

# Research on the Impact of Multi-Agent Information Traceability on Quality and Safety of Agricultural Product Supply Chain Under Blockchain

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## ABSTRACT

With the increasing prominence of food safety problems, consumers are paying more and more attention to the quality and safety of agricultural products. Information traceability of agricultural products supply chain is an important way to ensure the quality and safety of agricultural products. Blockchain technology provides a new solution for information traceability of agricultural products supply chain with its characteristics of decentralization, immutable and transparency. This paper reviews the basic principles of blockchain technology and its application in agricultural supply chain information traceability. By combing relevant literature, it is found that blockchain technology is widely used in the production, processing, logistics and other aspects of agricultural products, effectively improving the transparency and traceability of the supply chain. Finally, it is concluded that the information traceability of agricultural product supply chain under the blockchain improves the traceability, visibility and information security of the supply chain, and also promotes the cooperation and coordination among various entities in the supply chain. With the continuous development and improvement of blockchain technology, its application in agricultural product supply chain information traceability will be more extensive and in-depth, providing more solid technical support for the quality and safety of agricultural products.

## KEYWORDS

Blockchain; Agricultural supply chain; Information tracing; Quality and safety of agricultural products

## 1. INTRODUCTION

With the increasing global attention to food safety, the quality and safety of agricultural products has become a high-profile issue. The supply chain of agricultural products involves many links from farm to table, including production, processing, logistics, retail and consumption, etc. Each link involves different subjects and complex operation processes. Pollution in any link may cause quality and safety problems of agricultural products. Therefore, it is crucial to ensure the traceability of the entire supply chain of agricultural products. Traditional information traceability systems are often difficult to meet the needs of modern consumers due to problems such as information silos, data tampering and opacity. Blockchain technology, with its unique characteristics of immutability, decentralization and high transparency, provides new ideas and methods to solve this problem.

In recent years, numerous studies have begun to explore the application of blockchain technology in traceability systems for agricultural products. Qiqi Liu and Chunping Xia (2019) applied blockchain technology to build a quality traceability system for traceability of agricultural products, collect information from each node, investigate and analyze the quality situation before and after each node,

and quickly trace agricultural products with quality problems [1]. Meng Dequan et al. (2024) proposed a blockchain based agricultural product traceability system, which greatly improved the credibility of information and the practicability of the system through a one-time on-chain data writing method and a personalized data packaging pipeline. This technology not only ensures that information about each agricultural product is accurately recorded and easily traceable, but also automates the relevant processes through smart contracts, thus reducing the possibility of human error and fraud [2]. Most studies focus on how to design a traceability system that can ensure the quality and safety of agricultural products, but there are few studies on how information traceability among multiple agents of agricultural supply chain affects the quality and safety of agricultural products under blockchain technology. Through a comprehensive review of relevant literature, this paper discusses the application status of blockchain technology in information traceability among multiple agents in the agricultural product supply chain, and how it affects the quality and safety of agricultural products.

## **2. BLOCKCHAIN TECHNOLOGY AND AGRICULTURAL PRODUCT QUALITY AND SAFETY OVERVIEW**

### **2.1. Blockchain Technology Overview**

Blockchain originated from Bitcoin, a digital cryptocurrency that was proposed in 2008 by Satoshi Nakamoto (2008) as an architectural concept of an electronic trading system based on cryptography and time-stamping technology that does not rely on trust, enabling reliable financial transactions without a third-party platform [3]. But blockchain is not the same as Bitcoin, which is an application of blockchain technology. Christidis K and Devetsikiotis M (2016) define blockchain as a distributed data structure that is replicated and shared among network members [4]. Al-Saqaf W and Seidler N (2017) consider blockchain to be an Internet-based distributed ledger technology [5]. Butijn et al. (2021) strictly defined blockchain technology on the basis of predecessors, and they regarded blockchain technology as a form of distributed ledger technology, deployed on a peer-to-peer network, where data is replicated, shared and synchronized among multiple nodes. The technology ensures the execution, signing and announcement of transactions through public key cryptography. Nodes in the network verify the validity of transactions through consensus protocols and synchronize ledger data. When a new block is formed, a hash function is used to bundle the transaction data, associated metadata, and the hash of the previous block, thus ensuring that all previous transactions are connected to the new transaction, forming a tamper-proof chain of history [6]. Wang Yuandi et al. (2018) defined blockchain technology as an innovative application mode of computer technology in the era of value Internet. It is the result of the integration of database, cryptography, network technology and other technologies, and has the characteristics of decentralization, trustless, collective maintenance, and immutable [7].

Blockchain technology is widely used in the supply chain of agricultural products because of its characteristics such as traceability and immutable, which provides a powerful solution to solve the problem of information asymmetry in the supply chain of agricultural products.

### **2.2. Overview of Quality and Safety of Agricultural Products**

Agricultural products refer to plants, animals, microorganisms and their products obtained in agricultural production activities. These products include food, oil, vegetables, fruits, livestock and poultry products, aquatic products, etc., are an important material basis for human survival and development, including unprocessed and primary processed agricultural products. Agricultural products include edible agricultural products and non-edible agricultural products, edible agricultural products belong to the intersection of agricultural products and food.

The quality and safety of agricultural products means that agricultural products in the process of production, processing, storage, circulation and use, meet the stipulated quality and safety standards, and meet the requirements of protecting human health and safety. The quality and safety of agricultural products is related to every link of the supply chain of agricultural products, and pollution in any link will cause quality and safety problems of agricultural products. Therefore, ensuring the quality and safety of agricultural products requires the joint efforts and collaboration of all participants in the supply chain.

### **3. SUPPLY CHAIN INFORMATION TRACEABILITY STATUS ANALYSIS**

Due to the frequent occurrence of food quality and safety accidents, consumers' demand for traceability of agricultural products has surged. Agricultural product supply chain information traceability is an important means to ensure the quality and safety of agricultural products. Whether the existing supply chain information traceability technology can make up for the shortcomings of traditional supply chain information traceability is reviewed.

#### **3.1. Problems and Deficiencies of Traditional Supply Chain Information Traceability**

A complete traceability chain requires comprehensive data and information, which requires not only the perfection of traceability technology, but also the active participation of all nodes. Pizzuti T et al. (2014) pointed out that the traditional supply chain traceability system cannot link food records, and the fragmentation of information makes it difficult to form a complete traceability chain, and there are problems such as inaccurate records, incorrect information and failure to obtain necessary data in time [8]. Dabbene F et al. (2014) believe that traceability should be fully integrated into supply chain management, rather than exist alone, and the lack of transparency at one node will affect the whole chain [9]. Badia-Melis R et al. (2015) pointed out that the traditional information traceability system was not compatible with the existing technologies at that time, resulting in low traceability efficiency. The development and progress of new technologies and concepts provided new opportunities for improving the efficiency and compatibility of the traditional information traceability system [10]. Whether the main body of the supply chain can accept the application of traceability system is particularly important for the development of supply chain information traceability. Duan Y et al. (2017) pointed out that although traceability system plays an important role in ensuring food quality and safety, it is often regarded as a barrier by food enterprises due to high implementation cost, shortage of technical personnel and other reasons, so traceability system does not accurately and effectively capture, link and share food traceability data in practice [11]. Samantha I et al. (2022) believe that traceability information systems are faced with the problem of information loss, which is caused by the low efficiency of logistics and information flow caused by the vulnerability of traceability information system operators' internal or external traceability systems [12]. Zhao Shuang and Cui Yutong (2024) believe that the traditional cross-border supply chain traceability system has problems such as information asymmetry, data management difficulties, inconsistent technical standards, difficult to guarantee information credibility and high cost [13].

According to the above review, the problems and shortcomings of information traceability in traditional supply chain are not only reflected in the traceability technology itself, including technical compatibility, unified technical standards, accuracy and security, but also reflected in the willingness of each main body of the supply chain to adopt traceability technology, among which the factors affecting the adoption willingness include high implementation cost and shortage of technical personnel.

### **3.2. Development and Application of Existing Supply Chain Information Traceability Technology**

Kumar T A et al. (2021) applied blockchain technology to traceability systems and proposed a blockchain-based multi-layer textile and garment supply chain traceability framework. Blockchain allows the creation of a decentralized and immutable ledger of verifiable and traceable transactions, which enables the establishment of technology-based trust among supply chain partners. A blockchain-based traceability system will provide all partners with a unique opportunity, flexibility and authority to trace their supply networks and create transparent and sustainable supply chains [14]. Somdip D et al. (2021) used blockchain and QR (rapid response) codes to establish a framework that can react quickly and block food safety, which can digitize food production information and make it easy for consumers and producers to access, trace and verify by using QR codes [15]. Tarek F et al. (2023) combine deep learning-based image processing, blockchain technology, and the Internet of Things to achieve more intelligent control and accurate traceability of greenhouse operations in the agricultural sector, an integrated approach that promotes accountability, transparency, and trust [16]. Onu P (2024) et al. proposed a blockchain-based traceability framework to enhance the transparency, accountability and trust of the supply chain network by utilizing the inherent characteristics of blockchain, such as decentralization, unchangeable data storage, cryptographic security and smart contracts [17]. Xu Wenhong and Tang Yanjun (2021) built a monitoring platform for the quality and safety information of the dairy supply chain based on blockchain technology, and made use of core technologies such as distributed ledger, public and private keys, digital signature and consensus mechanism of blockchain to achieve timely and safe transmission and effective traceability of the quality and safety information of dairy products [18].

The organic integration of blockchain technology and supply chain information traceability, with its characteristics of decentralization, immutable, encryption security and smart contracts, can well make up for the problems and shortcomings of traditional supply chain information traceability.

## **4. THE APPLICATION OF BLOCKCHAIN TECHNOLOGY IN THE AGRICULTURAL SUPPLY CHAIN**

Blockchain technology provides strong technical support for information traceability among multiple entities in the agricultural product supply chain, and can improve the traceability, visibility and security of the agricultural product supply chain through blockchain technology. To make this argument more convincing, review existing research on how blockchain improves traceability, visibility, and security in agricultural supply chains.

### **4.1. Blockchain Technology Improves Agricultural Supply Chain Traceability**

Mokgomola F (2024) et al. utilize cutting-edge blockchain technology with smart contracts to effectively manage the agricultural supply chain, improve the agricultural sector by guaranteeing data traceability, security and integrity, and improve the quality and safety of agricultural products [19]. Sayma HM (2024) believes that supply chain corruption is an important factor in the price rise of agricultural products, and the application of blockchain in the supply chain of agricultural products can effectively trace the root of corruption in the supply chain, which provides an important means to solve the price rise of agricultural products [20]. Based on the perspective of integrated supply chain, Huo Hong and Zhan Shuai (2019) implemented whole-process supervision on the business flow, logistics, capital flow and information flow of the whole process of agricultural product quality and safety through the embedding of blockchain technology, and realized the traceability of agricultural product sources [21]. Jiang Yujie (2022) built a traceability supervision system for livestock products that included all stakeholders to ensure that all stakeholders were tracked and improve the traceability of the supply chain [22]. Fan Beibei et al. (2023) proposed that the

introduction of blockchain technology could enable the data interconnection between different links of the agricultural product supply chain and the whole product process to be accessible, thus breaking the "information island" of the supply chain from the basic level and realizing the whole process and comprehensive traceability of the supply chain [23].

#### **4.2. Blockchain Technology Improves Agricultural Supply Chain Visibility**

Panigrahi, A et al. (2024) introduce blockchain technology into agri-food supply chain management, improve the visibility of agricultural supply chain information, and reduce the risk of fraudulent behavior of supply chain participants due to opaque and tampered information. This will enhance the safety of agri-food and the profitability of all stakeholders [24]. From the perspective of principal-agent theory, MEDINA J M et al. (2024) introduce blockchain technology into the supply chain to improve the visibility of the supply chain, alleviate the problem of information asymmetry, reduce the opportunistic behavior of agents, and thus reduce the demand for trust from the principal, so as to solve the trust problem in the supply chain relationship "without trust" [25]. Mane, A. E et al. (2024) use the Internet of Things to collect environmental data, blockchain stores and validates environmental data, and smart contract algorithms control the interaction with different data segments, so that all participants in the supply chain will be able to visualize data and track product updates [26]. Yu Lina et al. (2017) believe that the combination of blockchain and agricultural product supply chain can provide corresponding services and share information for upstream and downstream enterprises in the supply chain [27].

#### **4.3. Blockchain Technology Improves the Information Security of Agricultural Supply Chain**

Zhimin G et al. (2018) believe that a supply chain management system based on blockchain technology is conducive to efficient information storage and information protection [28]. Purva G et al. (2019) emphasize that blockchain-based systems can prevent users or administrators from changing, deleting, and manipulating actual data [29]. Mane, A. E et al. (2024) believe that blockchain solves many disadvantages of centralized database. Due to its decentralized design, data is dispersed among nodes of the network, which reduces the possibility of single point failure and enhances security [26]. Liu Yaozong and Liu Yunheng (2018) proposed that if the blockchain technology and RFID technology are combined for quality traceability, the reliability and fidelity of the traceability system can be greatly improved [30]. Chen Weiling et al. (2021) integrated blockchain technology with the traditional supply chain of fresh agricultural products, used the asymmetric encryption of blockchain technology to ensure the security of information, and solved the problem of lack of trust and asymmetric information in all links of the supply chain [31].

### **5. THE IMPACT OF MULTI-AGENT INFORMATION TRACEABILITY ON QUALITY AND SAFETY OF AGRICULTURAL PRODUCT SUPPLY CHAIN UNDER BLOCKCHAIN**

In the traditional supply chain of agricultural products, due to the information opacity, traceability difficulties and other problems, the quality and safety accidents of agricultural products are frequent, which brings potential threats to the health of consumers. Blockchain technology, as a decentralized, immutable, transparent and traceable distributed ledger technology, provides a new solution for the information traceability of agricultural product supply chain. Information traceability based on blockchain technology improves the quality and safety of agricultural products ultimately delivered to consumers by ensuring the quality and safety of all links of the agricultural product supply chain.

### **5.1. Information Traceability Improves the Quality and Safety of Agricultural Production**

Galvez FJ et al. (2018) point out that blockchain can be used to issue and manage the creation of unique crypto tokens, and token strategies can encourage growers to use tokens to publish information generated by equipment and machines such as field sensors, drones, and precision spraying to cover the cost of their purchase of these devices [32]. Kshetri N (2018) verifies the data on the blockchain through the consensus mechanism, if the amount of drugs, hormones and antibiotics used by farmers is inconsistent and improper or illegal, the smart contract automatically terminates the transaction, and the data is not recorded in the blockchain [33]. Feng, H et al. (2020) propose a blockchain-based quality traceability architecture, which uses connected devices to record data, and sensors to automatically and continuously collect and transmit information such as temperature, humidity, O<sub>2</sub> and CO<sub>2</sub> in the environment, which can not be tampered with to meet the requirements of accountability and traceability [34]. Mane, A. E et al. (2024) combined blockchain with Internet of Things technology, enabling farmers to rely on real-time data to improve crop management technology, so as to obtain higher yields under the condition of ensuring quality and safety [26]. Li, C et al. (2024) analyzed the content levels and spatial distribution characteristics of eight heavy metals in agricultural products, and used factor analysis to analyze the monitoring related indicators to facilitate the traceability of the quality and safety of agricultural products, thereby reducing the risk of excessive heavy metals and improving the quality and safety of agricultural products by using the accountability system [35]. Liu Shuangyin et al. (2022) designed a block structure for traceability of agricultural products, which can record seed and seedling information, environmental information and input information in detail, and the information cannot be tampered with and is open and transparent to ensure the quality safety of agricultural products at the source [36]. Lu Ming (2024) pointed out the application of Internet of Things technology in the agricultural field. Sensors can detect the growing environment of crops in real time and record soil moisture, temperature, fertility and other information in the growing process, so as to meet data transmission and information sharing and lay the groundwork for information traceability [37].

### **5.2. Information Traceability Improves the Quality and Safety of Agricultural Products Processing**

Patel, A. S et al. (2023), through the application of blockchain and sensors, recorded the equipment availability, use and disinfection procedures followed by livestock product processing plants, data on processing methods, the use of packaging technology, label details of each batch of products and other information, and monitored the whole process of the supply chain in real time [38]. Yao Guanxin et al. (2019) pointed out that improper handling of processing links in the supply chain of fresh agricultural products would cause quality and safety problems, and believed that information traceability and information sharing could solve this problem [39]. Liu Hongchao et al. (2021) pointed out that data such as the amount of agricultural inputs used and processed materials in the production process of agricultural products should be uploaded to the blockchain to accept the supervision of the whole society, so as to standardize and restrict the behaviors of various entities in the supply chain from a macro level and guide them to produce agricultural products safely [40].

### **5.3. Information Traceability Improves the Quality And Safety of Agricultural Products Logistics**

Namani, S and Gonen, B (2020) point out that some research and development groups are focusing on adopting some specific iot technologies, such as RFID and wireless sensor networks, to achieve remote monitoring of conditions in food transportation scenarios [41]. Zijiang Z et al. (2021) adopted 5G iot RFID technology to build an iot architecture model for the circulation of e-commerce agricultural products, collect EPC number or vehicle number information of agricultural products at

each stage of circulation, and store it in the database to track agricultural products [42]. Shouchen L and Zhaoyu Y (2023) record cold chain product logistics information, quality information and quality inspection information by combining blockchain with the Internet of Things, thereby improving the quality and management efficiency of cold chain products [43].

#### **5.4. Information Traceability Improves the Quality and Safety of Agricultural Products Retail**

Caro, M. P et al. (2018) propose a fully decentralized traceability system for agricultural supply chain management, and point out that in the retail chain, retailers store detailed information on the quantity of products received from distributors in the blockchain, and sensors store information about the state of the retail environment in the blockchain autonomously at certain intervals. An auditable record is created when an exception occurs [44]. Yele, S and Litoriya (2024) point out that when retailers deliver food ingredients to restaurants, a unique QR code must be used to participate in the proposed system for each individual item, each sub-package and each wholesale order. Material details, production date, expiration date, lot number, total amount produced in the lot, and authorized logistics partner information are included in the QR, eliminating the possibility of contaminated goods [45].

#### **5.5. Information Traceability Improves the Quality and Safety of Agricultural Products Consumption**

Yiheng T et al. (2023) believe that if downstream stakeholders in the agricultural product supply chain value the authenticity of traceability information recorded on the blockchain, farmers' willingness to fabricate information will be reduced, and the willingness of the blockchain platform to verify authenticity will be increased, thereby reducing the risk of quality and safety problems at the source of agricultural products. Tao Z and Chao J (2024) pointed out that the food traceability system based on blockchain significantly improved consumer willingness to purchase organic agricultural products by enhancing product quality perception, product trust, and environmental information transparency perception, thereby promoting consumer confidence in agricultural product quality and safety. Jiang Ning et al. (2018) built a supply chain traceability system based on consumption experience, fully utilizing supply chain information resources to enhance supply chain information management capabilities and meet consumer traceability needs, thereby enhancing the market competitiveness of the supply chain.

## **6. CONCLUSION**

This paper discusses the application of blockchain technology in multi-agent information traceability of agricultural products supply chain and its impact on quality and safety. Through detailed analysis of various problems existing in information traceability of traditional agricultural products supply chain, it is realized that blockchain technology provides practical solutions to these problems. Blockchain technology effectively improves the authenticity and integrity of information in the supply chain of agricultural products through its characteristics of decentralization, transparency, and immutability. In the entire process of agricultural products from production to consumption, blockchain technology enables the data of each link to be recorded, traced and verified in real time, thus ensuring the traceability of the quality and safety of agricultural products. This traceability not only enhances consumer trust in agricultural products, but also provides government regulators with strong data support to help timely detect and deal with agricultural product safety issues.

Blockchain technology facilitates cooperation and coordination among various actors in the agricultural supply chain. By building a shared and transparent information platform, each entity can obtain real-time information about the production, processing, transportation and other aspects of agricultural products, so as to more accurately grasp the market dynamics and consumer demand.

This cooperation and coordination not only improves the operational efficiency of the agricultural supply chain, but also provides a strong guarantee for improving the quality of agricultural products.

To sum up, blockchain technology has important application value in agricultural product supply chain information traceability, and has a positive impact on the improvement of agricultural product quality and safety. Looking forward to the future, it is necessary to promote the innovative development and application of blockchain technology, combined with more high-tech technologies, in order to play a more powerful synergistic effect, help the agricultural industry to achieve high-quality and efficient development, and provide consumers with safer and more reliable agricultural products.

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## REFERENCES

- [1] Liu Qi-Qi, Xia Chun-ping. Construction of agricultural product quality traceability system based on blockchain technology [J]. High-tech Communication, 2019, 29 (03): 240-248. (in Chinese)
- [2] Meng Dequan, Hu Xiangpei, Tang Yuhui, Chen Qi, Sun Shigen. Research on data link and packaging pipeline of Traceability agricultural products blockchain system [J]. Engineering Management Technology Frontier, 1-12.
- [3] Wright, C. S. Bitcoin: A Peer-to-Peer Electronic Cash System.
- [4] Christidis K ,Devetsikiotis M . Blockchains and Smart Contracts for the Internet of Things. [J]. IEEE Access, 2016, 4 2292-2303.
- [5] Al-Saqaf W ,Seidler N . Blockchain technology for social impact: opportunities and challenges ahead [J]. Journal of Cyber Policy, 2017, 2 (3): 338-354.
- [6] Butijn, B.-J.; Tamburri, D. A.; Heuvel, W.-J. V. D. Blockchains: A Systematic Multivocal Literature Review[J]. ACM Comput. Surv. 2021, 53 (3), 1–37.
- [7] Wang Yuandi, Li Granule, Hu Quan. Review of blockchain research [J]. Journal of China University of Mining and Technology (Social Science Edition), 2018, 20 (03): 74-86.
- [8] Pizzuti T ,Mirabelli G ,Sanz-Bobi A M , et al. Food Track & Trace ontology for helping the food traceability control [J]. Journal of Food Engineering, 2014, 120 17-30.
- [9] Dabbene F ,Gay P ,Tortia C . Traceability issues in food supply chain management: A review [J]. Biosystems Engineering, 2014, 120 65-80.
- [10] Badia-Melis R ,Mishra P ,Ruiz-García L . Food traceability: New trends and recent advances. A review [J]. Food Control, 2015, 57 393-401.
- [11] Duan Y ,Miao M ,Wang R , et al. A framework for the successful implementation of food traceability systems in China [J]. The Information Society, 2017, 33 (4): 226-242.
- [12] Samantha I ,Louise M ,M. J C . Systematic assessment of food traceability information loss: A case study of the Bangladesh export shrimp supply chain [J]. Food Control, 2022, 142
- [13] Zhao Shuang, Cui Yutong. Study on the Pattern of Blockchain Enabling Cross-border Supply Chain Traceability under the Framework of TOED Theory [J]. Logistics Technology, 2024, 47 (10): 155-159+178.
- [14] Kumar T A ,Vijay K ,Rudrajeet P , et al. Blockchain-based framework for supply chain traceability: A case example of textile and clothing industry [J]. Computers & Industrial Engineering, 2021, 154 (prepublish): 107130-.
- [15] Somdip D ,Suman S ,Kumar A S , et al. FoodSQRBlock: Digitizing Food Production and the Supply Chain with Blockchain and QR Code in the Cloud [J]. Sustainability, 2021, 13 (6): 3486-3486.
- [16] Tarek F ,Jalel K ,Bechir Z , et al. Integrating blockchain and deep learning for intelligent greenhouse control and traceability [J]. Alexandria Engineering Journal, 2023, 79 259-273.

- [17] Onu P ,Mbohwa C ,Pradhan A . Blockchain-Powered Traceability Solutions: Pioneering Transparency to Eradicate Counterfeit Products and Revolutionize Supply Chain Integrity [J]. *Procedia Computer Science*, 2024, 232 1420-1427.
- [18] Xu Wenhong, Tang Yanjun. Research on quality and safety monitoring of dairy supply chain empowered by blockchain [J]. *China Brewing*, 2021, 40 (07): 227-230.
- [19] Mokgomola, F.; Telukdarie, A.; Munien, I.; Onkonkwo, U.; Vermeulen, A. Blockchain and Smart Contracts Based Agricultural Supply Chain[J]. *Procedia Computer Science* 2024, 237, 637–644.
- [20] Sayma H M ,Hasan R M ,Khatun M , et al. Detecting the provenance of price hike in agri-food supply chain using private Ethereum blockchain network [J]. *Heliyon*, 2024, 10 (11): e30972-.
- [21] Huo Hong, Zhan Shuai. Construction of whole-process supervision system for Agricultural product quality and safety from the perspective of integrated supply chain [J]. *China Science and Technology Forum*, 2019, (08): 105-113.
- [22] Jiang Yujie. Application of blockchain in Traceability of agricultural and livestock products in Hulunbuir City [J]. *Quality and Safety of Agricultural Products*, 2022, (06): 76-82.
- [23] Fan Beibei, Li Jin, Feng Xian, Guo Meirong. Research on high-quality development of intelligent supply chain system of agricultural products [J]. *Engineering Science*, 2023, 25 (04): 92-100.
- [24] Panigrahi, A.; Pati, A.; Dash, B.; Sahoo, G.; Singh, D.; Dash, M. ASBlock:An Agricultural Based Supply Chain Management Using Blockchain Technology [J]. *Procedia Computer Science* 2024, 235, 1943–1952.
- [25] MEDINA J M ,Baudet C ,Lebraty F J . Blockchain and agency theory in supply chain management: A question of trust [J]. *International Journal of Information Management*, 2024, 75 102747-.
- [26] Mane, A. E.; Tatane, K.; Chihab, Y. Transforming Agricultural Supply Chains: Leveraging Blockchain-Enabled Java Smart Contracts and IoT Integration[J]. *ICT Express* 2024, S2405959524000316.
- [27] Yu Lina, Zhang Guofeng, Jia Jingdun, et al. Modern agricultural product supply chain based on blockchain technology [J]. *Transactions of the Chinese Society for Agricultural Machinery*, 2017, 48 (S1): 387-393.
- [28] Zhimin G ,Lei X ,Lin C , et al. CoC: A Unified Distributed Ledger Based Supply Chain Management System [J]. *Journal of Computer Science and Technology*, 2018, 33 (2): 237-248.
- [29] Purva G ,Kumar A K ,Marijn J . Diffusion of blockchain technology:Insights from academic literature and social media analytics [J]. *Journal of Enterprise Information Management*, 2019, 32 (5): 735-757.
- [30] Liu Yaozong, Liu Yunheng. RFID Big Data security traceability model based on blockchain [J]. *Computer Science*, 2018,45 (S2): 367-368+381.
- [31] Chen Weiling, Huang Min, Guo Yan. Construction of fresh agricultural products supply chain system based on blockchain technology [J]. *Business Economics Research*, 2021, (9): 123-126.
- [32] Galvez F J ,Mejuto J ,Simal-Gandara J . Future challenges on the use of blockchain for food traceability analysis [J]. *Trends in Analytical Chemistry*, 2018, 107 222-232.
- [33] Kshetri N . 1 Blockchain’s roles in meeting key supply chain management objectives [J]. *International Journal of Information Management*, 2018, 39 80-89.
- [34] Feng, H.; Wang, X.; Duan, Y.; Zhang, J.; Zhang, X. Applying Blockchain Technology to Improve Agri-Food Traceability: A Review of Development Methods, Benefits and Challenges [J]. *Journal of Cleaner Production* 2020, 260, 121031.
- [35] Li, C.; Lu, Y.; Bian, Y.; Tian, J.; Yuan, M. Design of Safety Evaluation and Risk Traceability System for Agricultural Product Quality[J]. *Applied Sciences* 2024, 14 (7), 2980.
- [36] LIU Shuangyin, Lei Mo Xi, Xu Longqin, et al. Research on reliable traceability system for Agricultural product quality and safety based on blockchain [J]. *Transactions of the Chinese Society for Agricultural Machinery*, 2022, 53(6): 327-337.
- [37] LU Ming. Application research of Internet of Things Technology under the background of big data era [J]. *Shihezi Science and Technology*, 2024, (3): 32-33.
- [38] Patel, A. S.; Brahmabhatt, M. N.; Bariya, A. R.; Nayak, J. B.; Singh, V. K. “Blockchain Technology in Food Safety and Traceability Concern to Livestock Products.” *Heliyon* 2023, 9 (6), e16526.
- [39] YAO Guanxin, Fan Xueru, Xu Jing. Review and prospect of research on quality and safety of fresh agricultural products based on Supply chain perspective [J/OL]. *Logistics Technology*, 2019, 42(9): 127-131.
- [40] Liu Hongchao, Wang Xiaowei, Chen Weihong. Research on safe production mechanism of agricultural products based on blockchain technology [J/OL]. *Issues in Agricultural Economy*,2021,(11): 66-76.
- [41] Namani, S.; Gonen, B. Smart Agriculture Based on IoT and Cloud Computing[J]. In *2020 3rd International Conference on Information and Computer Technologies (ICICT)*; IEEE: San Jose, CA, USA, 2020; pp 553–556.

- [42] Zijiang Z ,Yuehua B ,Wei Huang D , et al. Quality of e-commerce agricultural products and the safety of the ecological environment of the origin based on 5G Internet of Things technology [J]. *Environmental Technology & Innovation*, 2021, (prepublish): 101462-.
- [43] Shouchen L ,Zhaoyu Y . Modeling and efficiency analysis of blockchain agriculture products E-commerce cold chain traceability system based on Petri net [J]. *Heliyon*, 2023, 9 (11): e21302-e21302.
- [44] Caro, M. P.; Ali, M. S.; Vecchio, M.; Giaffreda, R. Blockchain-Based Traceability in Agri-Food Supply Chain Management: A Practical Implementation[J]. In *2018 IoT Vertical and Topical Summit on Agriculture - Tuscany (IOT Tuscany)*; IEEE: Tuscany, 2018; pp 1–4.
- [45] Yele, S.; Litoriya, R. Blockchain-Based Secure Dining: Enhancing Safety, Transparency, and Traceability in Food Consumption Environment[J]. *Blockchain: Research and Applications 2024*, 100187.
- [46] Yiheng T ,Xiyang H ,Wei L . Does blockchain-based traceability system guarantee information authenticity? An evolutionary game approach [J]. *International Journal of Production Economics*, 2023, 264
- [47] Tao Z ,Chao J . The impact of a blockchain-based food traceability system on the online purchase intention of organic agricultural products [J]. *Innovative Food Science and Emerging Technologies*, 2024, 92 103598-.
- [48] Jiang Ning, Zhang Liangliang, Chen Yongping. Supply chain information traceability and its system Construction based on consumer experience Demand [J/OL]. *Information Theory and Practice*, 2018, 41(7): 123-128.