

Transformation Digital Supply Chain Management in Agriculture: A Systematic Literature Review

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Abstract

Regardless of the times that are increasingly growing and developing. The transformation of farming activities also needs to be adjusted. What is usually called digital transformation combined with supply chain management. This paper aims to look at recent knowledge trends and development strategies in supply chain activities in agriculture. The writing method uses *Systematic Literature Review* (SLR), bibliometric analysis, and *crucial route main path analysis*. The results of this research show that there is an emerging knowledge trend regarding digital transformation in agriculture. Hopefully, this research can become a reference for scholars, academics and agribusiness practitioners in developing agriculture in Indonesia as a form of Sustainable Development Goals (SDGs) 2030, one of which is alleviating poverty among farmers. Then, it can become a recommendation and evaluation for all marketing channels in the management supply chain, especially farmers and companies and become a reference for the government in determining policies that lead to farmer welfare.

Keywords: supply chain management, supply chain, digital transformation, agriculture

1. Introduction

The world population is increasing; by 2050, it is estimated that the world population will grow by 10 billion. Indonesia is one of the countries that dominate the population in Southeast Asia, with a growth of 1.17 per cent in 2022 (BPS, 2022). Therefore, there is a need for sufficient food availability for human survival. Food is produced from agricultural products with a long food supply chain, but the problem is frequent disruptions in product distribution. To avoid various issues in the supply chain, such as the unavailability of products in outlets or the occurrence of production excesses and shortages, one of which is caused by information not conveyed from one network to another in the supply chain. This problem can be resolved by using digitalization in the supply chain. The increasingly rapid technological progress can be a solution for agribusiness actors, so they need to adapt to rapid technological changes to gain a sustainable competitive advantage in the future (Fearne 2002).

This paper will evaluate the role of digital transformation in the agricultural supply chain and whether it is necessary to carry out digital transformation in the agricultural supply chain. Apart from that, this paper also not only discusses AI but also several other technologies that can be used in the supply chain, such as machines, blockchain, IoT, and more. We conducted a bibliometric and critical route analysis to examine knowledge surrounding the digital transformation of supply chains in agriculture. Thus, this research provides significant insight

to academics and business practitioners in deciding on appropriate and sustainable supply chain management designs. The study also reveals the most influential papers, authors, sources and countries by identifying and presenting the current status, research gaps, and future research directions this research can contribute to academia and industry.

2. Literature Review

Digitalization of the value chain has changed the agricultural business (Kamilaris *et al*, 2019). Such as developing flexibility for manufacturing by prioritizing digitalization so that it can reduce costs, sustainability, and flexibility, and companies will be quicker to realize when severe market disruptions such as the COVID-19 pandemic occur (mantravadi *et al*. 2023). In addition, the use of technology such as blockchain is very safe in the supply chain because, in this process every individual is connected to the network and information, so it can be easily shared in a faster mode because this new technology has the prospect of overcoming obstacles in transactions and improving data management (Khan *et al*. al 2022). Apart from that, agricultural products have easily damaged characteristics, so care needs to be taken in supply chain management by combining it with the role of technology.

The existence of digital transformation also has an impact on companies' ability to survive longer and the increasing interest in using digital technology for agricultural supply chains related to food integrity, transparency, and traceability (Rejeb *et al*, 2021). Digital transformation also promises increased sustainability in manufacturing and has also begun to change some processes in manufacturing itself to make it more sustainable (Moghrabi *et al*, 2022).

3. Research Method

The method used is *Systematic Literature Review* (SLR), which uses bibliometric analysis and *key route primary path analysis*. *Bibliometric reviews* are a systematic analysis tool that helps researchers determine the most influential authors, affiliations, selected keywords, and relationships between works (Aria M *et al* 2017). Using bibliometrics is appropriate for investigating current trends in a particular research field using various indicators, including influential authors, journals, countries, and academic institutions. The data taken was from the Scopus database on the date with the initial data collection process using the keyword Digital Supply Chain Agriculture; 312 searches were found, and 10 articles were retrieved. The second search using the keywords Digital, Supply Chain, and transformation found 1038 searches and retrieved 12 articles. The third search for Digital, Supply Chain, and Agriculture transformation found 57 out of 57 journals using the criteria for the year range (period) 2020-2023 and document type article. Then, we took 17 open-access articles. This selection was chosen to describe current knowledge trends. The total number of articles selected was 42 out of 1407 articles. The visual tool chosen to generate this network is VOSviewer. Density is used to measure the strength of association between keywords. In VOSviewer, VOS mapping allows researchers to obtain a map of keyword nodes and the distance between each pair of keywords based on density.

4. Finding and Discussion

Descriptive Statistics Results. Descriptive statistical results are based on bibliometric analysis by looking at publications by year, country, journal, institution, keywords.

Publications by Year

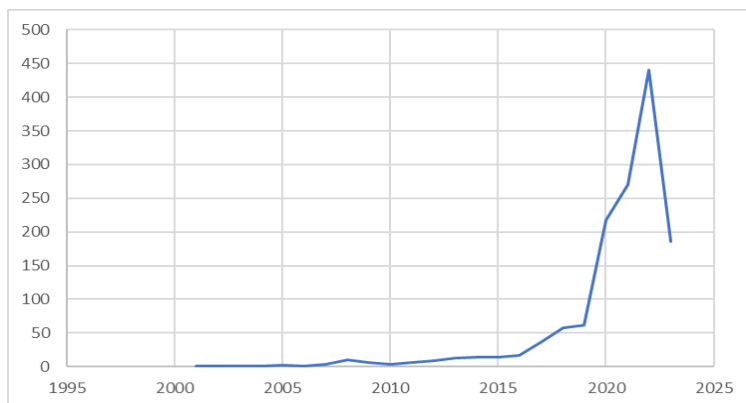


Figure 1. Publications by year

Figure 1 shows that the research trend regarding digital transformation began in 2001. Moreover, experienced a constant trend in the first two decades, namely (2001-2004). Then the trend began to experience an exponential increase because it increased rapidly from (2004-2022) and then decreased in (2022-2023) but there is still much research on this topic, with 186 journals published on Scopus.

Publications by Country

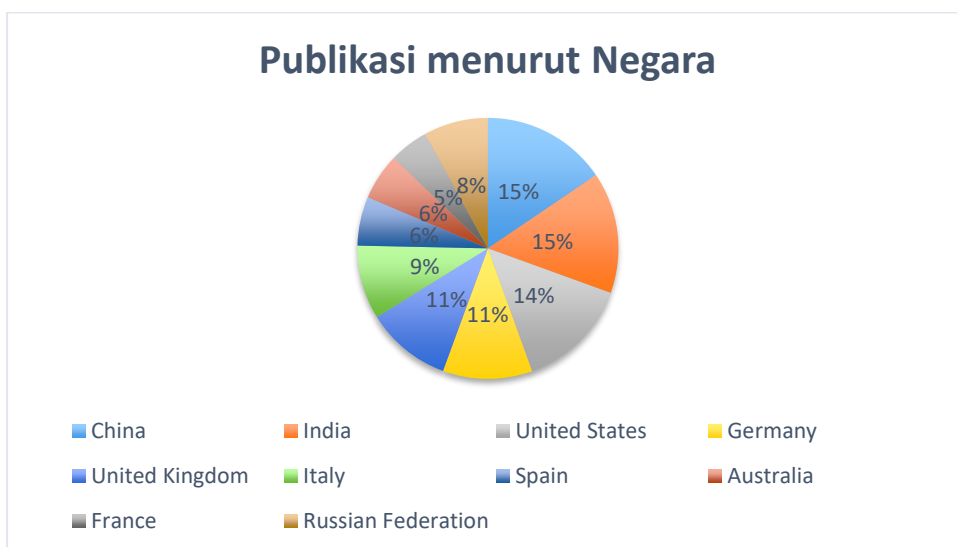


Figure 2. Top 10 most relevant countries

Figure 2 shows that the topic of digital supply chain has been carried out in various countries. The most countries where it has been published come from China (161) followed by India (156), United States (145), Germany (115) and United Kingdom (110). It can be seen that developed countries dominate more than developing countries. However, as a developing country, India is already discussing digital transformation in agriculture. In Indonesia, there has not been much research on digital supply chains in agriculture, so it needs to be a reference topic for academics.

Publications According to Journals

Table 1. Top 14 Most Relevant Journals

Journal	Number of Publications
Sustainability Switzerland	50
Lecture Notes in Network systems	28
IFIP Advances in Information and Communication Technology	26
Lecture Notes In Mechanical Engineering	18
ACM International Conference Proceeding Series	19
Proceedings Of The Annual Hawaii International Conference On System Sciences	15
International Journal Of Supply Chain Management	13
IEEE Transactions On Engineering Management	12
Journal Of Cleaner Production	10
International Journal Of Operations And Production Management	9
E3s Web Of Conferences	9
Sustainability Switzerland	3
Agricultural Systems	2
IFIP Advances In Information And Communication Technology	2
IFIP Advances in Information and Communication Technology	26

The table above shows that the topic of *digital supply chains* in agriculture was published in 216 journals (15 %) out of the 1407 samples we selected. Sustainability Switzerland occupies the top journal with 50, followed by Lecture Notes in Network Systems with 28 and IFIP Advances in Information and Communication Technology.

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Publications by institution

Table 2. Top 20 most relevant institutions

Institution	Number of Publications
Peter the Great St. Petersburg Polytechnic University	16
Friedrich-Alexander-Universität Erlangen-Nürnberg	13
Norges Teknisk-Naturvitenskapelige Universitet	10
Russian Academy of Sciences	10
Politecnico di Milano	10
Hochschule für Wirtschaft und Recht Berlin	9
LUT University	8
University of Cambridge	8
OFU Bamberg	7
CNRS Centre National de la Recherche Scientifique	7
University of Guelph	5
CSIRO Data61	5
Queensland University of Technology	4
SRM Institute of Science and Technology	4
Murdoch University	4
Kansas State University	3
University of Illinois Urbana-Champaign	3
Wageningen University & Research	3

Institution	Number of Publications
Dr. B.R. Ambedkar National Institute of Technology	3
Fudan University	3

Table 2 shows that the affiliates who contributed the most to the topic of digital supply chain transformation in agriculture were Peter the Great St. Petersburg Polytechnic University with 16, followed by Friedrich-Alexander-Universität Erlangen-Nürnberg with 13 and followed by Norges Teknisk-Naturvitenskapelige Universitet, Russian Academy of Sciences and Politecnico di Milano are 10. Most of the affiliates are from developed countries. This means there is still not much Research and Development (R&D) on this topic in developing countries. Lack of adequate cooperation coordination cooperation coordination between countries, especially between scholars from developing and developed countries. The lack of technological and infrastructure resources may be another reason for the digital divide between these countries.

Table 3. Top 15 most relevant keywords

Keywords	Frequency
Digital Transformation	425
Supply Chains	371
Supply Chain Management	219
Industry 4.0	169
Supply Chain	122
Blockchain	114
Digital Technologies	81
Metadata	75
Digitalization	73
Sustainability	71
Agriculture	156
Food supply	12
Internet Of Things	9
Sustainable Development	9
Sustainability	8

Keyword frequency analysis determines research hotspots and development trends based on the number of keyword occurrences (Fu H et al 2014). Usually, keywords are created based on the essence of the published article. So it becomes a reference for scholars to see development trends to determine research topics. Table 3 shows that the 15 keywords most frequently used by researchers from Due to increasing consumer awareness and higher resource consumption, food industry stakeholders must achieve sustainable consumption and production by coordinating and optimizing their food supply chain operations (Govindan K 2018). The

integration of sustainability and FSC is a growing research field that has given rise to new methods and practices in managing food systems over the last decades (Bernardi DPD et al 2019). Then we looked at which keywords were relevant and frequently appeared from the journals that had been selected based on the third disbursement. The reason is to make it easier for researchers to see what trends are currently occurring in the keyword digital supply chain transformation in agriculture. Assisted with VOS viewer. VOS viewer can show citation analysis, namely by describing performance and recency. This analysis aims to find out how often a publication is cited by other publications and can measure how much influence the publication has on its field.

VOS Viewer Results

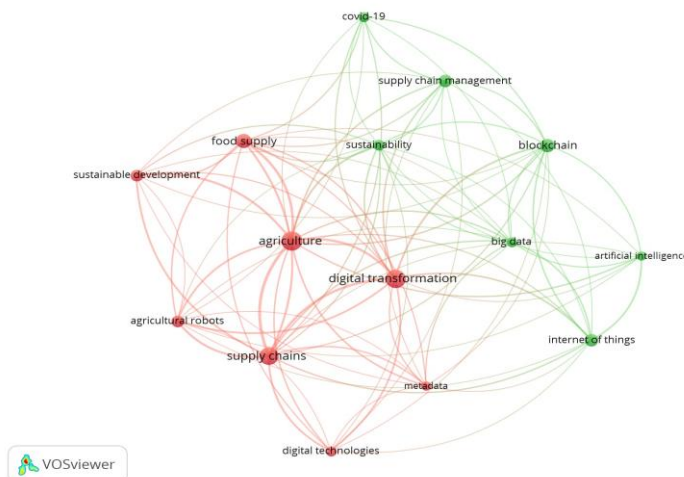


Figure 3. Vos viewer results

Vos Viewer results image from the third search journal, the most influential keywords were obtained, namely 2 colors, red: digital transformation, agriculture, supply chains, food supply, sustainable development, agricultural robots, digital technology, metadata and green: covid 19, supply chain management, sustainability, big data, internet of things, artificial intelligence. This word has become a trend in the world of agricultural digital transformation. So from here we can describe the role of digital transformation in the agricultural supply chain with descriptive analysis with the journals we chose from these keywords.

Study of Digital Transformation in Agricultural Supply Chains. Supply chain professionals realize that digital transformation is not just focused on cutting costs but creating new processes that make it faster and more connected to create value across the enterprise. In this internet era, speed is very important because the life cycle of a product is becoming shorter because production and distribution are spread globally (Kwon *et al* 2021). Of course, the implementation of digital transformation must be in line with business goals. The key factors for the success of digital workplace transformation are grouped into three basic categories, namely 1) organizational factors, starting from having the right vision

and strategy through organizational culture and leadership that supports the digital transformation process. 2) team or group factors, namely the readiness of the team or group to accept the "new normal" in the transition from traditional to digital workplaces. 3) individual factors, namely knowledge of skill levels, on changes in the transition from traditional to digital workplaces (Micic and Mastillo 2022). Knowledge acquisition activities (creation and transfer) are the most significant factors influencing the increased use of digital technology in Saudi SMEs (Rasool *et al* 2023). The supply chain is believed to have an important role in encouraging the adoption of Agriculture 4.0 technology carried out in business-to-business (B2B) and business-to-consumer (B2C) relationships. Therefore, it is necessary to respond to "customers" who require guarantees of "behavior in business activities greater sustainability. Innovation in response to modern consumer needs is a substantial lever of age in promoting this process. The more this process is dominated by contractual relationships (supply chain relationships), the greater the need for digital transformation (Scuderi *et al* 2022).

Digital technologies such as sensors, drones, satellites, climate-smart agriculture and blockchain are promising developments for global cocoa and commodity supply chains (Quayso *et al* 2020). In the era of the digital economy, if you want to develop the agricultural business economy better, you must first analyze the problems in developing the digital agricultural economy and improve the integrated development guarantee system for the digital economy and the agricultural economy. Second, the digital transformation of traditional industry is realized with digital technology, so that it can realize effective digital economic development in the green economy of agricultural businesses. Finally, realizing the digital transformation of the agricultural green economy industry (Hu *et al* 2021).

There are four types of technology adoption. The first type of adoption is called supplier dominance. At this stage, farmers are customers of digital technology suppliers. They buy technology in anticipation of profits, especially from efficiency gains. The second type of adoption is the scale-intensive adopter, where those in the food system such as bulk handlers or fertilizer producers derive value from scale. These organizations are highly vertically integrated and adopt digital technologies to improve processes up and down the value chain to support efficiency gains, purchasing power or marketing. The third type of adoption of digital agricultural development is specialist suppliers. At this stage, companies derive value from digital technologies by embedding them into agricultural machinery or into other specialized inputs such as agrochemicals or germplasm, which they then sell to farmers or other parties in the food system. Digitally enhanced products or services command higher prices based on the superior performance enabled by the technology embedded within them. The fourth type of adoption is called science-based adoption. It develops technological applications based on a strong public science base, fostered through strong concentric integration between actors in the agricultural system (Cook and Cammarano 2023).

Apart from having a good function and impact in the supply chain, as (Rasool *et al* 2022) said, the introduction of digitalization will pose several challenges for implementing companies during the implementation process and even before starting the process. Such as implementation costs, low awareness of benefits, distrust, and technical difficulties (

Quayson *et al* 2020). (Zscheischler *et al* 2022) stated that stakeholders also identified four areas where there were four unintentional side effects that created risks and vulnerabilities that were felt as a consequence of the major changes brought about by digital transformation in the agricultural sector, namely:

1. Impacts on agroecology , such as reductions in biodiversity, negative impacts on soil structure, negative impacts on resources, and unfavorable changes to established cultural landscapes.
2. Data rights and market concentration, various parties predict that digitalization in food will lead to accelerated structural changes in agricultural production, processing and trade. The competitive advantage of having access to large amounts of data across the food system enables new value creation potential and collaboration , but the accelerated formation of oligopolies and monopolies must also be considered critically.
3. Changes in knowledge and decision-making competence through digitalization, where digitalization and the gradual use of digital farming models (eg twin) change the farmer's skill profile. Potential risks and limitations in farmers' decision-making competence arise along with the many steps taken by external parties in the digital production chain.
4. Food security, unintended consequences of digitalization (unseen) may result from information asymmetries, false prices and market signals, lack of internalization of (environmental) costs, and new opportunities for genetic manipulation.

In the supply chain institutional actions can minimize challenges, reduce barriers to adoption, and increase sustainability and ultimately support digitalization technologies (Quayson *et al* 2020). The above barriers, where companies implementing reverse logistics are in a better position to face obstacles that hinder and engage in digitalization activities, include initial costs which are reported as one of the biggest obstacles to digitalization (Rasool *et al* 2023). The supply chain system involves various networks to carry out the production and transportation process from origin to consumer , so that to get the product into the consumer's hands properly, traceability is necessary . The traceability process consists of three smart contracts, namely Registration Contract (RC), Add to Lot Contract (ALC) and Add Transaction Contract (ATC). These contracts require the address of each previous contract to maintain traceability of the transaction chain. For this purpose, all three contracts are deployed to obtain their respective addresses. In this way, the solution helps end consumers to achieve complete traceability and maintain data provenance (Shahid *et al* 2016).

Several technologies including digital, blockchain, and the internet of things can provide real-time tracking and visibility to improve supply chain resilience, sustainability, and responsiveness. Additionally map and view the entire value chain and take appropriate actions to increase agility, sustainability and collaboration between supply chain players to secure the supply chain in case of risks (Cherrafi *et al* 2022). According to Brohm and Klein (2019), marketing-oriented corporate social responsibility with sustainability in climate-smart

agricultural production processes can be achieved through innovation and technology. Through this technology, product transparency, tracking of the entire supply chain, and traceability will be ensured throughout the process from manufacturer to end user. The high share of offline stores characterizes the low representation of digital innovation well in studying stores. The direction of development can be found in the expansion of "Basic" tools, while the implementation of "Marketing" tools such as Twitter, YouTube, or the Sign-up function on websites is not used at all (Csordas *et al* 2022).

Companies that adopt reverse logistics tend to have higher levels of digitalization and collaboration than companies that do not adopt reverse logistics (Brohm and Klein 2019). The transportation and logistics stages need to be considered critical for all industries (Rasool *et al* 2023). Blockchain technology makes decentralized information networks safer, more accessible, and more fun. With a smart model, the food supply chain will be more efficient and reliable. Blockchain technology makes supply chain management more efficient and transparent. We provide cutting-edge blockchain technology to optimize traditional supply networks. Because smart contracts eliminate the need for intermediaries, multi-agent systems manage the entire supply chain. Every supply chain can be secured and optimized by our automated systems. We protect agriculture using blockchain technology (Adow *et al* 2022). The technical requirements for the adoption of blockchain and related technologies relate to several categories of the ISM model, namely planning, infrastructure acceptance, and buy-in from external stakeholders (Heim and Hopper 2022).

Like organic crops with a short shelf life, the production process is oriented towards maintaining freshness, so the production of fresh food for final consumption requires a short supply chain. So the successful implementation of strategies for the development of sustainable organic production, however, is less fruitful without the targeted use of digital technologies (Nesterenko *et al* 2020). Participants in the supply chain can access data recorded on the processor's blockchain, blockchain technology has the potential to help the agricultural industry significantly. The use of blockchain technology in agriculture can lead to increased trust among stakeholders, more efficient information sharing, and cheaper transaction costs (Adow *et al* 2022). Blockchain's economic value lies in saving, not making money (Heim and Hopper 2022).

As with the COVID-19 pandemic, it has affected all sectors and human activities throughout the world. So it also impacts all types of agriculture, namely corporate agricultural production systems, to small and medium scale entrepreneurs and small farming households, by various measures implemented by the government such as reducing mobility, closing public and private places and restrictions at borders. Larger corporate farming systems with vertical market integration and a high degree of control or coordination in supply chains, and small or subsistence farming systems with a significant focus on production for own consumption and little use of external inputs, are both relatively less affected and show adaptability compared to medium and small enterprise farming systems that depend on agriculture as their primary income and with less control over the upstream and downstream parts of their supply chains.

The importance of digital technology in dealing with the COVID-19 outbreak. Intelligent supply chain demand planning and forecasting tools have helped our organization detect supply risks and can take preventive action by working with suppliers to ensure a wide range of products for daily needs. Additionally can have acceptable supply chain control and visibility by identifying past and current product locations, delivery dates from suppliers as well as supplier manufacturing programs and status. These tools have helped inform supply networks and move inventory from regional distribution centers to local warehouses closer to customers (Cherrafi *et al* 2022).

Leveraging technology for managers, policy makers and governments to collaborate in developing effective infrastructure. Through the integration of industry 4.0 technologies such as blockchain it can lead to the creation of environmentally friendly and innovative products in the food industry (Ada *et al* 2023). The digital transformation of enterprises in the supply chain is mainly to realize data sharing at the end of the supply chain, reduce non-value-added activities at the end of the supply chain, and realize the value creation of the entire industrial chain (Yang and Cui, 2022). In the supply chain, especially on the sales side, increasing online sales, greatly reducing the proportion of sales staff, and strengthening receivables management, reducing receivables turnover days and multi-year receivables e transfer management can improve sales efficiency and increase enterprise value (Yang and Cui, 2022).

From the perspective of a market participant micro company, digital transformation is a process. In the early stages of transformation, the driving effects of digitalization on business performance are not yet clear. As the maturity of digital transformation increases, digitalization will be realized throughout the company's production, operations and management value chains. After transformation, the cost reduction and efficiency improvement of enterprises will be more obvious (Yang and Cui, 2022). Thus, using smart farming on farms can increase crop yields and ease overall operations. Smart farming uses sensors that measure soil moisture, fertilizer concentration, and enable farmers to make better decisions regarding irrigation and fertilizer application (Ibrahim *et al* 2020).

Digital empowerment of all aspects of the enterprise, while reducing costs and increasing efficiency, strengthens the enterprise's response to internal and external uncertainty risks (Yang and Cui, 2022). The application of smart agriculture such as smart farming combined with IoT technology for the classification of cocoa beans as a basis for processing to achieve the best results in finished products with data stored in the cloud can also be used by processing factories to solve operational management problems (Adhitya *et al* 2020). IoT is used to model data collection and monitoring by means of intelligent automated computing (Ibrahim *et al* 2020). With the digital economy green supply chains can be hierarchical management of suppliers to maximize supplier collaboration capabilities; appropriate production plans to increase the ability to respond quickly to customers; inventory reduction and use of green energy saving concepts, reducing inventory; intelligent production automation, improving the technical competitiveness and production coordination ability of agricultural enterprises; optimize logistics management, explore new logistics models from

traditional logistics models; embed digital intelligent systems, and make intelligent business decisions (Hu *et al* 2021).

Digital innovation is a strategic lever capable of guaranteeing greater competitiveness for the entire supply chain, from production in the field to distribution and food processing. The first prerequisite for seeing digital transformation in the primary sector is to see this process as an extended supply chain that starts in the field and arrives at the shelf, or more generally, at the point of contact with the consumer, according to the Industry 4.0 paradigm (Scuderi *et al* 2022). The existence of digital transformation has an impact on companies being able to survive longer and increases interest in using digital technology for agricultural supply chains related to food integrity, transparency and traceability . With digital transformation , we can also handle disruptions that occur in the supply chain, such as information not being conveyed, product unavailability in outlets, delays in delivery, damage to products before they reach consumers . Digital transformation also not only promises greater sustainability in manufacturing, but has begun to change some processes in manufacturing itself to make them more sustainable.

Digital transformation in sustainability also states that there can be businesses that support green practices. Because it can have an effect from BT, IoT and BDA on SSCM and become a problem that companies must face. Many companies have been planning since 2013 to transform their supply chains into green supply chains, due to strict regulations from the UN and EU as well as public awareness (Zhu, Q et all 2013). It cannot be denied that economic and environmental sustainability receive the most excellent attention in literature and practice from academics and companies, while social sustainability receives less attention (Mani V 2016). This is unfortunate because the three pillars of sustainable development must be examined to create a truly sustainable organization or company (Seuring S 2008).

Another pillar of sustainable development is the economic pillar. According to the economic pillar, SSCM tries to make supply chains cheaper and more efficient while ensuring they do not harm the natural environment and social groups (Pagell, M 2014). Research conducted by Curkovic and Sroufe 2011 found that the goal of a sustainable supply chain is to avoid the negative impact of goods on the environment. Research on the environmental pillar of SSCM (green supply chain management) should, as a goal, adopt environmental policies into supply chain operations, such as product design, supplier selection, operations, and transportation, as well as end-of-life. Combining new technologies and sustainable practices can improve a company's social, economic and environmental performance.

5. Conclusion

The supply chain is important in managing agribusiness farming; more planned and structured management will make farming activities more profitable, especially when adopting technology. Digital transformation is a process of adoption that moves towards changes in the industrial revolution. Digitalization is helpful for reducing costs, increasing company efficiency, and strengthening company responses to internal and external uncertainty risks. Enterprise digital transformation in the supply chain aims to realize data sharing, reduce non-

value-added activities at the end of the supply chain, and realize value creation of the entire industrial chain

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