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The Role of Technology in Transforming Agricultural Supply Chain Management: Systematic Literature Review

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Abstract. Purpose: The main aim of this review paper is to explore and discuss the role of technology in transforming agricultural supply chain management.
Design/methodology/approach: The research conducted a systematic review using the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA). The study identified articles between 2017 and 2022 focused on technology in agricultural supply chains. Additionally, the Scopus database was also utilized to gather pertinent data regarding "technology, agriculture, and supply chain." The primary keyword used in the search strategy was "technology, agriculture, supply chain".
Findings: The authors manually assessed the entire 680 articles by perusing their titles, abstracts, and entire articles. 83 articles were eliminated due to duplication, and 213 abstracts were discarded due to screening. In addition, 307 articles were rejected after screening the complete text, and 67 articles were rejected after screening the eligibility of the full text. Hence, only 10 documents were considered appropriate for further analysis. The study found that the technology has transformed the agricultural supply chain operations by using advanced technology such as data analytics, blockchain, IoT and other technological aspects. Additionally, this has significantly contributed to the overall operation of agricultural supply chain tasks and as well as enhanced the capability of stakeholders of agriculture supply chain.
Research, Practical & Social implications: There are many stakeholders involved in agriculture that can benefit from these ideas, including agricultural institutions, farmers, landowners, agribusiness managers, producers, suppliers, distributors, customers, and consumers.

Keywords: Technology, Agriculture, Supply chain, Systematic literature review

1. Introduction

The agricultural industry has been involved in fulfilling worldwide food requirements and safeguarding food security, making it a vital field that influences the entirety of human existence. Additionally, agricultural production plays a substantial role in a nation's economy and in ensuring its population's security, nutrition, and well-being. It is challenging to work in agriculture because the weather changes from season to season, the price of agricultural goods changes on the market constantly, soil quality is getting worse, crops cannot be sustained, weeds and pests cause damage to crops, and climate change is impacting the world (Bhat et al., 2021).

Moreover, a highly underdeveloped agricultural industry needs to transform its technology to ensure food safety and reliability. Furthermore, blockchain technology plays a significant role in implementing sustainable e-agricultural supply chain management (e-AgriSCM). In the era of blockchain advancements in digital marketing, product websites (web design) must be aligned with supply chain partners' expectations, ensuring streamlined operations (Alkahtani et al., 2021).

According to Leng et al., (2018), an agricultural supply chain is a complex system that distributes agricultural products on the market. In order to meet the demand of agricultural products and to ensure their safety and quality, agricultural commercial resources play a crucial role in the circulation of agricultural products (Leng et al., 2018).

Numerous studies have emphasized that the digitization of value chains has brought about transformative changes in agricultural business transactions (Kamilaris et al., 2019; Abdullahi & Mohamud, 2023). In the value chain, barcodes provide the most notable effect, allowing products to be tracked (Rogerson & Parry, 2020). Meanwhile, the internet has enabled consumers and farmers to connect through mobile applications and has empowered agricultural stakeholders to manage the agricultural supply chain efficiently. Technology is changing due to the use of cheap sensors that monitor situations and smart sensors that are more sophisticated (Wang et al., 2019).

The agricultural industry has encountered significant challenges in managing supply chains efficiently and effectively. However, adopting technology has brought about a remarkable transformation in the field, revolutionizing the technological aspects of agricultural supply chain management. Innovations like the Internet of Things (IoT), blockchain, big data, data analytics, and digital platforms have played a pivotal role in reshaping agricultural supply chain practices, leading to a substantial paradigm shift in the industry (Bhat & Huang, 2021; Kumarathunga, 2020; Lin et al., 2016).

The main purpose of this review paper is to explore and discuss the role of technology in transforming agricultural supply chain management. This paper examines how technological advances have revolutionized agricultural supply chains, including the use of digital platforms, data analytics, Big data, RFID, Internet of Things (IOT) and blockchain technology. It also discusses the advantages and disadvantages of implementing or adopting technology in agricultural supply chains. Furthermore, it emphasizes how these technological innovations have significantly enhanced efficiency, value chain operations, transparency, traceability, and sustainability within agricultural supply chain management.

In addition, the study tries to pinpoint the main difficulties and impediments that can prevent the successful application of technology in agricultural supply chain management. This research offers insights into the many solutions and best practices proposed or implemented to solve these difficulties by performing a thorough systematic literature review. A critical assessment of the socioeconomic impacts of technological change on agricultural supply chains, including its effects on farmers, distributors, consumers, and the general market dynamics, is also included in the objectives. Through the synthesis of existing research, this study ultimately strives to offer a holistic understanding of the current state of technology-driven advancements in agricultural supply chain management and to pave the way for future research initiatives and practical implementations in this evolving field.

The article follows a structured approach that focuses on the role of technology in transforming agricultural supply chain management. It includes a detailed discussion of the research methodology and framework employed in the study. Furthermore, the article presents and analyzes the results obtained from a systematic review, shedding light on the topic. Finally, the article concludes by summarizing the main findings and implications discussed throughout the paper.

2. Methodology

This section explains where to get publications about technology, agriculture and supply chain. The process involves strict procedures as well as steps that look at pertinent content. Preferred Reporting Items for Systematic Reviews (PRISMA) and Meta-Analyses are the methodologies for performing literature reviews. It serves as the framework for the method used to find the articles. As part of PRISMA, the review report emphasizes using randomized assessments as a springboard for systematic reviews. The criteria for selecting and omitting articles relevant to this study are also included (Moher et al., 2009). In a systematic review, PRISMA emphasizes the importance of randomized trials as a basis for other types of research, such as intervention, which presents several challenges, specifically when evaluating qualitative or mixed-method study designs (Moher et al., 2009).

By searching numerous scientific databases and all available alternatives, PRISMA ensures no significant study is missed (Rosa & Broday, 2018). The screening technique may be able to decrease the number of discovered studies given the research selection criteria (Moher et al., 2009). PRISMA is often used in medical research, but it is equally useful to operation management because it emphasizes research difficulties connected to the requirement for a systematic review. This method may also offer inclusion and exclusion standards for studies. Academics from various fields, not just medicine, have been forced to analyze more methodologically oriented literature articles based on systematic literature reviews due to the absence of methodological direction in research and the inadequacy of current methodological references.

Besides, the Scopus and web of science are the two top citation databases currently in rivalry, according to (Zhu & Liu, 2020). However, the papers used in this evaluation were from the renowned database Scopus. Alryalat et al., (2019) showed that it is more relevant to examine related papers if they are found in a single database rather than multiple databases such as Scopus because WoS produces fewer documents than Scopus. Further, the Scopus database contains a multidisciplinary collection of abstracts and citations, making it an invaluable resource for researchers looking for pertinent publications (Patel et al., 2021). It is a relatively new rival that is challenging WoS's hegemony.

Using Scopus search strings, researchers looked for all terms associated with this review. Researchers conducted an initial keyword search for "technology", "Agriculture", and "supply chain" The research keywords were extended using synonyms, related terms, and variants found in prior studies. These keywords were then entered into the Scopus advanced search tool, which yielded a total of 680 articles from the database. Kraus et al., (2020) asserted that the author's capacity to carry out the review article frequently determines the quality of the literature review. Since the exclusion criteria enhance the quality of the results, this review only contains journal articles (Baashar et al., 2020). In addition, only English-language documents were included in order to reduce the complexity that could result from the need for translation.

The year of publication was not a restriction for this study, despite the fact that many researchers use it as an exclusion criterion. The search results indicate that the publications were published between 2016 and 2022. The publication year was not an exclusion criterion. The inclusion and exclusion criteria for the selected article are summarized in Table 1.

Table 1: Criteria for Inclusion and Exclusion

Inclusion Criteria	Exclusion Criteria
Scopus-indexed articles Journal articles English language articles Empirical study	Non-Scopus-indexed articles Conference proceedings, review articles, book chapters and books Non-English language articles Conceptual study and review article

The authors manually evaluated the entire 680 articles by perusing their titles, abstracts, and entire articles. 83 articles were eliminated due to duplication, and 213 abstracts were discarded due to screening. In addition, 307 articles were rejected after screening the complete text, and 67 articles were rejected after screening the full text for eligibility. Thus, 10 documents were deemed suitable for further analysis. Figure 1 illustrates a flowchart of the entire search process.

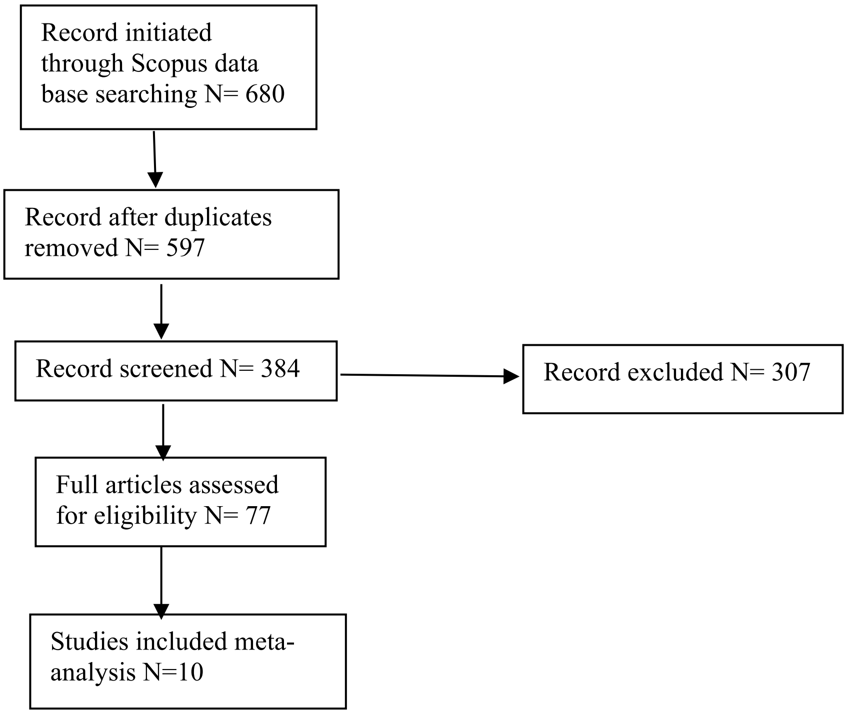

Fig.1: flowchart of the search process

3. Result and Discussion

This part discusses the aim, results, recommendations, and methodologies that were adopted in prior research on the role of technology in agricultural supply chain management.

Table 2: Content review of the selected articles

Author	(Narwane et al., 2022)	(Niu et al., 2021)	(Kittichotsatsawat et al., 2021)	(Amr & Elkader, 2020)	(Sharma et al., 2020)	(Saputri et al., 2019)	(Leng et al., 2018)	(Nayal et al., 2022)	(Majumdar & Kar, 2017)	(Lin et al., 2016)
Aim	to analyze the essential aspects that influence the AFSC's adoption decision of IoT technology.	to determine the parameters within which incentive alignment among supply chain participants may be achieved in order to implement blockchain technology.	providing insights into how to best leverage cutting-edge technology and big data analytics to optimize the coffee supply chain at every stage.	analyses the development of ten technologies to determine how logistics 4.0 might affect agricultural systems in a way that helps achieve SDGs.	risks associated with interruptions in agricultural supply chains (ASC) were identified and evaluated.	evaluate the ecological footprint of GMO and conventionally grown foods in order to draw conclusions on which is more sustainable.	Provides a public blockchain for the agricultural supply chain by investigating dual chain architectures, storage modes, rent seeking mechanisms, and consensus algorithms.	to verify AI's effect on reducing supply chain risks and investigate the elements that determine its adoption.	to quantify the 'emission intensity' of India's 15 most developed industrial and agricultural sectors.	uses a Technology-Organization-Environment (TOE) paradigm to examine the factors influencing the implementation of IoT in China's agriculture supply chain.
Method	Review	Model setting	Review	Review	Interviews	Qualitative and Quantitative	Structured Data	Interview	Secondary data	Questionnaire

Result	The findings offer novel perspectives on how to address important difficulties in the agro-food industry and boost performance as a result. In addition, a strategy for introducing IoT in developing countries is laid forth in this research.	It's noteworthy to note that blockchain encourages the retailer to depend more on supplier B, who offers high-quality goods, even while supplier A would still receive orders from the store.	The study found that a number of innovative technologies, such as wireless sensor networks, cloud computing, image processing, the Internet of Things (IoT), convolutional neural networks (CNN), and remote sensing, might be used to enhance the coffee supply chain.	The findings highlight how these technologies are utilized within agricultural systems and their potential effects.	Several factors influence ASC, including supply risks, demand risks, financial risks, logistical risk, operational risk, policy risk and regulatory risk, biological risk and the size of the organization.	According to the study's findings, non-GMO rice performs better than GMO rice.	The study shows that an agricultural supply chain with two chains is open, secure, and private, and can match resources and rent seekers automatically, thus improving the efficiency of the system and the reliability of the public service platform.	This study shows how process variables, information sharing, and supply chain integration (SCI) affect AI adoption and how AI has positive impacts on supply chain relationship management (SCRM).	The study found that after a certain threshold, technological adoption helped lower emission intensity across industries.	According to the findings, internal resistance and doubts play little to no role in determining whether or not an organization will adopt the IoT.

Recommendation	New strategies/policies for the efficient adoption of IoT in the agri-food industry can be developed with the help of this paper, which offers guidance to agri-food management, IoT service providers, and the Government.	There is a gap in this paper where the output unpredictability of agricultural goods might be explored.	The usage of big data applications led to greater effectiveness in meeting client demands and running the business.	Farmers need financial support to develop and implement logistics 4.0 technology.	Sustainable futures can be achieved through a number of suggested initiatives, including the implementation of industry 4.0 technology, supply chain collaboration, and shared accountability.	The results of this study will continue to shape how GMO products are used in Indonesia in the future.	A simulation experiment environment established for this study ignores many realistic factors, such as carbon emissions and refrigerated vehicle depreciation.	The sample size of the AI data study can be enlarged so that more general conclusions can be drawn.	to incorporate firm-level data and future extensions of in-depth techniques like IDA and SDA.	If the product's promoters are aware of the potential drawbacks, they can work to lessen their impact by making changes to the product's design.

Years of publication

It is important to note that there has been a considerable increase in the number of articles published each year with regard to the publication timeline. 191 articles were published in total in 2022, compared to 171 articles in 2021 and 115 pieces in 2020. With 68 articles published in 2019, 47 articles in both 2018 and 2016, and the lowest publishing rate seen in 2017 with 40 articles, the trend is still going strong. The data, as shown in Figure 2, unmistakably shows an increase in the number of publications produced each year.

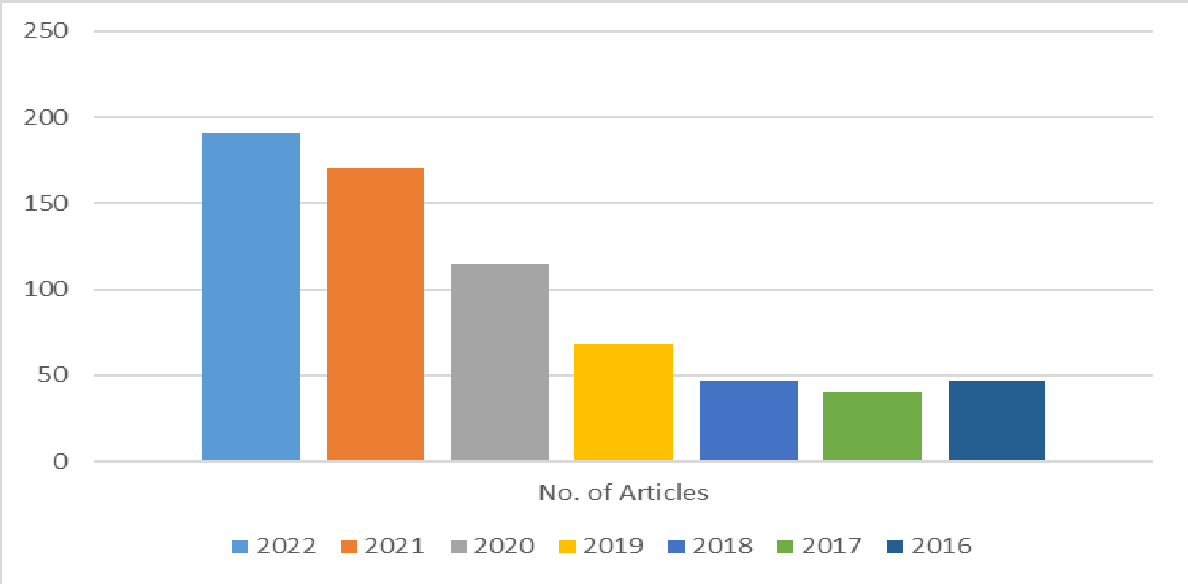

Fig.2: year of publication

A complex network of links moves food and other agricultural goods throughout the economy through the agricultural supply chain. Commercial agricultural resources play a crucial role in ensuring that farmers can keep up with demand for their goods while also preserving their quality and safety (Umirzakov et al., 2019).

Supply chain management in agriculture is a growing field of research. These studies examined a wide variety of topics related to agricultural supply chains, including supply chain disruption (Tong, 2017), food and agricultural product quality and safety (Padjung, 2018; Rum et al., 2019), supply chain evaluation (Karunanayaka et al., 2020; Kumarathunga, 2020), and more general supply chain problems (Kittichotsatsawat et al., 2021). However, little research has been done to determine how to best utilize new technology to enhance agricultural output. Researching the uptake of emerging technologies in the agricultural supply chain is important because they might improve efficiency in many ways. Internet of Things (IoT) technology, which is made up of embedded gadgets (things) that can connect to the Internet, could be a key way to boost production and improve services. RFID is a key foundation technology for IoT applications, so many experts have looked into how well it works in the supply chain (Candido et al., 2016; Narwane et al., 2022).

The widespread implementation of new technology in the agricultural supply chain has been a major driver of recent shifts in this sector. A large body of prior research (Leng et al., 2018), has argued that the degree to which farmers adopt new technologies is a major factor in supply chain efficiency. Farmers can now make data-driven decisions due to technological solutions like precision agriculture, satellite imaging, and GPS-enabled gear (Majumdar & Kar, 2017; Abdullahi et al., 2021). Smart devices and IoT (Internet of Things) sensors in farming operations have allowed for real-time monitoring of crop health, weather conditions, and soil moisture, resulting in improved decision-making at all stages of the supply chain (Lin et al., 2016; Mohamud et al., 2023).

Furthermore, smart farming technologies were crucial in meeting the rising demand for organic agriculture products (Kittichotsatsawat et al., 2021). Both consumer and farmer health would benefit from the deployment of these technologies, which might help regulate and limit the application of pesticides, antibiotics, and synthetic chemical fertilizers. As stated by Padjung, (2018), big data has the potential to improve the economic model of the agriculture industry and thus become the cutting-edge agricultural technology of the future.

The advent of technology has empowered stakeholders to ensure greater traceability and transparency across the agricultural supply chain. For example, blockchain technology is seen as revolutionary in this respect (Eluubek kyzy et al., 2021; Abdullahi et al., 2023). Trust and accountability in the supply chain are bolstered by blockchain's immutable and decentralized ledger, allowing for safe record-keeping of each transaction. According to studies, food fraud can be reduced and the authenticity of where products come from can be improved with the use of blockchain technology (Niu et al., 2021).

Effective logistics and transportation depend on timely delivery of agricultural products and the reduction of post-harvest losses. Fleet management systems, route optimization software, and real-time tracking are just a few examples of technological advancements that have streamlined transportation (Nayal et al., 2022). Better coordination, shorter transit times, and optimal vehicle capacity utilization are all made possible by these technologies, eventually leading to cost savings and less environmental effect (Karunanayaka et al., 2020).

Technology has made it possible for small farmers to sell their goods to a bigger range of customers through e-commerce sites. Researchers have shown (Orjuela et al., 2021), that digital marketplaces can give farmers more bargaining power and direct access to end customers, cutting out intermediaries and their costs. Also, online sites give farmers access to useful market information, which helps them find prices and learn more about the market (Khan et al., 2020).

Previous researchers (Majumdar & Kar, 2017; Niu et al., 2021) have acknowledged the transformative potential of technology in agricultural supply chain management; however, their works frequently exhibit certain limitations that necessitate a more critical examination. Despite the fact that numerous studies emphasise the positive effects of technology adoption, they frequently lack a nuanced examination of the contextual factors that may influence the effectiveness of these innovations. For instance, the applicability of certain technologies may vary across regions with distinct infrastructural, cultural, and economic landscapes, thereby rendering the proposed solutions less universal than originally portrayed.

Moreover, some of the reviewed articles emphasize technology's benefits without sufficiently exploring its potential drawbacks and implementation challenges. While innovations such as digital platforms and data analytics unquestionably improve transparency and traceability, they may also exacerbate the digital divide, marginalizing small-scale farmers and other stakeholders with limited resources (Amr & Elkader, 2020; Narwane et al., 2022). In addition, the complexity of integrating diverse technologies into existing supply chain structures is frequently discussed relatively superficially. The actual integration process may involve significant costs, technical complexities, and opposition from various stakeholders, which could impede the realization of the anticipated benefits (Amr & Elkader, 2020; Narwane et al., 2022).

4. Conclusion

There is no doubt that technology has played a crucial role in enhancing the agricultural supply chain management and it also facilitates the value chain operations, transparency, traceability, and sustainability of agricultural supply chain process. Moreover, the implementations of technology in agriculture industry have changed the traditional agricultural supply chain practices by utilizing advanced technology such as IoT, data analytics, Blockchain technology, and other technological innovations.

According to the review, it was found that Technology has been very useful for agricultural supply chain operation. For instance, IOT devices allow farmers to track and trace the movement of agricultural products. It also permits monitoring storage conditions to ensure product quality and safety. As a result of this, inventory management is improved, deliveries are made on time, and traceability is improved throughout the supply chain.

Meanwhile, blockchain has contributed to the improvement of agricultural supply chain operations. Blockchain provides a decentralized and transparent ledger system that enables the secure recording and verification of transactions throughout a supply chain. The traceability and transparency of agricultural products can be improved through this technology, ensuring food safety and quality. Thus, blockchain technology has potential transformation to the agricultural supply chain and enhanced agriculture supply chain operations' sustainability, productivity, and efficiency.

Furthermore, the adoption of technology has brought the agricultural stakeholders to enhance their decision by using data analytics. This allows to improve forecasting of demand and supply and enables to optimize production, reduce waste, and ensure timely delivery of agricultural products. In addition to that, digital platforms and online marketplaces have created more transparency in the supply chain and facilitated direct communication between farmers and consumers. Hence, technological innovation has improved the overall efficiency of agricultural supply chain and sustainable operation in the industry. In a nutshell, technology has significantly transformed agricultural supply chain management by enhancing transparency, traceability, productivity, sustainability, and efficiency of agricultural products.

Researchers could investigate the dynamic interactions between emergent technologies and their collective impact on agricultural supply chain management to gain a deeper understanding of the potential of technology-driven transformations. Examining the scalability and adaptability of these technologies in diverse agricultural contexts and regions could shed light on the potential challenges and opportunities confronted by various stakeholders. As the agricultural sector continues to struggle with food security, climate change, and resource constraints, future research may also investigate how innovations in the supply chain facilitated by technology can contribute to mitigating these issues.

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