness Business Sustainability in the Framework of Logistics 4.0

Sustainability implies environmental soundness, social equity, and economic viability (Borsellino *et al.*, 2016). Some applied models were reported in the review conducted: Value Co-creation, Agrifood-Tech, Supply Chain Management Dashboard, Routinization. These strategies should aim at supply chain viability, since the ability of a supply chain to sustain and survive in a changing environment by redesigning structures and replanning performance with long-term impacts should be counted on (Ivanov, 2020). Value co-creation are dialogic processes of the company and the customer that merge into an integrated process of coordinated actions, in which both parties are active, learn together from each other and can influence each other directly (Handayati et a., 2015). In a value co-creation, both the firm and consumers interact closely with each other to co-create a value service that may include goods delivery components.

Agrifood-Tech business models contribute to the growth and sustainability of the agribusiness sector by implementing digital environment, fostering innovation, accelerating institutional and structural change, improving productivity, and introducing new products and services to the market (Vlachopoulou *et al.*, 2021). The Supply Chain Management Dashboard (SCM-D) is an integrated supply chain management tool and they promote integrated supply chain management by facilitating collaboration between different business units and supporting executive management decision making with more information. This tool increases transparency and operational efficiency, cost-effectiveness of funds, and ultimately supports the delivery of critical food assistance to millions of vulnerable families (Sithole *et al.*, 2016). Routinization is an important aspect in terms of better understanding the capabilities by which firms reconfigure their knowledge base (Wohlgemuth and Wenzel, 2016). Routinization moderates the relationship between the impact on internal operations and the impact on farm operations performance (Haberli *et al.*, 2019).

5.4 Digital Technologies in Logistics 4.0 for Business Sustainability in the Agribusiness Sector

Disruptive technologies and digitized processes are changing the structures and business models of various industries, as well as the supply chains to which they belong (Da Silva *et al.*, 2019). Technological capabilities are necessary for Logistics 4.0 enablement. Firms need to focus more on their ability to generate information, manage it and use it. Digital technologies, Industry4.0, in the supply chain increase demand responsiveness and capacity flexibility, reducing inventory, lead times due to additive manufacturing (Ivanov *et al.*, 2018; Phillips *et al.*, 2019). technologies such as Internet of Things (IoT), Big data, Blockchain and Simulation were recognized. IoT enables increased transparency and aids logistics planning, supports some logistics activities indirectly, such as packaging and order picking. This data can be considered a key capability to generate information (Winkelhaus and Grosse, 2020). Likewise, an IoT-based coordination system for the agricultural supply chain enables increased competitiveness as a technique and support resource in the face of market uncertainties (Yadav *et al.*, 2020).

Blockchain technology can provide a way to achieve immutable data storage that can reduce the need for third-party verifications (Lin and Liao 2017). This is useful for businesses and consumers in complex supply chains. This technology has greater viability in the food industry, as it can help reduce food loss along the global supply chain stages, control temperature variation during transportation, increase transparency of food processes, etc. (Kayikci *et al.*, 2020). Big data technologies are capable of handling information. Information management can be done centrally through cloud computing and decentralized in autonomous systems (Winkelhaus and Grosse, 2020). Data analytics capability is linked to and complements organizational flexibility, supply chain resilience, and competitive advantage during supply chain disruptions. data analytics capability under the moderating effect of organizational flexibility improves supply chain resilience and competitive advantage (Dubey *et al.*, 2019).

Simulation processes allow visualizing scenario behaviours to obtain the best models that interact optimally within a system. Within these processes, Robust Optimization and Mixed Linear Programming have been used, a model that links social constraints with modern supply chain constraints in situations of possibility and probability. It allows testing of cost-benefit trade-offs with respect to green facility location and supply chain cost decisions when operating under uncertainty (Sundarakani *et al.*, 2020).

6. CONCLUSIONS

Logistics 4.0 is a new phase of supply chain improvement. Materials, information, and financial flows are coordinated through automation and digital technologies. By leveraging new trends, supply chains will become much faster and more accurate in information and physical flow, planning activities, performance and order management, inventory, supply chain service and costs. Logistics 4.0 could be achieved after a progressive transformation process that includes environmental, social, and societal dimensions. Logistics 4.0 contributes significantly to the sustainability of firms in general, and even more so to the agribusiness sector. Logistics 4.0, through digital technologies and new business models, allows to create competitive advantages in agribusiness firms. Logistics 4.0 include different technologies and practices form Industry 4.0. Agri-business s has implemented data analysis capabilities, block chain, robust Optimization and Mixed Linear Programming, internet of things, Agrifood-Tech and Routinization to improve logistical processes. Also, the different risks in agri-food production are assessed with digital technologies.

This research provided valuable management implications that can help organizations and practitioners to have a better understanding of logistics 4.0 and its impact on business sustainability in the agribusiness sector. To the best of our knowledge, this is the first publication that analyses the role of logistics 4.0 in sustainable business development, specifically in the agribusiness sector.

6.1 Future Lines of Research

Logistics 4.0 is an emerging area of research that can be applied in various industries and sectors. It is proposed to conduct empirical studies that demonstrate the positive results of the implementation of digital technologies in the supply chains of different agribusiness firms. Likewise, it is important to explore the degree of development of these technologies in the logistic processes of the firms through qualitative studies directed to the organizational leaders. Likewise, it is proposed to measure the degree of adaptability and development of firms in the implementation of digital technologies in logistics 4.0.

CONFLICTS OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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