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Article

The confluence of Logistics 4.0 and agribusiness: A systematic review and future directions

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Abstract: Amid the unfolding Fourth Industrial Revolution, the integration of Logistics 4.0 with agribusiness has emerged as a pivotal nexus, harboring potential for transformational change while concurrently presenting multifaceted challenges. Through a meticulous content analysis, this systematic review delves deeply into the existing body of literature, elucidating the profound capacities of Logistics 4.0 in alleviating supply chain disruptions and underscoring its pivotal role in fostering value co-creation within agro-industrial services. The study sheds light on the transformative potential vested within nascent technologies, such as Internet of Things (IoT), Blockchain, and Artificial Intelligence (AI), and their promise in shaping the future landscape of agribusiness. However, the path forward is not without impediments; the research identifies cardinal barriers, most notably the absence of robust governmental policies and a pervasive lack of awareness, which collectively stymie the seamless incorporation of Industry 4.0 technologies within the realm of agribusiness. Significantly, this inquiry also highlights advancements in sustainable supply chain management, drawing attention to pivotal domains including digitalization, evolving labor paradigms, supply chain financing innovations, and heightened commitments to social responsibility. As we stand on the cusp of technological evolution, the study offers a forward-looking perspective, anticipating a subsequent transition towards Industry 5.0, characterized by the advent of hyper-cognitive systems, synergistic robotics, and AI-centric supply chains. In its culmination, the review presents prospective avenues for future research, emphasizing the indispensable need for relentless exploration and pragmatic solutions. This comprehensive synthesis not only sets the stage for future research endeavors but also extends invaluable insights for practitioners, policymakers, and academicians navigating the intricate labyrinthstry of Logistics 4.0 in agribusiness.

Keywords: logistics 4.0; agribusiness; industry 4.0; systematic literature review; bibliometric analysis

1. Introduction

Logistics, with its origins in military personnel and material provision and maintenance, witnessed a significant pivot in the 1960s as it incorporated physical

goods, giving birth to "business logistics" (Ballou, 2007). Nowadays, logistics is understood as the orchestration of material and information flows within an organization, encompassing associated data management for storage and transportation, aiming for efficient, cost-effective delivery of finished products while maintaining service and quality standards (Christopher, 2016).

Before delving deeper into our conceptual understanding of Logistics 4.0, it's pivotal to recognize its representation as the convergence of advanced digital technologies with traditional logistics processes, driven by the 4th industrial revolution. "Logistics 4.0" signifies a paradigm where interconnected systems, automation, real-time data analytics, and cyber-physical systems centralize in logistics operations, using tools like autonomous vehicles, tracking and decision-making systems, and collaborative robots (Miškić et al., 2023; Islam et al., 2023; Lin and Hu, 2022). This integration not only enhances efficiency but also fosters adaptability, predictability, and sustainability in the supply chain (Puška and Stojanović, 2022). As we embark on our exploration of Logistics 4.0 in the context of agribusiness, it's crucial to note the significant savings and efficiencies it brings. Yet, challenges like the lack of digital competence and resistance to change must be addressed.

In the wake of digital technology evolution, the emergence of "Logistics 4.0" stands as a testament to the industry's adaptability and innovation (Winkelhaus and Grosse, 2020). This novel incarnation, underpinned by real-time data accessibility and automation, has been influential in reshaping the logistics landscape, promising unparalleled advantages like diminished lead times, environmental conservation, and superior decision-making capabilities (Russell and Swanson, 2019; Tjahjono et al., 2021). A thorough evaluation of logistics' economic, environmental, and social implications and potential for improvement is necessary to deliver efficient and sustainable logistics (Dey et al., 2011; Ahi and Searcy, 2013). With increasing sustainability concerns and evolving customer needs, Logistics 4.0 integrates technology to automate both forward and reverse logistics processes (Winkelhaus and Grosse, 2020; Russell and Swanson, 2019).

Born from the cradle of Industry 4.0, Logistics 4.0 is a beacon of transformation, embedding digital technology to revolutionize logistics processes (OECD, 2017; Lasi et al., 2014). Industry 4.0, an embodiment of concepts like Smart Factory, Cyber-Physical Systems (CPS), and the Internet of Things (IoT), has been a global catalyst, prompting governments worldwide to fortify their industrial sectors (Hermann et al., 2016; OECD, 2017; Baque-Cantos et al., 2023). Implementing Logistics 4.0 across different economic sectors is a complex task due to the multifaceted approach necessary for digital transformation (Sordan et al., 2022).

Logistics 4.0 strives for perfection. It endeavors to eliminate glitches, foster integration across processes, and establish a harmonious blend of front-end and back-end technologies for unparalleled efficiency (Frank et al., 2019; Barreto et al., 2017). This transformation is manifested through vertical, horizontal, and end-to-end engineering integration (Strandhagen et al., 2017). It leverages both front-end and back-end technologies to coordinate goods movement and information flow, leading to cost-effective, customer-centric solutions (Frank et al., 2019). Advanced systems such as warehouse management, intelligent transportation systems, information security, and autonomous order processing via blockchain technology and smart

contracts are cornerstones of Logistics 4.0 (Barreto et al., 2017). Deploying dynamic capabilities like technological and environmental competencies are essential for planning and executing digital technologies (Winkelhaus and Grosse, 2020; Tjahjono et al., 2021; Rincón-Guio et al., 2023).

Yet, amidst these strides in innovation, a glaring lacuna exists. The interplay between smart production methodologies and their ramifications on agribusiness performance remains enigmatic and under-researched (Hardjomidjojo et al., 2022; Lin et al., 2018; Kumari et al., 2023). This article aspires to bridge this chasm. By shedding light on how Logistics 4.0 can bolster the agriculture industry's competitive edge within the Industry 4.0 ecosystem, this review seeks to augment our understanding of this intricate relationship. By conducting a comprehensive literature review, we identify key technologies, their uses, impacts on competitiveness and sustainability, and the challenges and barriers agribusinesses face when implementing these technologies (Büyüközkan and Göçer, 2018; Queiroz et al., 2020). Furthermore, we unearth the intricacies of how global trade's upsurge has complicated agri-food supply chains. In a world where ensuring food safety becomes paramount, there's an irrefutable call for intricate, interconnected systems (Zupaniec et al., 2022; Frazzon et al., 2020; Codex Alimentarius Commission, 2016; Bourlakis et al., 2014).

In this backdrop, this review aims to enhance existing knowledge on Logistics 4.0's contribution to agribusiness performance in the Industry 4.0 context (Hardjomidjojo et al., 2022; Lin et al., 2018; Kumari et al., 2023). Our goal is to provide valuable insights for practitioners and future researchers helping formulate effective technology adoption strategies for sustainable and competitive growth (Kamble et al., 2018; Soledispa-Cañarte et al., 2023a; Soledispa-Cañarte, 2023b). We delve into the potential impact of digital technologies on future agri-food systems' sustainability and resilience, implications for rural development, social justice, and environmental stewardship (Bronson and Knezevic, 2016; Frizzo-Barker et al., 2020).

This review seeks to accentuate Logistics 4.0's pivotal role in agribusiness performance, providing actionable insights for industry mavens and researchers alike. By highlighting the potential ramifications of digital technology on future agri-food systems, our goal is to set the stage for subsequent empirical endeavors that delve deeper into the real-world implications of Logistics 4.0 in the realm of agribusiness.

2. Methodology

To enhance the trustworthiness of research focused on a specific issue, it is imperative to apply a methodology that encompasses a sequence of unambiguous procedures (Kraus et al., 2022). The Systematic Literature Review (SLR) has emerged as a distinguished benchmark in identifying, electing, and integrating published resources with the objective of addressing a pre-established research inquiry (Snyder, 2019). Further, this methodology exhibits multifaceted roles, ranging from mapping the scholarly landscape to identifying forthcoming research potentials and crafting relevant research inquiries (Borrego et al., 2014). This is accomplished through a rigorous methodology encompassing the formulation of the research question, establishing the inclusion and exclusion criteria, undertaking literature search and

selection, collating and integrating data, evaluating the quality of the study and risk of bias, and ultimately, transmitting and propagating results (Snyder, 2023).

In congruence with the above-mentioned, we utilized the SLR methodology to scrutinize the existing body of literature on Logistics 4.0 and Agribusiness or Agroindustry. In addition, we conducted a bibliometric review, which holds the merit of managing a considerable corpus of published works and examining them to propose future trajectories (Linnenluecke et al., 2019). To guarantee impartiality and dependability of the bibliometric review, a review protocol was constructed, as presented in **Table 1** (Kraus et al., 2022). **Figure 1** illustrates the phases pursued to implement the SLR, the particulars of which are expounded subsequently.

Table 1. RSL protocol.

Protocol	Description
Data base	Scopus, Web-of-Science (WOS)
Search item	Title, keywords and abstract
Keywords	"logistic" "logistics 4.0", "industry 4.0" OR "digital techonolog*" OR "I4.0" OR "Industry 5.0" OR "I5.0" OR "fourth industry" OR "fourth revolution", "farm*" OR "agro*" OR "agri*"
Inclusion criteria	- Type of document: article - Language: English and Spanish. - SCOPUS Knowledge area: Engineering, Management, Computer Science and Agricultural and Biological Sciences. - WOS Research area: Engineering, Computer Science, Business economics.
Exclusion criteria	- Not aligned with Logistics 4.0 and Agribusiness or Agroindustry - Written in a language other than English - Duplicates (same articles found in different databases)
Analysis tool	VOSViewer for bibliometric analysis
Data analysis	Bibliometric and content analysis

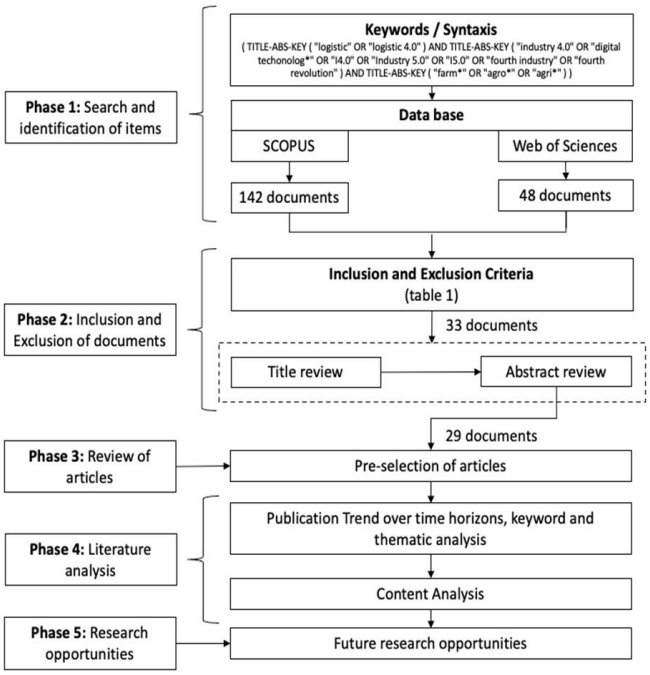

Figure 1. SLR search methodology.

2.1. Exploration and identification of documents

The materials for review were harvested from esteemed academic repositories, namely Scopus and Web of Science. The utilized keywords and syntax included (TITLE-ABS-KEY (“logistic” OR “logistics 4.0” OR “supply chain”) AND TITLE-ABS-KEY (“industry 4.0” OR “digital technology*” OR “I4.0” OR “Industry 5.0” OR “I5.0” OR “fourth industry” OR “fourth revolution”) AND TITLE-ABS-KEY (“farm*” OR “agro*” OR “agri*”)). This exploration was carried out in May 2023.

2.2. Criteria for inclusion/exclusion

The keyword search culminated in the discovery of 142 articles in Scopus and 48 articles in Web of Science. The inclusion and exclusion criteria as elucidated in Table 1 were enforced to exclude unrelated documents and duplicates. This selection process whittled down the number to 33 articles. Subsequently, a thorough selection of abstracts was conducted to integrate the most pertinent articles into the review, concordant with the research theme. Consequently, a total of 29 articles were earmarked for subsequent review and analysis.

2.3. Evaluation of selected articles

The chosen articles underwent rigorous review and analysis to comprehend the status quo of research, development, and application of logistics 4.0 within agribusiness, to appreciate the progression of innovative research, notable concerns, and evolution within the field.

2.4. Analysis of literature

Bibliometric and content examinations were undertaken on the selected articles. The bibliometric analysis enabled us to scrutinize publication trends (by year and country), citation patterns, and keyword usage. We deployed VOSviewer © software to conduct a keyword analysis to discern the frequency of keyword co-occurrence. Additionally, we pinpointed, assessed, and deliberated the most significant themes.

2.5. Opportunities for research

The literature review facilitated the identification of existing research voids. Grounded in these gaps, we delineated research opportunities that we introduce in this segment.

3. Findings

Bibliometric analysis

This is a quantitative research method that uses statistics to analyze and interpret the distribution, frequency, patterns, and trends of published materials. In this specific study, bibliometric analysis was used to review publications on the topic of logistics 4.0 and agribusiness. A descriptive analysis was implemented to consolidate essential information regarding the publications earmarked for this review study. The descriptive analysis supplied an in-depth comprehension of publication trends across time, geographical distribution, and domains of expertise. Moreover, a keyword

analysis was carried out to illuminate the most pertinent concepts canvassed in the existing literature.

This **Figure 2** showcases how often papers on logistics 4.0 and agribusiness were published year by year, from 2019 to May 2023. This helps in understanding the evolution and interest in this research topic over time. It is acknowledged that this research field is relatively nascent in comparison to the study of logistics at large, potentially due to the applications of emerging digital technologies and external events such as the COVID-19 pandemic (Soledispa-Cañarte et al., 2023). **Figure 3** delineates the distribution of documents by area of knowledge. This research theme piques the interest of a wide spectrum of fields, ranging predominantly from business to materials science and social sciences. This provides insight into which academic fields are most interested in logistics 4.0 and agribusiness. By understanding which disciplines are contributing to the discourse, we can comprehend the multidisciplinary nature of the topic.

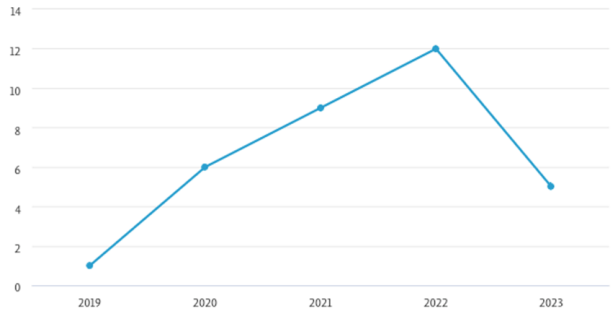

Figure 2. Publications by year.

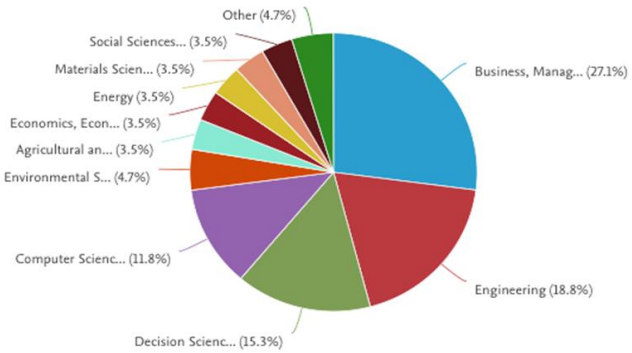

Figure 3. Publications by area of knowledge.

The analyzed studies accumulated contributions from 27 countries. **Figure 4** exhibits the 10 nations that published two or more articles. 29 studies were collected from authors in 27 countries, which demonstrates the global interest in the topic. Authors from India demonstrated the highest contribution (13 studies), trailed by Italy (5), United Kingdom (5), Turkey (4), and Brazil (3).

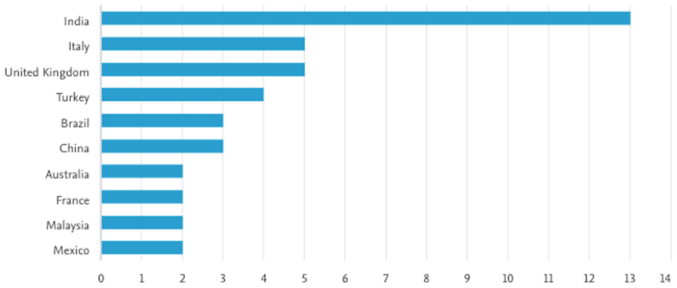

Figure 4. Top 10 publications by country.

When the journals were examined, it was found that the 29 documents were published in 23 different venues, indicating a widespread interest in various academic platforms. The International Journal of Logistics Research and Applications submitted three papers to peer-reviewed journals. However, Sensors (Switzerland) has the most citations for a single article—109—among peer-reviewed journals. The Journal Of Cleaner Production comes in second with two articles and 157 citations. Citations are an indication of how impactful or influential a research paper has been in the academic community. The table provided (**Table 2**) ranks the most cited papers on logistics 4.0 and agribusiness. A key observation here is the relatively high number of citations for articles published in the last two years, suggesting a recent and growing interest in the subject. The reviewed papers have collectively received 816 citations (as of May 2023), with an average of 28 citations per article. It is apparent that a substantial number of highly cited papers have been published in the past two years. This could signal a surge in interest and implementation of I4 logistics 4.0 and agribusiness.

Table 2. Most cited documents.

Document	Citations	Average citation per year publication
Sharma et al. (2020)	164	54,7
Kumar et al. (2021)	130	65.0
Khan et al. (2020)	109	36.3
Kayikci et al. (2022)	102	0.0
Mukherjee et al. (2021)	49	24.5
Aamer et al. (2021)	28	14.0
Mahroof et al. (2021)	27	13.5
D'souza et al. (2020)	25	8.3
Fagundes et al. (2020)	22	7.3
Mangla et al. (2022)	18	0.0

Figure 5 displays the most frequently employed keywords and the co-occurrence among them. Three clusters of keywords, differentiated by color, form the network. For instance, the congruent hues of "internet of things", "blockchain", and "industry 4.0" potentially demarcate a technologically-centered cluster. This nexus suggests that the scholarly conversation is heavily entwined with the role of nascent technologies in the rejuvenation and enhancement of the agricultural supply chain. The integration of these technological marvels within the discourse delineates the literature's progressive trajectory. Positioned centrally, the terms "agriculture supply chain", "industry 4.0",

and "supply chain management" can be construed as the cardinal themes within the dataset. Their strategic placement and extensive relational ties intimate that they serve as foundational pillars in the discourse, frequently coalescing with a myriad of other keywords. While "Covid-19" is not central, its presence is noteworthy, insinuating investigations into the pandemic's ramifications on supply chains, albeit as a peripheral or emerging area of inquiry. The linkage between "circular economy" and "industry 4.0" unveils a burgeoning interest in sustainable methodologies, emphasizing resource conservation, cyclical processes, and waste curtailment, particularly in the backdrop of the Fourth Industrial Revolution. The intricate web of interconnections among the keywords attests to an integrative and interdisciplinary approach in the literature, mirroring the complex realities of agricultural supply chains in today's dynamic landscape. 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., 2021).

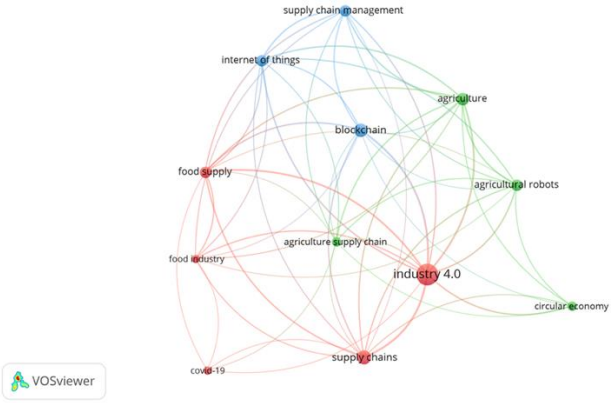

Figure 5. Co-occurrence of keywords.

4. Discussion

The integration of Logistics 4.0 technologies within the agricultural sector provides a promising avenue for enhancing sustainable and efficient supply chains, as evidenced by numerous studies in this field. These studies collectively explore the multitude of ways in which emerging technologies can be harnessed to transform the agri-food industry.

Ali and Govindan (2021) accentuate the susceptibility of modern supply chains to various disruptions and risks, a vulnerability further highlighted during the COVID-19 pandemic. They advocate for a digital transformation as a solution to these challenges, with their studies demonstrating a decreased impact of operational risks on firms implementing Industry 4.0 technologies (I4Ts). Bonamigo et al. (2023) introduce the notion of Lean 4.0, which merges the Lean philosophy with I4Ts to reduce waste and maximize resource efficiency. They suggest that future studies explore the potential for value co-creation in agro-industrial services through Lean 4.0. Concurrently, Compagnucci et al. (2022) investigate the adoption of blockchain technology in the agri-food supply chain, noting its transformative role in data

gathering and stakeholder engagement. Nevertheless, they also highlight the challenges in encouraging stakeholders to participate in a blockchain-based network.

In a similar vein, Kayikci et al. (2020) argue for blockchain's potential in combating food waste and ensuring food authenticity, presenting a framework for a blockchain-driven food supply chain. Likewise, the work of Taskin et al. (2021) and Raza et al. (2023) underscores the role of IoT and Blockchain in bolstering supply chain management by improving data transfer, device control, and security, thereby enhancing transparency and safety in food supply chains.

In their research, Krstić et al. (2022) provide a multi-criteria decision-making model ranking vital aspects of circular economy related to the implementation of I4.0 technologies in agri-food logistics. Kumar et al. (2021) and Kumar et al. (2022) delve into the obstacles hindering the adoption of I4.0 and circular economy principles in India's agricultural supply chain, pointing to a lack of governmental support and policy guidelines, as well as a need for increased awareness of technological benefits and recycled products.

Within the context of sustainable supply chain management, Mangla et al. (2022) evaluate an interdependent hierarchical structure pertinent to Industry 4.0. They explore factors such as digitalization, labor conditions, supply chain financing, and social responsibility, among others. Their research identifies several valid indicators capable of improving practices in the Indonesian coffee industry. Sharma et al. (2020) underscore the significance of resilience in agricultural supply chains, offering mitigation strategies based on I4.0 technologies adoption and supply chain collaboration. They apply a Fuzzy Linguistic Quantifier Order Weighted Aggregation (FLQ-OWA) approach to evaluate supply chain risks.

Mahroof et al. (2021) advocate for innovative solutions, such as AI-driven drones, to manage challenges like pesticide overuse in agricultural supply chains. In an interesting development, Verma et al. (2022) discuss the evolution from Industry 4.0 to Industry 5.0, characterized by the deployment of hyper-cognitive systems, virtual and extended reality, digital prototyping, collaborative robots, and AI-enhanced supply chains. They propose blockchain technology for secure data transfer in these industrial networks, suggesting a blockchain-based architecture for human-robot interaction as a future research area. Latino et al. (2022) present a voluntary food traceability framework reliant on digital technologies to facilitate end-to-end traceability, from data collection to consumer communication.

The collective body of research underscores the transformative potential of emerging technologies, such as IoT, Blockchain, and AI, in creating sustainable and efficient agricultural supply chains. However, the challenge lies in overcoming existing barriers and fostering widespread adoption. The future lies in creating an environment conducive to technological adoption that promotes sustainable development, resource efficiency, and robust supply chains in the agri-business sector.

Research opportunities

The confluence of Logistics 4.0 and agribusiness heralds an era rife with research opportunities. The integration of the Fourth Industrial Revolution technologies into this agricultural sector promises transformative potential. Distilling from extant

literature and current technological trajectories, we identify the following salient avenues for further exploration:

a) Risk management and disruption mitigation: Ali and Govindan's (2021) seminal work lays the foundation for a deep dive into the role of Industry 4.0 technologies (I4Ts) in attenuating supply chain perturbations. Future research should illuminate the relative efficacy of individual I4Ts in assuaging specific risks, perhaps drawing on illustrative case studies for empirical richness.
b) Lean 4.0 principles in agro-industrial services: Bonamigo et al. (2023) gesture toward the transformative power of Lean 4.0 in agribusiness. Prospective studies can delineate methodologies for transplanting these principles within specific agro-industrial sectors, providing actionable blueprints for real-world application.
c) Blockchain integration in agri-food supply chains: Building on the insights of Compagnucci et al. (2022) and Kayikci et al. (2020), scholars could untangle the intricate web of challenges surrounding blockchain adoption, designing protocols that cater to the idiosyncrasies of diverse agri-food supply chains.
d) Circular economy and industry 4.0 synergies: In light of Krstić et al.'s (2022) pioneering exploration, future inquiries might elucidate the potential harmonization of I4.0 technologies with circular economy tenets, focusing on deriving and codifying best practices for technological implementation.
e) Surpassing adoption barriers of industry 4.0: Kumar et al. (2021) and Kumar et al. (2022) highlight critical impediments to I4.0 assimilation in agriculture. Succinct strategies to address and potentially circumvent these obstructions—Ranging from policy lacunae to awareness deficits—Warrant in-depth research.
f) Advancements in Sustainable Supply Chain Management (SSCM): Expounding on Ming-Lang et al.'s (2022) paradigm, further studies should dissect the nuances of the proposed interdependent hierarchical structure, validating its applicability across divergent agri-food supply chain scenarios.
g) Augmented resilience through Industry 4.0: Drawing inspiration from Sharma et al. (2020), future endeavors might dissect the modalities through which I4Ts can bolster supply chain resilience, especially against the backdrop of macro challenges like climate fluctuations and global pandemics.
h) The transition to industry 5.0: As the world teeters on the precipice of the Fifth Industrial Revolution, Verma et al.'s (2022) study serves as a beacon. A granular understanding of the paradigmatic shifts, opportunities, and challenges inherent in transitioning from Industry 4.0 to 5.0, contextualized for agribusiness, remains a compelling research frontier.

The research avenues outlined above aim to tackle both present and future challenges and harness the advantages offered by Logistics 4.0 and emerging technologies within the agribusiness sphere. They underscore the need for continued examination into the pragmatic application of these technologies, as well as the development of supportive frameworks and policies for their successful deployment.

5. Conclusion

This Systematic Literature Review (SLR) offers a comprehensive understanding of the confluence between Logistics 4.0 and the agribusiness sector. It is evident that

this intersection harbors vast potential to bolster sustainable, efficient, and resilient supply chains, particularly given the emergent digital transformation trends characterized by the Fourth Industrial Revolution. These opportunities range from mitigating supply chain disruptions and risks to promoting value co-creation within agro-industrial services through Lean 4.0. Moreover, the utilization of blockchain technology promises advancements in data collection, stakeholder interaction, traceability, and accountability in the agri-food supply chain. However, existing barriers, including technical and economic challenges, as well as the absence of comprehensive government support, policies, and awareness require targeted attention and strategies to facilitate the widespread adoption of Industry 4.0 technologies.

The contributions valuable insights into key areas of interest in the circular economy, sustainable supply chain management, and supply chain resilience, respectively. Furthermore, the anticipated shift from Industry 4.0 to Industry 5.0 as signals an emerging research frontier that could further revolutionize the agribusiness sector through hyper-cognitive systems, virtual and extended reality, digital prototyping, collaborative robots, and AI-based supply chains.

As research progresses, the exploration of emerging opportunities in risk management, Lean 4.0 applications, blockchain technology, circular economy, overcoming adoption barriers, sustainable supply chain management, increasing supply chain resilience, and transitioning to Industry 5.0 remains imperative. These areas provide fertile ground for innovative investigation and practical problem-solving. The quest for more sustainable and efficient agri-food logistics systems, fueled by the application of Logistics 4.0, is a journey of continuous learning, adaptation, and innovation. It is a journey that will undoubtedly shape a more sustainable, resilient, and efficient future for the agribusiness sector.

The implications of this study are multi-dimensional, touching upon numerous aspects of the intersection of Logistics 4.0 and the agribusiness sector. The incorporation of Logistics 4.0 in the agribusiness sector can significantly enhance operational efficiency, decrease waste, and reduce vulnerability to supply chain disruptions. These findings imply that firms in the agribusiness sector should consider adopting Industry 4.0 technologies to enhance their operational resilience. This study underlines the potential of blockchain technology in promoting traceability and accountability in the agri-food supply chain. Thus, stakeholders in agribusiness, particularly those in roles managing supply chains, should consider investing in blockchain technology to improve the transparency of their operations.

The insights drawn from this study highlight the crucial role of Industry 4.0 technologies in promoting sustainability within the agribusiness sector, particularly through the application of circular economy principles and sustainable supply chain management practices. This calls for industry leaders and policymakers to prioritize sustainability in their strategies, ensuring it is at the core of their operations. The exploration of research opportunities in the intersection of Logistics 4.0 and agribusiness provides valuable insights into future research directions. This calls upon researchers and academicians to delve into these identified areas, furthering our understanding and helping to develop practical frameworks and solutions. With the imminent shift from Industry 4.0 to Industry 5.0, organizations within the agribusiness sector must prepare to navigate this transition. They should consider investing in

emerging technologies like hyper-cognitive systems, virtual and extended reality, and AI-based supply chains to stay competitive and innovative in an ever-evolving industrial landscape.

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