

Research on the integration of blockchain technology in agricultural supply chain

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Abstract

Blockchain technology is a distributed database, which realizes the safe transmission and sharing of data in a decentralized system through technical means such as consensus mechanism, encryption algorithm and smart contract. Its application in the field of agriculture can effectively solve many problems in the supply chain of agricultural products. Therefore, the application of blockchain technology to agricultural supply chain management can provide security and information sharing for agricultural supply chain management, thus improving the operational efficiency of agricultural supply chain. This paper focuses on the problems existing in agricultural supply chain and the application of blockchain technology in agricultural supply chain.

Keywords

Blockchain technology, agricultural products, agricultural supply chain

1.Introduction

Building a decentralized information sharing platform through blockchain technology can effectively solve many problems in the supply chain of agricultural products. First, data generated at all points in the agricultural supply chain can be shared through blockchain technology[1]. For example, traceability information and logistics information generated during the production, circulation and sale of agricultural products can be shared and transmitted through blockchain technology. For example, in the production process of agricultural products, a node can be set up to record and save the data; In the process of agricultural products circulation, a node can be set up to record and store the data[2]. In the process of selling agricultural products, a node can be set to verify and update the data; Finally, these data are applied to the agricultural supply chain management process through smart contracts.

Therefore, blockchain technology can provide security and information sharing for agricultural supply chain management, thereby improving the efficiency and operation quality of agricultural supply chain management. At the same time, blockchain

technology can also play an important role in promoting the development of agricultural informatization, promoting the process of agricultural modernization, and increasing farmers' income[3-4].

2.Overview of blockchain technology

2.1.Blockchain is a decentralized distributed

Blockchain is a decentralized distributed database that records all transaction information in the entire network in blocks, which are recorded and stored through a distributed ledger. Through blockchain technology, a decentralized information sharing platform can be built to achieve data sharing, transmission and analysis. Therefore, blockchain technology is known as the "next generation Internet", which uses characteristics such as decentralization and information sharing to realize the information sharing of data in supply chain management[5].

Blockchain technology builds a decentralized database through technical means such as consensus mechanisms, encryption algorithms and smart contracts. In a blockchain system, transactions and data information are stored in blocks in the form of digital signatures. The content of the digital signature mainly includes the following two aspects: First, when the two parties publish the transaction information on the network, the digital signature will be recorded in the blockchain[6]; Second, once the transaction information is written into the blockchain, all its transaction records will be immutable. In addition, in order to prevent double-payment problems on the network, two-factor verification of digital signatures is required. In addition to two-factor verification of digital signatures, blockchain systems also authenticate both parties to a transaction. Through the authentication mode, the authenticity of the identity of the other party can be detected.

In terms of data transmission, blockchain technology enables data transmission and sharing through peer-to-peer communication and digital signature technology. Point-to-point communication refers to encrypted communication between users. Digital signature technology refers to the use of encryption algorithms to transform messages into digital signatures[7-8]. When data is transmitted and shared through blockchain technology, the information is converted into an encrypted digital signature. In the process of data encryption transmission, the digital signature can realize the secure transmission and verification of the message content, so it can effectively avoid the problem of message tampering. In addition, signature authentication is required for transmitted data during data transmission and sharing. Therefore, blockchain technology can solve the security problems existing in the transmission and sharing of data.

In terms of smart contracts, blockchain technology realizes the automatic processing of data and automatic operation of the system through smart contracts. In a smart contract, you can set trigger conditions, execution conditions, trigger conditions and other content.

Once these conditions are met, the program is automatically triggered to execute the corresponding instructions and operations. In the process of smart contract execution, order information, commodity information, inventory information and other content can be stored and processed. In the smart contract, the specifications of the goods can also be set to meet the needs of different consumers.

2.2. Development status and problems of China's agricultural product supply chain

At present, there are many problems in the development of the supply chain of agricultural products in China, which are mainly manifested in the low circulation efficiency of agricultural products, inadequate supervision, information opacity and asymmetry. First, there are too many links in the agricultural supply chain. At present, there are too many links in the supply chain of agricultural products in our country, resulting in low circulation efficiency and high cost[9]. Secondly, the supply chain information of agricultural products is asymmetrical. Due to some farmers' weak information awareness, lack of professional and technical knowledge and lack of effective sharing of agricultural information, it is difficult for farmers to grasp the market demand and price changes. Thirdly, the quality and safety of agricultural products cannot be effectively guaranteed. Due to the lack of effective quality supervision and information sharing mechanism in each link of our country's agricultural products supply chain, fake and inferior products often occur. Finally, the financial problems of agricultural supply chain are prominent. Due to the small scale of agricultural production, poor infrastructure conditions and low standardization of agricultural products in most areas of our country, it is difficult for financial institutions to effectively support agricultural production and agricultural products circulation.

3. Mainly reflected in the following aspects

3.1. Farmers operate on a small and scattered scale, lacking professional management and technical personnel

The scale of peasant household management in most areas of our country is generally small, and there are serious dispersions. At present, farmers in most areas of our country are dispersed management, and the small scale and dispersion of farmers' management is the main problem in the supply chain of agricultural products. There are many problems in agricultural production in many areas of our country: (1) the scale of production is small. At present, farmers in most areas of our country are very small, and even many areas have only one or several households to grow a small amount of agricultural products, which cannot be compared with large-scale farms in terms of production scale.

3.2. Lack of professional management and technical personnel.

Due to the low cultural level of farmers in most areas of our country, the lack of professional knowledge and the influence of traditional agricultural thought, most of the

farmers lack professional management and technical personnel, and the quality of agricultural products is difficult to be effectively guaranteed.

Although many areas of our country have begun to try to establish professional cooperatives or associations and other organizational forms, but because of the small scale, scattered and lack of corresponding supporting policies, the internal management of cooperatives or associations is chaotic, lack of effective system constraints and low operating efficiency. At the same time, because cooperatives or associations often only manage and supervise the members of cooperatives or associations, they can not effectively manage other farmers. In addition, because many cooperatives or associations have not established corresponding management systems and operating mechanisms, there are often many problems in the management process: (1) lack of unified planning and management. Because of the small scale of farmers in most areas of our country and the lack of unified planning and management, the cooperatives or associations in each area tend to act independently, and it is difficult to manage their members effectively. (2) Lack of effective institutional constraints. Because agricultural production in most areas of our country belongs to traditional agriculture and extensive agricultural production mode, it is difficult for farmers to obtain advanced agricultural production technology and management experience.

3.3. Farmers lack brand awareness and standardization awareness of agricultural products

Brand awareness and standardization awareness of agricultural products are the key to ensure the quality and safety of agricultural products. At present, there are many fake and inferior products in the agricultural products market of our country, which not only disturb the normal market order, but also bring great security risks to the majority of consumers. At present, most farmers in our country lack the awareness of brand and standardization of agricultural products, lack the awareness of quality and safety responsibility of agricultural products, and produce products that do not meet the quality standards in order to pursue short-term interests. At present, some farmers in our country have not formed brand awareness and standardization awareness of agricultural products, and even some farmers do not have a complete understanding of standardized production and brand management, which leads to hidden dangers in the quality and safety of agricultural products.

In addition, the lack of brand awareness and standardization awareness of most farmers in our country also leads to the confusion of market prices of agricultural products. In recent years, with the implementation of "three products and one standard" policy, a number of high-quality agricultural products brands have emerged in our country. This is also confirmed by the phenomenon that some high-quality agricultural products are expensive and unsalable in the market. Due to the lack of a correct understanding of the brand and standardization of agricultural products, farmers do not know how to improve the brand and quality of their agri-

cultural products, and can not obtain competitive advantages in the market.

3.4. Low informatization degree of farmers

With the rapid development of Internet technology, China's agricultural products market information network has been basically formed, but because the supply chain of agricultural products is a multi-participant network, it leads to weak information awareness of farmers, lack of professional and technical knowledge, information asymmetry and so on. First of all, because farmers themselves have limited understanding of Internet technology, they cannot obtain timely and accurate market information, which makes it difficult for farmers to make reasonable production plans according to market demand. Secondly, because agricultural production is a labor-intensive industry, the output and quality requirements of agricultural products are high, and professional and technical personnel are needed to manage and operate. At present, the overall quality of agricultural technicians in our country is low, and it is difficult to meet the production demand of agricultural products. Finally, because most farmers lack effective awareness of agricultural product quality and safety and brand awareness, the quality and safety of agricultural products cannot be guaranteed. In addition, due to the limited understanding of market information, some farmers lack reasonable production plans and market forecasts in the production process, and it is difficult to arrange production scale reasonably. In addition, due to the low information level of farmers in China, farmers have insufficient information on market prices, sales channels and sales cycles, and it is difficult to grasp the changes of agricultural product market information. Therefore, the low informatization degree of farmers has seriously restricted the improvement of the efficiency of China's agricultural product supply chain.

4.Application of blockchain technology in the supply chain of agricultural products

Blockchain technology has the characteristics of immutable, traceable and auditable, and its application to the supply chain of agricultural products can solve the problems of asymmetric information, high cost, and difficult product quality assurance in the supply chain of agricultural products. The application of blockchain technology in the supply chain of agricultural products can improve the quality and information sharing level of agricultural products and ensure the stable operation of the supply chain of agricultural products.

In the field of agriculture, blockchain technology can realize the distributed storage and transmission of data, which realizes the ability of data through technical means such as information encryption and smart contracts.

On the one hand, blockchain technology can achieve the secure transmission and sharing of data through the establishment of alliance chains in all links of the supply chain; On the other hand, blockchain technology establishes a trust mechanism be-

tween the participants in the supply chain through the form of smart contracts, so as to ensure the safe and efficient transmission and sharing of data in the supply chain. In the field of agriculture, blockchain technology can organically connect all links in the agricultural supply chain through smart contracts and realize information sharing. For example, applying blockchain technology to the supply chain management of agricultural products can effectively solve the problem of information asymmetry in the production process of agricultural products; At the same time, the trust mechanism between the participants in the production and processing of agricultural products is established in the form of smart contracts in the blockchain technology. For example, the application of smart contracts to the production and processing of agricultural products can achieve reliable records of agricultural product quality and safety information. In terms of food safety, blockchain technology can achieve distributed storage and transmission of data through the establishment of an alliance chain. Firstly, data sharing and information transfer are realized in the form of alliance chain in the food supply chain. Secondly, trust mechanism can be established between alliance nodes through consensus mechanism, encryption algorithm and other means. Finally, trust mechanism is established between alliance chain nodes in the form of smart contracts. For example, after data sharing and information transfer are realized in the form of alliance chain in the food supply chain, relevant participants can conduct transactions based on information. For example, food production enterprises can upload product sales information to the alliance chain node platform for storage and transmission; Consumers can also access the relevant information platform through the terminal device to obtain product information.

In terms of agricultural supply chain finance, blockchain technology can enable data sharing in agricultural supply chain finance by establishing a digital currency. First of all, digital currency and traditional currency have the same essential attributes; Secondly, digital currency is composed of technical means such as cryptography technology, encryption algorithm and distributed network. The efficiency of agricultural supply chain can be improved by using digital currency as an intermediary to realize data sharing and information transfer in agricultural supply chain finance. For example, an agricultural production enterprise can settle the accounts receivable generated in its production process through digital currency transactions.

4. Conclusion

Blockchain technology can solve the trust problem in the agricultural product supply chain, achieve the safe transmission and sharing of agricultural product supply chain data, and thus improve the operational efficiency of the agricultural product supply chain. However, the application of blockchain technology in the agricultural supply chain is still in the preliminary stage, so it needs to be studied from the following aspects:

First, the application of blockchain technology in agricultural supply chain manage-

ment requires the use of blockchain technology platform, and there are many types of blockchain technology platform, the most typical of which is the decentralized blockchain technology platform represented by Bitcoin. This blockchain technology platform can be applied not only in the field of agriculture, but also in other industries. However, due to the limitations of the existing decentralized blockchain technology platform, the application of blockchain technology platform in the agricultural product supply chain also needs to be further improved. Therefore, relevant departments need to actively promote the construction of agricultural supply chain management platforms based on blockchain technology.

Second, it is necessary to strengthen the deep integration of blockchain technology and new generation information technologies such as the agricultural Internet of Things. The Internet of Things technology is used to monitor the supply chain of agricultural products in real time, realize real-time information transmission and sharing, and then reduce the problem of information asymmetry in the operation of the supply chain of agricultural products. By using blockchain technology to monitor and deal with various quality and safety problems in the agricultural product supply chain in real time, it can effectively improve the information sharing level and decision-making efficiency of all links in the agricultural product supply chain.

Third, it is necessary to strengthen the construction of laws and regulations for the application of blockchain technology in the supply chain of agricultural products. At present, China's laws and regulations on the supply chain of agricultural products are not perfect, the relevant departments should actively formulate relevant laws and regulations and policies based on the actual situation, and constantly improve the laws and regulations system of agricultural supply chain management on this basis.

Fourth, it is necessary to strengthen the understanding of the importance of the application of blockchain technology in the agricultural product supply chain. When applying blockchain technology in the agricultural field, it is necessary to exert the forces of governments, enterprises, consumers and other parties to jointly promote the application of blockchain technology in the agricultural field. The government should strengthen the publicity and training of all subjects, and guide all subjects to actively use blockchain technology for agricultural management and operation; Enterprises should establish a sound blockchain application system and actively promote the application of blockchain in the enterprise; Consumers should raise their awareness of the importance of blockchain technology applications through relevant training activities conducted by government and business organizations.

Fifth, it is necessary to establish and improve the agricultural supply chain blockchain information sharing mechanism. At present, there are many problems of information silos in China, one of the important reasons is the lack of reliable data sharing mechanism. Therefore, relevant departments should actively promote each subject to establish and improve the corresponding information sharing mechanism to achieve the improvement of information sharing level and efficiency; At the same

time, relevant incentive mechanisms should be established to encourage enterprises to adopt blockchain technology for agricultural management and operations.

With the development of modern information technology such as the Internet and big data, the application prospect of blockchain technology in the agricultural field will be broader, but its application in the agricultural field is still in the exploratory stage. Blockchain technology is a decentralized, traceable and immutable distributed database, and its application in the supply chain management of agricultural products is an effective supplement to the supply chain management of agricultural products, through which the security of the supply chain of agricultural products can be guaranteed. In the future, the application of blockchain technology in the agricultural field should continue to be deeply studied, so that blockchain technology can play a greater role in the agricultural product supply chain, and thus improve the operational efficiency of the agricultural product supply chain. In addition, it is also necessary to accelerate the application of agricultural Internet of Things, big data, artificial intelligence and other technologies in the agricultural field, and constantly improve the innovation ability of agricultural science and technology and the transformation ability of scientific and technological achievements.

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