Digitalization and Management Innovation
A.J. Tallón-Ballesteros and P. Santana-Morales (Eds.)

doi:10.3233/FAIA230038

A Review of Research on the Impact of Digitalization on Agricultural Supply Chain Security

Haishui JIN [a] and Yining XIE [a,1]
[a] *Business School, Beijing Wuzi University, Beijing, 101149, China*

Abstract. The safety of agricultural products is a fundamental guarantee of people's lives. Advances in technology and policy support have led to a steady rise in agricultural production, and the problems at the production end of agricultural products have been solved. However, there are problems in three aspects of China's agricultural supply chain: information flow, food safety supervision, and supply chain risk monitoring and control. The application of information technology and digitalization has alleviated the problems in the above three aspects of China's agricultural supply chain and enhanced the security of the supply chain, but it has also brought new risks. In-depth solutions to the problems of the agricultural supply chain and further improvement of supply chain security need to rely on the continuous and in-depth promotion of digital technology.

Keywords. Digitalization, Agricultural Supply Chain, Supply Chain Security

1. Introduction

Digitization refers to the systematic and comprehensive transformation of the strategy, structure, operation, management, production and marketing of enterprises, governments and other types of entities at all levels through the use of new generation information technology such as the Internet, big data and artificial intelligence. With the rise and development of the information revolution, information technology and digitalization are gradually taking a leading role in innovation-driven development strategies. Supply chain security refers to the application of procedures, systems, rules, technologies and solutions in dealing with supply chain-related risks to ensure an orderly and healthy society, high economic development and quality of life for citizens. Under the leadership of the new development concept, China's economic development has entered a new normal. In the face of the current situation of China's agriculture, ensuring the safety and stability of the agricultural industry chain and supply chain plays a crucial role in boosting the agricultural economy. The supply chain of agricultural products in China is very fragile, and there are various security risks. The solution to the supply chain security of agricultural products needs to rely on digital technology.

In order to further meet people's growing demand for a better life, ensure the stability and safety of the agricultural product supply chain and minimising the impact of the COVID-19 outbreak on the agricultural supply chain, it is necessary to implement digital

[1] Corresponding Author: Yining XIE, Business School, Beijing Wuzi University, Beijing, China. Master's Degree, Research Direction: Supply Chain Management. E-mail: nining7770905@163.com.

technology in all aspects of the agricultural product supply chain, speed up the implementation of digital transformation and upgrading of the entire process of the agricultural product supply chain from producers to wholesalers and end retailers, and deepen the further application of digital technology in production testing, risk monitoring, emergency prevention and control.

On the whole, digital technology has significantly impacted the security of the agricultural supply chain, including both beneficial effects and security risks, but the benefits far outweigh the disadvantages. The further promotion and optimisation of digital technology in the agricultural supply chain are of great significance in further enhancing the safety of the agricultural supply chain and reducing the risk of various safety hazards occurring in the agricultural supply chain.

2. Review of the literature

2.1 Digitalization and information transfer in the agricultural supply chain

Information sharing is an essential part of China's agricultural supply chain security, and scholars have conducted much research on this, Liu et al. (2021) studied the formation of an integrated system of fresh agricultural products supply chain, taking Yonghui Supermarket as an example, and used big data to forecast the quantity of consumer demand, and coordinated the resources of the entire fresh agricultural products supply chain with the results of the predicted information data, which led to a significant improvement in the response speed and transportation efficiency of the agricultural products supply chain system[1]; Huang (2022) pointed out that there are currently problems such as disconnection between production and sales, imbalance between supply and demand, and low operational efficiency of agricultural supply chain in the process of circulation of agricultural products in China, and used the supply chain maturity model to evaluate the best path for digitalization of information exchange in the agricultural supply chain in China[2]; Jin et al (2022) emphasized the strong correlation between information transparency and the construction of stable and efficient agricultural supply chain, and emphasized the strong correlation between information transparency and the construction of stable and efficient agricultural supply chains, and proposed an agricultural supply chain information collaboration model based on "blockchain + platform" to solve the problems of information silos and false information in agricultural supply chains[3]; Zhao et al. (2022) pointed out that the supply chain of agricultural products can be precisely marketed through digital technology, thus helping suppliers to deliver products to consumers accurately[4]; Zhang et al. (2022) built a "cloud" based cloud platform framework for new agricultural products logistics services in the post-epidemic era, and on this basis, analyzed the information flow of the fresh agricultural products logistics services supply chain in the post-epidemic period[5]; Du (2022) pointed out that building an information platform and reducing intermediate circulation links in the supply chain can effectively control the risks of the agricultural products supply chain[6].

2.2 Digitalization and food safety regulation in the agricultural supply chain

The food safety issue is one of the safety hazards in China's agricultural products supply chain. Establishing a strict traceability and supervision system is of great significance to

guarantee the safety of the agricultural products supply chain. Lu (2021) through the application of IoT technology, digitizes and intelligently manages the whole process of the agricultural product supply chain, enabling the whole process of traceability and enhancing the safety of the agricultural product supply chain[7]; Wang et al. (2022) point out that the digital transformation and upgrading of food safety is an important project related to the implementation of food safety strategies and that the high-quality development of the food supply chain has to go through three stages: Internet of Things, digitalization and intelligence[8]; Zhang (2022) points out that in the context of the rural revitalization strategy, agricultural development has become the focus of attention of all sectors of society, and confirms the feasibility of applying blockchain technology to the traceability system of the agricultural supply chain to guarantee the food safety of agricultural products and curb the occurrence of food safety incidents[9]; Zhang (2022) pointed out the powerful advantages of using the information transparency, non-tampering and sustainable traceability of blockchain technology for replacing the traditional information tracing technology in the agricultural products supply chain and conducted a study and verified the feasibility of the experimental mechanism in terms of reducing the storage space of the agricultural products traceability data on the chain and better realizing the mutual access of the account nodes in the supply chain in the blockchain network[10]; Wang (2022) introduces the "Internet+SCER traceability platform" system that can generate various quality reports by aggregating information on the quality of agricultural production processes[11]; Huo et al. (2022) point out that the introduction of blockchain technology can improve the credibility of agrarian quality and safety traceability information and thus reduce the uncertainty of agricultural quality and safety[12].

2.3 Digitalization and risk forecasting in the agricultural supply chain

Detecting, evaluating and controlling potential risks beforehand is one of the critical elements of supply chain security. Zhang (2021) points out that although China's agricultural products supply chain has been continuously extended, it still faces various emergencies and multifaceted risks. The challenges should be met by strengthening the top-level design of the supply chain security risks, the support of core supply chain enterprises and the support system of supply chain elements[13]. Chen (2021) conducted a study on the risks of agricultural supply chains, starting from the unique characteristics of agricultural supply chains, and showed that by using digital technology and strengthening the application of the Internet of Things and blockchain combined in the agricultural supply chains, the risks of agricultural supply chains can be reduced[14]; Ma et al. (2020) used Citespace visualization software to analyze data from current academic articles on agricultural supply chain risk management. They concluded - that the current research hotspots are focused on fresh agricultural supply chain, quality and safety, finance, network environment and new forms, and the above aspects of Risk control measures are proposed for the above areas[15]; Liu et al. (2021) used the hierarchical analysis method to rank the weights of the various types of risks in the agricultural supply chain and made suggestions for the optimisation of the agricultural supply chain based on the results of the analysis and calculations[16]; Chao et al. (2022) pointed out that blockchain technology has unique features such as distributed data storage, consensus mechanism, and peer-to-peer transmission, which can effectively identify supply chain risks[17]; Ran et al. (2021) established a CVaR model and applied it to the simulation analysis of supply risks in agricultural logistics[18].

3. The impact of digitalization on the security of the agricultural supply chain

3.1 Enabling supply chain information sharing to ensure secure supply chain information transfer for agricultural products

The slow speed of information transmission, the low authenticity of the information in the transmission process and information asymmetry in the traditional agricultural supply chain have caused an imbalance between the supply side and the demand side of the supply chain, resulting in economic losses for farmers and consumers. Through observing China's agricultural products end retail market, we found that the sales prices of agricultural products are characterised by volatile prices and random and rapid price changes. The fundamental problem with this phenomenon stems from the information transfer process in the agricultural supply chain. Firstly, China's agricultural products are imported in large quantities on top of local production. Due to the uncertainty of the import and export policies for agricultural products, the demand for some agricultural products in the domestic market may change drastically, while farmers and co-operatives still produce according to the original production plan due to their limited ability to obtain information, which results in an oversupply or devaluation of agricultural products in the consumer market. Secondly, due to the limited authenticity of the information received by farmers and their inability to discern, when they receive a price increase for a particular agricultural product, most farmers will produce the product on a large scale for profit. However, the production of agricultural products is cyclical, and mass production will lead to a surplus of production and lower prices in the next cycle, resulting in a loss of economic benefits.

By building an information-sharing system through networking and intelligence and applying digital technology to the information transfer process of the agricultural supply chain, the problems of poor information and low information accuracy in the agricultural market can be significantly solved. Rural cooperatives can receive the latest news about the market supply and demand conditions before production and planting and communicate them to farmers so that production can be reasonably arranged according to demand, alleviating the problems of soaring and falling agricultural prices and wasteful stagnation of agricultural products, balancing the contradiction between farmers' agricultural supply and market demand, stabilising agricultural prices and safeguarding farmers' income.

3.2 Building traceability systems to ensure food safety in the produce supply chain

As a necessity in people's daily lives, the wide range of users and the high frequency of use of agricultural products determine that a food safety and security system for agricultural products is essential for the lives and health of the general public. The complexity of the process from production by farmers to logistics and distribution to purchase by consumers, the need for multiple concentrations and dispersion, and the short shelf life of agricultural products, exceedingly fresh produce, which is perishable and perishable, all combine to make agricultural products vulnerable to food safety problems.

Food safety problems occur with high frequency in China. To safeguard people's lives and health effects, the relevant departments have increased their efforts in food safety supervision and established a food information traceability system. The regulatory authorities can investigate responsibility for the entire supply chain through the food

information traceability system when food safety problems occur. However, most agricultural products are not equipped with specific packaging containing production dates, production addresses, shelf life and nutritional content, making it more difficult to access the relevant information. Tracing the source and pursuing responsibility is particularly difficult in a food safety problem.

The electronic traceability system of agricultural products supply chain information established by using digital technology has laid the foundation for establishing the security guarantee system of the agricultural products supply chain. The electronic traceability system of agricultural product supply chain information records the production information, logistics and distribution information, and the information of terminal distribution locations of agricultural products into the database system. When problems arise in the agricultural products purchased by consumers, the supervisory department can be relied on to investigate all the information of the agricultural products purchased through the query of the database system and trace the responsibility for the occurrence of safety problems, find out the causes of the occurrence of this food safety problem The cause of the food safety problem is identified and the responsibility is traced. The digital electronic traceability system for the agricultural supply chain strengthens the supervision of the quality of agricultural products, reduces the chances of food safety problems occurring in agricultural products and provides a guarantee for the safety of the agricultural supply chain.

3.3 Establishing a risk assessment system for ex-ante control of agricultural supply chain risks

Agricultural products are characterised by short shelf life, unstable and uneven market supply and demand, and vulnerability to damage during transportation. Their supply chains are complex, with many links, loading and unloading operations, and participants. The vulnerability and low resilience of agricultural products and their supply chains are determined by the characteristics of agricultural products and their supply chains, in the event of an unexpected crisis, the supply chain of agricultural products will be blocked or even interrupted, making it difficult to return to average circulation within a short period.

China's agricultural supply chain faces a wide range of unexpected crisis events and a high frequency of occurrence, in order to ensure the safety and stability of the supply chain, timely control measures must be taken to deal with unexpected crisis events; in contrast, control during or after the event is contradictory to the vulnerability and low resilience of China's agricultural supply chain, so a suitable risk assessment system must be set up to detect and regulate crisis events before they occur.

Digital computing, testing systems, data storage, and analysis systems play a crucial role in the supply chain risk assessment system. The first step in establishing China's agricultural products supply chain risk assessment system is to establish a crisis event data storage library, firstly summarise and collate the crisis events that have occurred and may occur and their characteristics; on this basis, extract the data characteristics of the crisis events and enter them into the database, after the data characteristics of the crisis events are entered into the database carry out the construction of the crisis event scenario, and through analysis and calculation come up with the optimal solution; the second step is through The second step is to analyse the possibility of various crisis events through the detection and prediction of supply chain data features, immediately analyse the type of potential crisis events and their risk of occurrence when the data value is abnormal,

and immediately take timely pre-control measures until the data value returns to normal when the risk exceeds the safe range.

Integrating the above three parts of the study, the author has collated the impact of digitalization on the security of China's agricultural supply chain, as shown in Figure 1.

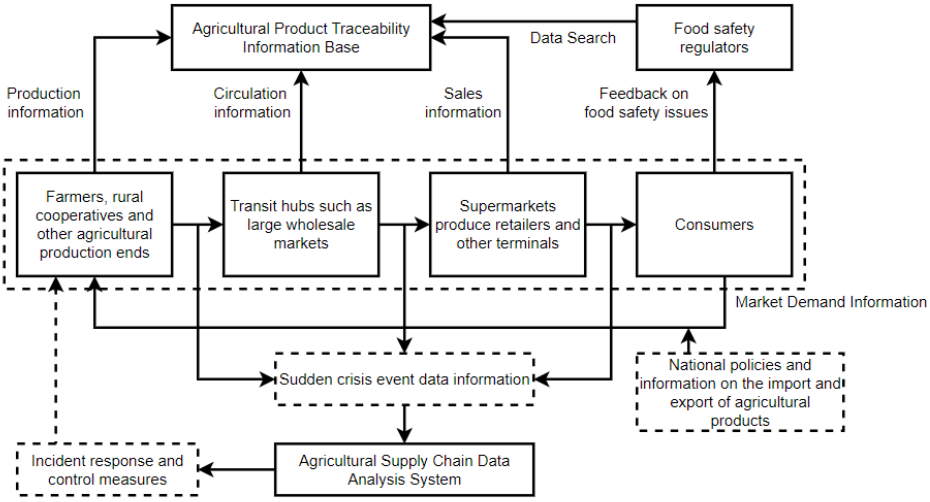

Figure 1. Mechanisms for the impact of digitalization on the security of our agricultural supply chain

3.4 Potential risks of digitalization for the agricultural supply chain

While digital technology provides security for our agricultural supply chain, it also poses potential risks. As digital technology advances and the internet grows, confrontations between countries spill over into the internet, making network security increasingly tricky. The security systems provided by digitalization for our agricultural supply chain are based on network security and database security, if the network fails, it will lead to the failure of the agricultural products information traceability system, the agricultural products supply chain information sharing system and the agricultural products supply chain risk monitoring system, and the information transmission, risk prevention and food safety guarantee functions of the agricultural products supply chain will stop running. The possibility of security problems in the agricultural products supply chain will increase steeply. Suppose hackers invade the database and the data information is leaked. In that case, it will cause more severe information security problems and significantly threaten China's agricultural economy and social security.

4. Responses and recommendations

The application of digital technology has protected our fragile agricultural supply chains and enhanced their security and economic efficiency in agriculture[19]. However, many unresolved issues and unexcluded risks exist in our agricultural supply chains. To eliminate risks and solve problems and further strengthen the security of the agricultural supply chain, the government and relevant departments should encourage digital research projects and provide policy support for the digital transformation of enterprises

related to the agricultural supply chain, establish a sound risk-sharing mechanism[20]and diversified risk control initiatives[21] to promote the in-depth promotion of digitalization in China's agricultural supply chain; farmers and agricultural cooperatives and other agricultural products production side should actively cooperate with the information sharing of the digital supply chain system, stable production based on accurate information on market supply and demand and timely transmission of production data to maintain a balance between supply and demand in the agricultural market; according to Enterprises related to the agricultural products supply chain should actively introduce the latest research results of digital technology and promote the digital transformation and upgrading of their enterprises in line with the policy, and at the same time must increase the supervision of digital network security, continuously and deeply apply the latest digital technology to the agricultural products supply chain and establish At the same time, it is necessary to strengthen the supervision of digital network security, to apply the latest digital technology to the agricultural supply chain and to establish an appropriate evaluation index system, to select the most suitable solution for the digital transformation and upgrading of the agricultural supply chain and to promote the solution continuously.

References

[1] Liu D, Sun J, Wang P. Digital evolution of fresh produce supply chain model: the case of Yonghui Supermarket[J]. Rural Economy,2021(07):25-33.
[2] Huang CY. A comparative study on the digitalization model of agricultural products supply chain led by different link subjects [D]. Hebei University of Economics and Business, 2022.
[3] Jin JF, Wang L. Research on information collaboration in agricultural supply chain under "blockchain+platform" model[J]. Logistics Science and Technology,2022,45(06):128-131.
[4] Zhao XF, Lu N, Li M. Digital transformation of agricultural supply chain: theoretical framework and realization path[J]. Yunnan Social Science,2022(06):59-67.
[5] Zhang SW, Chen K. Construction of cloud platform and information flow analysis for fresh agricultural products logistics service supply chain[J]. Logistics Engineering and Management,2022,44(10):67-69+75.
[6] Du H. Risk identification and control of agricultural products supply chain in the context of rural revitalization[J]. Rural Economy and Technology,2022,33(10):197-199.
[7] Lu YF. A study on digital technology adoption for enhancing stakeholder coordination in agricultural supply chains[J]. Journal of Nanchang University of Aeronautics (Natural Science Edition), 2022,36(02):51-57.
[8] Wang CZ. Adopting digital management technology to make food supply chain safer[J]. Journal of Food Safety,2022(13):10-11.
[9] Zhang MQ. Research on traceability system of agricultural products supply chain under blockchain technology[J]. Rural . Agriculture. Farmer(B),2022(05):20-21.
[10] Zhang XD. Research on blockchain-based data storage technology for agricultural products traceability [D]. Hebei University of Geosciences, 2022.
[11] Wang J. A digital modern agricultural supply chain ecosystem regulatory information platform[J]. Social Scientist,2022(01):147-151.
[12] Huo H, Zhong HY. Evolutionary analysis of blockchain technology inputs in quality and safety of agricultural supply chain[J/OL]. Operations Research and Management:1-8 [2022-11-30].
[13] Zhang XC. Research on security risks and coping mechanism of agricultural supply chain[J]. Agricultural Economic Issues,2022(02):97-107.
[14] Chen LL. Exploring the special characteristics of agricultural supply chain and risk prevention[J]. Guangdong Sericulture,2021,55(05):132-133.
[15] Ma YC, Gao SS. Visual analysis of hot spots of agricultural supply chain risk management research[J]. Logistics Science and Technology,2020,43(07):123-127.
[16] Liu RW, Wang PQ. Risk analysis of agricultural supply chain based on hierarchical analysis[J]. Rural Economy and Technology,2021,32(01):115-117.

[17] Chao MH, Zhu YL. Research on risk control of agricultural products supply chain based on blockchain technology: an example of Maoming litchi industry[J]. Guangdong Economy,2022(09):66-71.
[18] Ran W, Zhou L. Study on the risk model of agricultural supply chain logistics [J]. Supply Chain Management,2021,2(10)
[19] Jiang J, Qi Y, Chai T, Yang AJ. The significance of digitalization of agricultural products circulation to improve the economic efficiency of agriculture and the methods to achieve it[J]. Farm Economic Management,2022(10):43-45.
[20] Chen K. Research on countermeasures to promote the digitization of agricultural supply chain finance in the context of financial technology [J]. Agricultural Economics,2022(11):119-121.
[21] Nie YM. Research on innovation and risk control of rural supply chain finance model[J]. Agricultural Economics,2022(07):95-96.