Research on the Construction of Traceability System for E-commerce Agricultural Products Quality and Safety in China Based on Blockchain

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Abstract. This paper analyses the current situation and problems of the traceability system of e-commerce agricultural product quality and safety in China, puts forward an innovative idea of reconstructing the traceability system of e-commerce agricultural product quality and safety by using blockchain technology, and expounds its advantages from the aspects of distributed accounting, trust consensus, collective maintenance and decentralization.

Development Status of Traceability System for Quality and Safety of E-commerce Agricultural Products in China

"Traceability" is the ability to restore the whole process of product production and the track of application history, place of occurrence and sales channel. Currently, product traceability is carried out by registered identification code. The traceability management system of e-commerce agricultural product quality and safety in China is to supervise the whole process of e-commerce agricultural products from planting to consumption, and to form an integrated information system of production, supply and marketing. The traceability process can be divided into two kinds: one is forward tracing, that is, tracing the upstream link to the downstream link according to the life cycle of e-commerce agricultural products; the other is reverse tracing that is, tracing the downstream link to the upstream link of the industrial chain.

Development Process of Traceability System for Quality and Safety of E-commerce Agricultural Products in China

In order to effectively solve the problem of information asymmetry among various links of e-commerce agricultural products industry, establish a punishment mechanism for quality information exchange and implementation of safety responsibility, and implement recall of e-commerce agricultural products and accountability for quality and safety incidents of e-commerce agricultural products, China has launched relevant system construction. The construction of traceability system of e-commerce agricultural product quality and safety has roughly gone through two important stages. The first stage is characterized by "piecewise management as the main feature and variety management as the supplement". Since the State Ministry of Agriculture formally proposed the establishment of traceability system for agricultural product quality and safety in 2006, four types of traceability systems have emerged according to the different subjects of construction: the first type is led by the government, for example, the traceability system of national crop products, animal labeling and epidemic traceability system, aquatic products led by the State Ministry of Agriculture. Traceability system of quality and safety, traceability system of e-commerce agricultural products quality and safety, traceability system of meat and vegetable circulation led by the Ministry of Commerce, etc. The second category is dominated by some social organizations, such as the national food safety traceability platform built by the National Goods Coding Center, the food safety supervision and management platform built by the National Food Safety Management Technology Standardization Committee, traceability and recall public service platform, etc. The third category is

the retroactive public service platform for agricultural products led by enterprises. The fourth category is the internal quality and safety traceability system built by food production enterprises independently. The second stage is after the reform of China's food safety regulatory system in 2013. At the first session of the 12th National People's Congress in 2013, the State Council voted to adopt a plan for organizational reform and functional transformation. The State Administration of Food and Drug Administration were established to unify the production, circulation and consumption of food safety supervision. China's food safety supervision function formally entered the "whole industry chain management" mode. In recent years, local governments and enterprises have actively promoted related work. The Ministry of Commerce and the Ministry of Finance have supported 58 pilot cities in China to develop meat and vegetable traceability system, and 18 provinces and municipalities to develop traditional Chinese medicine traceability system. At present, more than 15,000 enterprises in China have established traceability system for meat and vegetable, covering more than 320,000 business households, initially forming traceability network radiating the whole country and connecting urban and rural areas, which has played a positive role in promoting the innovation of food safety management mode and safeguard mode and creating a safe consumption environment. Beijing, Shanghai, Shouguang City, Shandong Province, Hainan Province and other places have built their own characteristics of e-commerce agricultural product quality and safety traceability system platform. China Food Group, Zhengda Food Group and other leading agricultural enterprises are also working to build a traceability system of e-commerce agricultural products from farm to dining table.

Although all sectors of society have reached a consensus on the importance of product quality and safety traceability, and relevant systems and system construction have achieved initial results, there are still many problems in practical application, and the long-term existence of these problems will inevitably consume the vitality of the whole system construction and operation, and gradually accumulate into chronic diseases.

Problems in Traceability System of E-commerce Agricultural Products Quality and Safety in China

China's agricultural product quality traceability system is being built and operated on a large scale, and gradually exposes many problems. From the external point of view, the problems include the imperfection of legal rules, the need to supplement the coordination system among government departments, and the need to establish public trust in the traceability system. From the point of view of the problems existing in the construction of e-commerce agricultural product quality traceability system itself, this paper mainly includes the following points, aiming at these problems.

The Enthusiasm and the Utilization Rate of the Enterprises are not High

For agricultural products processing and production enterprises, to join and use traceability system, they need to build corresponding systems, purchase hardware equipment, develop software systems, increase information upload in the original process, or even change the existing operating procedures. Enterprises need to increase costs. Because the benefits and prospects of traceability system for enterprises are not clear, most enterprises have no motivation to participate in and use the quality traceability system, only to meet the regulatory requirements of online system; the enthusiasm of using the system is not high. In agricultural production, China is a typical small-scale production mode with large market, low productivity, weak industrialization and poor standardization. Farmers do not have the consciousness and ability to integrate into the quality traceability system. The retroactive system is faced with the embarrassing situation of "people who build up, and people who use it". The entry and tracking of traceable data mainly depends on the self-discipline of market participants, and the quality is difficult to guarantee.

The Information Acquisition and Information Sharing of the Whole System is Facing Challenges

Because of the subsection and link-by-link supervision system, the current system adopts the way of self-built database and information query platform by various departments. China has a vast

territory, a traceability system covering both urban and rural areas, and many participants. Each of them needs to purchase a large number of hardware equipment and develop database and application systems. It not only wastes repeated construction and capital investment, but also is prone to problems such as information islands and incompatibility of technical standards. Multi-sectoral, multi-system, multi-channel operation, traceability chain docking difficulties, traceability information does not share, it is difficult to achieve complete information tracking and traceability.

In addition, the efficiency of information collection, transmission and exchange in agricultural production is restricted by technology. In our country, automatic identification technology is mainly used to record and query product information, and it develops rapidly, but barcode technology is the main technology. Radio Frequency Identification (RFID) technology has good technical performance and high efficiency, but if it is to be widely used in the agricultural Internet of Things, in addition to the constraints of high hardware costs, another big problem is that the Internet of Things needs to break through the management technology of terminal modules. Nowadays, Internet of Things (IOT) technology adopts C/S mode to manage terminals. A large number of IOT modules need to communicate with management platform, transfer data frequently and synchronize between systems. And for the highly dispersed and diversified quantities of e-commerce agricultural products

As a matter of fact, this technology mode will cause enormous cost of system construction and management.

The Management of Quality and Safety Traceability System is Difficult and Inefficient

Agricultural products management in China is characterized by "long distance, multi-link and large circulation". The main parties involved in agricultural products are not only producers and consumers, but also acquisition, storage, transportation and sales. There are many uncertain factors affecting the efficiency of the system operation and management is difficult. The management of the whole system is divided into technology management and system management. Technical management mainly includes various kinds of signs, data storage, data acquisition and transmission, and system management is mainly the laws and regulations issued by various regulatory departments. The contents are very complicated, such as China's Guidelines for Traceable Coding of e-commerce agricultural Products, Coding Rules for Origin of e-commerce agricultural Products, 128 Bar Codes for Commodities and 128 Bar Codes for Agricultural Products. Quality and Safety Law, Measures for Safety Management of e-commerce agricultural Products Origin, etc., as well as various guiding opinions, temporary regulations and trial norms, if all of them are supervised and managed by means of manual participation, their work difficulty and workload are imaginable.

Uality and Safety Traceability Industry Lacks Effective Business Models

Business model is the key factor to determine the sustainable development of the whole industry. At present, although the traceability system of e-commerce agricultural product quality has taken shape, it has not yet explored an effective business model. Many details of the traceability system have room to improve quality and value. Public distrust and high cost increase make enterprises in the industrial chain unable to see the value brought by the traceability system of e-commerce agricultural product quality. Therefore, it is difficult to form a situation of common aspirations. In addition, the whole industry has not produced effective big data, and the added value of the industry has not been revealed. In the absence of endogenous power and industry added value, it will not attract the attention and support of financial institutions and over-the-counter funds.

BlockChain Technology and Its Advantages

Blockchain technology originated from the technology application of bitcoin in 2008. After continuous development and evolution, the application technology paradigm characterized by distributed general ledger, consensus trust, asymmetric encryption, intelligent contract and timestamp has been formed. Most importantly, Blockchains can build people's confidence in

collaboration without central authority, which is the product of solving trust problems by mathematical methods.

The main characteristics of Blockchain technology can be summarized into four aspects: decentralization, consensus trust, collective maintenance and reliable database. One is to go centralization. There is no centralized hardware or management organization in the whole network. The rights and obligations of any node are equal, and the damage or loss of any node will not affect the operation of the whole system. The two is consensus trust. Nodes participating in the whole system need not trust each other, the operation rules of the whole system are open and transparent, and all the data content is open. Therefore, within the scope and time of the rules specified by the system, the nodes cannot and cannot deceive other nodes, and the trust relationship between nodes is achieved by this system. The consensus is that trust and trust are low cost. Three, collective maintenance. The data blocks in the system are maintained by all the nodes with maintenance function in the whole system. They no longer bear the risk of system failure for the collapse of a database, and these nodes with maintenance function are entitled to participate by anyone. The four is a reliable database. Because of the use of asymmetric encryption and hashing algorithm, data recording and transmission is true and unalterable. And the whole system will be in the form of distributed database, so that each participating node can get a copy of the complete database. Take the Bitcoin Blockchain as an example, unless it can control more than 51% of the computing power of the whole system at the same time, the modification of the database on a single node is invalid, and it cannot affect the data on other nodes.

Based on the above characteristics, the application of Blockchain has gone beyond the scope of encrypted currency, and gradually expanded, and formed the development trend of "Blockchain+", which mainly covers intelligent contracts, securities trading, e-commerce, Internet of Things, social communication, document storage, existence certification, identity verification, shareholding crowdsourcing and society. Management and other fields.

Construction of Traceability System for E-commerce Agricultural Products Quality and Safety Using Block Chaining Technology

The main contradictions faced by China's agricultural product quality traceability system are: there are many participants and they are scattered, so it is impossible to manage and operate in a centralized way; data and information integration is difficult, and it is difficult to establish the trust relationship between all parties in the industry. The characteristics of blockchain technology, such as distributed accounting, decentralization, collective maintenance, consensus trust and reliable database, provide a solution to the above problems.

Introduction of Quality Chain Traceability System for Blockchain E-commerce Agricultural Products

The agricultural product quality traceability system based on blockchain technology overlays the operational rules of the agricultural product quality traceability system according to the hierarchy of the blockchain system (data layer, network layer, consensus layer, incentive layer, contract layer and application layer) (as shown in Figure 1). In the blockchain system, the rights and obligations of any node are equal. Under the protection of encryption technology, consensus mechanism and reliable data, the participants of the traceability system complete every link of the work according to the business operation process, with real information and mutual trust. There is no centralized management in the whole system. Agencies cannot even build hardware systems such as servers. The cost of system construction, management and collaboration has been greatly reduced, the integrity and accuracy of information and data have been greatly enhanced, and the industrial value has been recognized and promoted.

The scheme chooses "alliance blockchain" as an organizational form. Unlike the "public blockchain" in which anyone can read and send transactions, or the "private blockchain" in which only the core nodes can operate the blockchain, it shows centralized control. The consensus process

of the alliance blockchain is managed by several main nodes. This form not only ensures the efficiency of the organization's operation, but also ensures the efficiency of the organization's operation. It can take into account the characteristics of system security and common maintenance of members. The Federation blockchain is also known as the "multi center" blockchain. At present, the R3 alliance adopts this form of organization.

From the bottom to the top, the basic data comes from the whole life cycle of farming, production, processing, packaging, transportation, sales and consumption of e-commerce agricultural products. The basic data is transmitted to the data layer and recorded in the blockchain following blockchain format, encryption and decryption algorithm, transmission mechanism and time stamp. The network layer stores blockchain in the database of related nodes according to authentication, access management and P2P mechanism. The data layer and the network layer guarantee the generation and transmission of the blockchain at the technical level. Consensus layer echoes the decision-making characteristics of alliance blocks, and uses the consensus mechanism of membership access similar to POS or DPOS. The Ministry of Commerce and the Ministry of Finance are the leading departments of the government to form the alliance. Other relevant government departments, enterprises and organizations join the blockchain as member nodes after being examined and approved by the alliance. The access mechanism can carry the audit and management of enterprise qualification by the government departments, and ensure the legitimacy and compliance of the participants. For the incentive layer, because the consensus mechanism adopts POS and other algorithms, the alliance node maintains the fairness and competitiveness of the work, the system does not need to use the "mining" workload like Bitcoin to obtain the legitimacy of writing blockchain, so the function of the incentive layer is weakened and not reflected in this framework. The contract layer embeds the important contents of national regulatory policies, legal provisions, industry standards and action outlines in the form of intelligent contracts in the blockchain, and realizes the automation and mandatory implementation of some industry regulatory functions, which can effectively alleviate the contradiction of inefficient human supervision. The application layer adopts B/S technology framework to provide information query function to consumers, enterprises and government/organizations through the agricultural product quality traceability information portal, and at the same time to support the call center service.

Characteristics and Advantages of Traceability System for Blockchain E-commerce Agricultural Products Quality and Safety

First, we should improve the enthusiasm of the participants with flexibility. The distributed desk account system of alliance blockchain is mainly constructed by government departments, institutions and large enterprises respectively. Small enterprises with light volume and high cost sensitivity can choose not to store accounts locally according to their business needs. This situation can be achieved through the commercial API and open source API interfaces provided by large nodes. Small nodes can write transactions in blockchain after invoking API. At the same time, full copies can be obtained by invoking API. Each record is traceable and verifiable.

The two is to solve the technical problems of e-commerce agricultural Internet of things by de centralization. In addition to the decentralization of retrospective information management, blockchain can also solve the technical problems of large-scale application of the agricultural Internet of Things in a decentralized way. In the future, there will be billions of information acquisition modules in the Agricultural Internet of Things. Data exchange between the nodes of the Internet of Things and the central platform makes it almost impossible for the central platform to centralize the management of nodes and data. Under the blockchain system, the IOT module can implement encryption algorithm, Distributed Accounting and consensus trust mechanism by means of built-in chips. After the IOT data is collected, it can be directly written into the data blocks and recorded into the blockchain without being recognized by the central role, and then entered into the whole traceability system.

Three is to collectively promote the unified and effective industrial data. All data in the blockchain database will be updated and stored in the system of the participating nodes in time. Each node in the

whole network also records the correctness of the results of other nodes while participating in records. The authenticity of the record can only be recognized by the whole network if most (or even all) of the nodes in the network agree that the record is correct at the same time, or when all the nodes involved in the record agree on the result of the comparison. Under this mechanism, the transaction information of the quality traceability system is collectively maintained by the participants, which not only ensures that all parties in the industry build large data together, but also reduces the systemic risk of the central management system being attacked by hackers or fraudulent central database.

The four is to innovate business common belief and mode with technological advantages. With the technical advantages of collective maintenance and encryption algorithms, blockchain can solve the trust problems of commercial activities at low cost and build a multilateral decentralized trust environment. The credibility of the business environment will gradually be verified and the credibility of the public to the traceability system will be reconstructed to increase the social effect of national projects. Really realize the management ideal of "the main body of responsibility has the record, the production process has the record, the main responsibility can be traced, the product flow can be traced, the risk hidden danger can be identified, the harm degree can be assessed, and the supervision information can be shared". When the internal collaboration mechanism is mature, the main body of the industry works together, the big data accumulates gradually, and the external influence expands gradually, the business model will mature rapidly under the drive of internal and external forces.

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