

# Reconstruction Research on rural cold chain logistics from the perspective of blockchain Technology

Mei Baolin

Xinyang College of agriculture and forestry (Xinyang 464000)

**Abstract:** Starting from the development of blockchain technology, this paper takes the construction of cold chain logistics under the rural background as the research object, and discusses the new mode brought by blockchain technology to improve the rural cold chain logistics. The decentralization of blockchain technology, data tamper prevention and traceability, and node transmission mechanism will bring data records of the whole process of cold chain logistics from the place of supply to the place of sale, giving cold chain logistics global positioning system, intelligent temperature control and the construction of the Internet of things three aspects to improve, which can achieve better implementation of rural cold chain logistics. The research shows that based on the problems of "the first kilometer" and "the last kilometer" under the current background of rural cold chain logistics, cold chain logistics combined with blockchain technology will bring about the deep integration of mode and technology. Finally, the paper puts forward the development suggestions and management enlightenment of current blockchain for rural cold chain logistics.

**Key words:** Blockchain; Cold chain logistics; Rural constructions

## 1. Rural cold chain logistics continues to develop under the attention of the state

With the continuous improvement of the national economy, food safety has been paid more and more attention. But in the category of fruits and vegetables of China's agricultural products, the annual loss is nearly 100 billion yuan. The interests of businesses and farmers have been seriously damaged, and the demand for consumption is also difficult to meet. At present, the comprehensive cold chain circulation rate in China is only 19%, and the cold chain circulation rate in Europe and America is more than 95%. According to document No. 1 of 2019, the state will continue to strengthen the development of modern agriculture, rely on county-level regions to form agricultural product processing industry clusters, change the pattern that rural areas are the origin of raw materials and cities are the processing places, so that the industrial chain will remain in the county, encourage the County to develop fine processing and deep processing of agricultural products, and build processing industry counties and towns and specialized towns of agricultural products. On July 30, 2019, the Political Bureau of the CPC Central Committee meeting deployed the economic work in the second half of the year, required to deepen the supply side structural reform around "consolidation, enhancement, improvement and unimpeded", improve the industrial infrastructure and industrial chain level, and clarify the implementation of the construction project of urban and rural cold chain logistics facilities.

At present, China's logistics shows the following trends. First, the scale of infrastructure has expanded. From the perspective of national cold chain logistics, the total capacity of cold storage and the number of refrigerated vehicles and insulated vehicles are increasing. The third-party cold chain logistics enterprises continue to grow, showing a large-scale, networked development trend. The trend of market segmentation, cross-border competition and global layout is on the rise. Secondly, the industry development

model continues to innovate. With the continuous development of e-commerce, fresh food, cross-border e-commerce and o2o markets continue to expand. In order to comply with the diversification of consumer demand of urban and rural residents, the development level of cold chain logistics continues to improve. Cold chain transportation and storage enterprises began to realize the transformation to comprehensive cold chain logistics service providers, and realized the innovative development of cold chain logistics mode. Finally, the standardization level of the industry is improving. The national department has issued a series of standards for the cold chain logistics industry, effectively promoting the large-scale operation of cold chain logistics enterprises, accelerating the formation of market order, and further promoting the standardization process of cold chain logistics.

## 2. The necessity of applying blockchain technology to agricultural products cold chain logistics under the new situation

Cold chain logistics is a kind of logistics activity based on refrigeration technology. The main difference from the main logistics mode is that in order to ensure the quality of goods and reduce the consumption of goods, the goods need to be under the specified temperature control in the whole process from production to sales. Cold chain logistics is not only an activity in the supply chain, but also a systematic project to ensure the quality of goods. The freezing process is applied in all links of production, storage, transportation, sales and consumption, as shown in Figure 1.

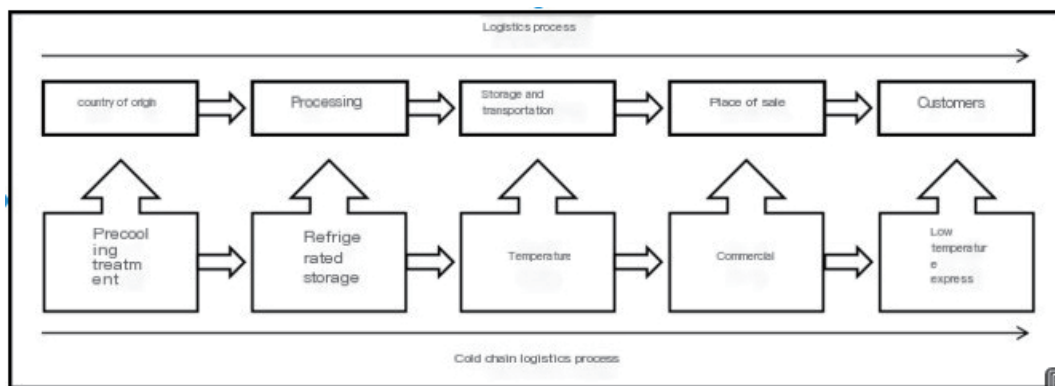


Figure 1 cold chain logistics process diagram

### 2.1 Blockchain technology features

Blockchain technology is essentially a set of technical means to solve trust problems. The main characteristics of the logistics process that can be accessed by other participants through digital information recording are that the data can not be tampered with through distributed data storage, the rapid recording of information can be realized through point-to-point transmission, the efficiency of information identification of multi-party participants can be improved through consensus mechanism, and the whole channel circulation of information can be realized through transparent sharing and equality. By combining these technologies in a new way, the stored data can be prevented from being tampered with, and the data can be traced to the source for viewing. Finally, the cost of multi-party trust can be reduced. Blockchain provides a low-cost trust solution for the interconnection of all things and the authenticity of data, which provides the basis for the construction of data infrastructure and enables interaction among trusted parties.

The value of blockchain technology is mainly reflected in three aspects: decentralization, data tamper prevention and traceability, and node transmission mechanism. First of all, decentralization means that the database is distributed, which can realize the decentralization of data storage. Due to its own consensus mechanism, it can realize the decentralization of management system. Different from the traditional supply chain business, blockchain can effectively avoid the occurrence of industrial monopoly. The partial decentralization and Wanquan decentralization capabilities are to maintain the fairness of the business platform. Weakening the centralized management is more conducive to SMEs' playing an important role in the supply chain system.

Secondly, data tamper prevention means that the traceability in the supply chain can be realized through cryptography technology and hash Traceability Technology, which effectively avoids data tampering by participants. Unlike traditional databases, the distributed storage of databases under the blockchain can effectively prevent participants on the chain from modifying data. Even if the data is modified, it will not affect the authenticity of the original data, which greatly enhances the trust of data and reduces the cost of data fraud.

Finally, the node transmission mechanism is a trusted point-to-point transmission mechanism. P2P network can satisfy point-to-point transmission, and the trigger contract is automatically executed by using programming code through smart contract, thus realizing the construction of trust mechanism. The contract program

automatically builds a trust environment under point-to-point transactions, anchoring digital assets and actual value, and the trust network built in the blockchain, which will facilitate the circulation in the future with multi scenario mode.

The core significance of blockchain is to realize the trusted value circulation by using the technology system composed of a variety of technologies and technology collaboration. Blockchain realizes data minimum cost trust by building a consensus decentralized ecosystem. The tamper proof and traceable data storage mode of blockchain, coupled with a trusted transmission mechanism, can well achieve value storage and quantification.

### 2.2 Feasibility and necessity of applying blockchain technology to cold chain logistics

In the context of "Internet +" in rural areas, rural commerce is in a growing stage. According to the data of the Ministry of Commerce, the national online retail sales of rural products reached nearly 137million yuan in 2018, and the national online retail sales of agricultural products reached 230.5 billion yuan, with the rapid development of rural e-commerce. As a member of the industrial Internet, how to improve the quality of agricultural means of trade, agricultural equipment leasing and product sales still need to be improved. Industry leaders are actively looking for new methods of rural development, taking the Internet as the basic means, promoting agricultural construction as the basis, constantly strengthening the rural e-commerce system, accelerating the penetration of e-commerce into the countryside, using the e-commerce platform, realizing the construction of rural related Internet sales network, and completing the transformation of agricultural products from the traditional sales mode to the new mode of e-commerce supply chain.

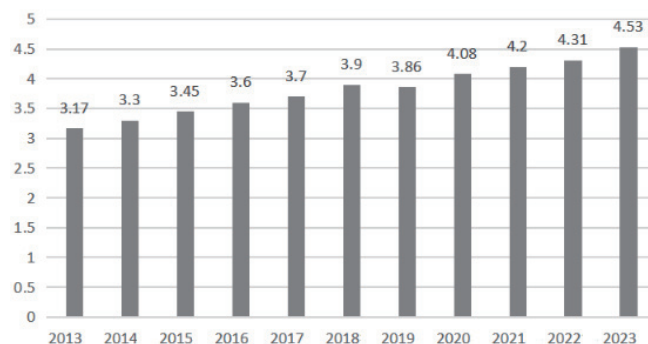


Table 1 Statistics and forecast of total logistics volume of agricultural products in China

The total logistics volume of agricultural products will exceed 4trillion yuan. In recent years, the total logistics volume of China's agricultural products has been increasing year by year. According to the analysis report on the market prospect and investment strategic planning of China's agricultural cold chain logistics industry, the total logistics volume of domestic agricultural products reached 3.03 trillion yuan in 2012, which increased to 3.7 trillion yuan in 2017, an increase of 2.78% year-on-year. By 2018, China's total agricultural product logistics had reached 3.9 trillion yuan, a year-on-year increase of 3.5%, and the growth rate was 0.4% lower than that of the same period last year. According to the data, it is predicted that the total logistics volume of China's agricultural products will reach 3.86 trillion yuan by 2019, and will exceed 4trillion yuan by 2020. It is predicted that the total logistics volume will reach 4.53 trillion yuan in 2023, and the compound annual growth rate from 2019 to 2023 will be 4.08%.

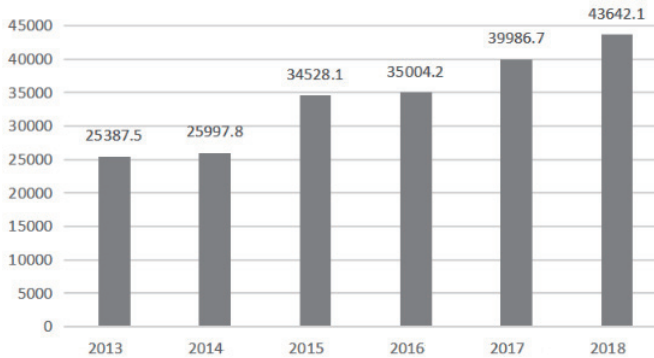


Table 2 total cold chain logistics of agricultural products in China

In terms of the total amount of agricultural products cold chain logistics, statistics show that as of 2017, the total amount of China's agricultural products cold chain logistics was nearly 4trillion yuan, and the total amount of social logistics reached 252. 8 trillion yuan, accounting for only 1.6%. The market space is very broad, and there will be room for further development of the logistics market of agricultural products in the future. At the same time, there will be more demand in the cold chain market. In 2018, the total amount of China's agricultural products logistics cold chain will exceed 4trillion yuan.

At present, the cold chain logistics of agricultural products also has its own shortcomings, and transformation and upgrading is the only way. The defects of cold chain of agricultural products are mainly reflected in the following two aspects. First, the degree of marketization of cold chain logistics of agricultural products is not high. The cold chain market in developed countries is relatively

mature, and the industry has formed outsourcing services to contract perishable agricultural products to high-quality cold chain logistics companies, making the market division of labor continuously refined and specialized, which to a large extent ensures the freshness and safety of agricultural products and reduces the loss in the logistics process. Secondly, the relevant regulations and standardization of domestic agricultural cold chain logistics need to be improved. The realization of full traceability of the logistics process of fresh products can effectively protect the interests of all parties. Domestic support for cold chain logistics of agricultural products is very strong, but it lacks a relatively perfect guarantee mechanism. In order to ensure the food quality and safety of cold chain logistics, a complete agricultural cold chain logistics system needs to be established.

### 3. Construction of agricultural products cold chain logistics mode based on blockchain Technology

#### 3.1 Blockchain gives new value to cold chain logistics

In order to ensure the quality of agricultural products in cold chain logistics, the sustainability of low temperature environment and the kinetic energy of data transmission, blockchain will endow the project with some new technologies and modes. The first is the global positioning system. When the blockchain Technology Award positioning system is applied to cold chain logistics, it can realize real-time recording of data information, and ensure the credibility of the product's location information during the transportation time. It can achieve real-time location query of transportation vehicles, and can effectively trace the data source. In the later stage, the troubleshooting problem has been effectively guaranteed. The second is the intelligent temperature control technology. In order to ensure the quality of products, it is necessary to achieve the whole process temperature control. With the help of the whole process cold chain circulation technology, commodities can be in a dormant and quality guaranteed state. Through the whole blockchain quality monitoring, we can avoid the loss of products and reduce the high cost caused by transportation loss. Finally, there is the Internet of things technology. The products of the Internet of things technology awards endow the network with value. In the network, it realizes visual management, controls the low-temperature insurance status of products to the greatest extent, collects temperature information at any time, and can realize the alarm processing mechanism with the help of blockchain technology to reduce the loss caused by uncontrollable conditions in the process of freight transportation and reduce the logistics cost.

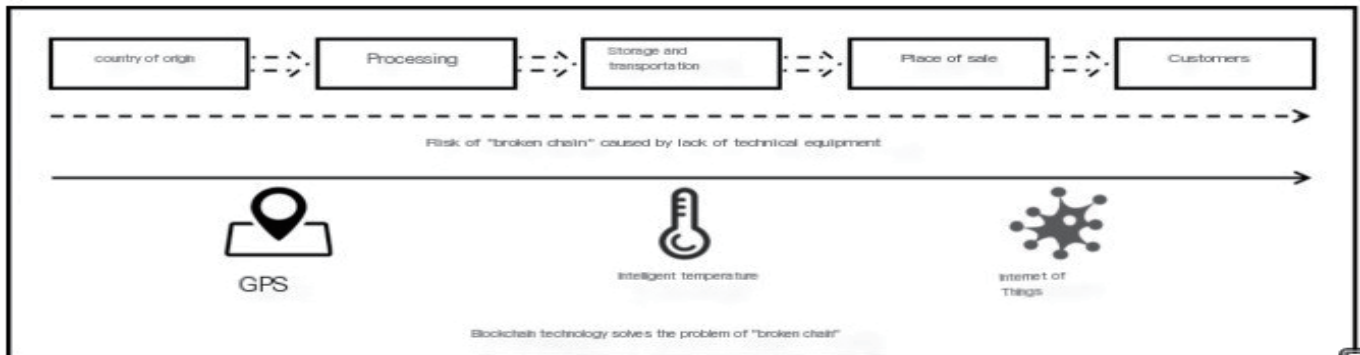


Figure 2 new value of blockchain to cold chain logistics



### 3.2 Seize the "first kilometer"

In the whole logistics supply chain, "the first kilometer" refers to the distance between raw material suppliers and manufacturers in the upstream of the supply chain. The first kilometer is the cornerstone of the whole cold chain supply chain system. In rural areas, it is difficult to ensure the freshness of agricultural products due to the imperfect infrastructure construction such as cold storage. Therefore, graded storage of perishable agricultural products after picking is an important guarantee for the subsequent circulation of agricultural products. The construction of cold chain front end has become the most concerned place of traditional logistics enterprises and self operated e-commerce.

The e-commerce platform, taking jd.com as an example, established the fresh food business department to achieve strategic cooperation with leading enterprises in the industry and develop projects in cold chain logistics. The layout is mainly focused on warehousing, procurement of products of origin and other services. E-commerce companies make great efforts to build collaborative warehouses to ensure that they can obtain the lowest cost of product procurement in the origin of agricultural products. This greatly reduces the time consumption of intermediate links and product

consumption, and realizes the direct delivery from the production area. Collaborative warehouse can also be combined with rural e-commerce, relying on cold chain logistics technology, which can solve the problem of distance between rural areas and consumer areas, and realize the entry of agricultural products into cities. The advantage of e-commerce platform over express companies is that e-commerce enterprises can use the advantages of their own e-commerce platform to achieve the effective connection between production and sales, and express companies have less influence than e-commerce enterprises.

Express companies, taking SF as an example, mainly rely on their accumulated advantages in the logistics cold chain to realize the cooperation with railway transportation and other companies to layout the countryside and seize the front-end market of agricultural products cold chain logistics. Through the end-to-end cold chain logistics service, the database can be established during the warehousing of agricultural products, and the tamper proof data can be established through the advantage of distributed data. Such cold chain logistics services are recorded after the agricultural products are picked, which can effectively reduce the cost of temperature control services and ensure the accurate control of staff.



Figure 3 blockchain technology helps "the first kilometer"

### 3.3 Competition "last mile"

The last kilometer" refers to the distance from the product to the customer, which is also the key part of the transportation process, that is, the completion of consumption. How to ensure that agricultural products enter the last kilometer in the best state and continue to maintain the product quality in the whole logistics process is the focus of many logistics enterprises and self operated e-commerce platforms.

Blockchain technology gives information and data on the supply chain of each agricultural product after warehouse withdrawal, and the temperature control during transportation is all written into the blockchain. It can truly realize the traceability process of each agricultural product. When the node information of agricultural products is recorded in each cold chain transmission process, the temperature drop brought by real-time monitoring is effectively guaranteed, so the quality of products will be further guaranteed. Monitor the timeliness of the process. It is more reflected in the quality assurance of perishable products. Once problems occur, it can effectively avoid the deterioration of other

agricultural products during transportation and reduce consumption. When the products are handed over to consumers, the information and data of agricultural products can still be queried by consumers. This effectively reduces the trust cost in the transportation of agricultural products. Consumers can query the whole process of purchasing, cold storage, transportation and entering the platform or store. It overcomes the information barriers between multiple participants, effectively achieves information fairness, and effectively breaks the information trust gap.

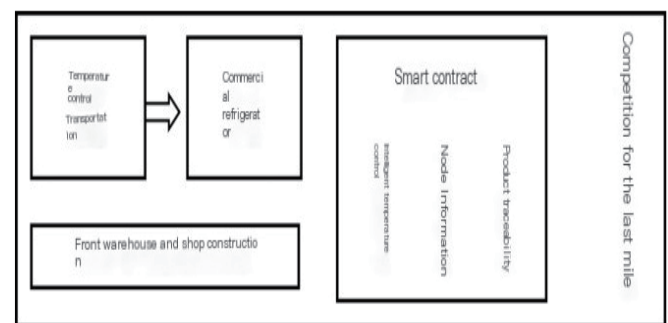


Figure 4 blockchain technology helps "the last mile"

## 4. Suggestions on the management of agricultural products cold chain logistics mode based on blockchain Technology

As a special form of supply chain under the supply chain system, cold chain logistics has huge development prospects in the process of increasing demand, especially in the rural context, mainly in the following aspects: there are prominent structural contradictions in the construction of rural cold chain infrastructure; The popularization of technical equipment, especially blockchain technology, needs to be improved; Cold chain logistics still lacks leading enterprises to lead the market development; The new technologies and models represented by blockchain have not yet been fully applied in the business model; The construction of service specification system and logistics standards still needs long-term exploration and improvement. In view of this, starting from the construction of agricultural products cold chain logistics mode under the blockchain technology, combined with the current situation, this paper gives the corresponding management suggestions.

Popularize the basic application of blockchain technology. At present, the cold chain system lacks the necessary positioning system, and even the temperature control system and other equipment are lack of layout. The whole storage, transportation and order management of the detachment has brought great security risks. The lack of information equipment in the cold chain logistics enterprises has caused great "chain breaking" risks for monitoring. Under the guidance of the government, realize the effective upgrading of technical equipment. At present, the mainstream traditional means of enterprises can not effectively meet the requirements of "the last mile", so manufacturers need to pay attention to increasing investment in technical equipment. Speed

up the most basic application of blockchain, and the problems of temperature control and data traceability will be effectively solved.

Leading enterprises are encouraged to lead the market. As far as the logistics industry is concerned, the concentration of China's cold chain logistics enterprises is low, the professional third-party cold chain logistics is in the early stage of development, and it is difficult to effectively guarantee the capital, technology and scale strength. The construction of the cold chain logistics network in the whole system is slow, and it cannot adapt to the current scale economic development. Therefore, it is necessary to promote the rapid development of leading enterprises with the encouragement of government departments to demonstrate and drive the development of market prospects. In the process of practice, leading enterprises should effectively control the operation cost in advance, improve the service level, and meet the combination of urban and rural production and marketing areas. Under the leadership of leading enterprises, the potential of cold chain logistics will be effectively brought into play.

Accelerate the integration and popularization of digital technology and business model. Although cold chain logistics has been proposed for many years, it is difficult to promote and popularize new technologies and new business models because they are still in the initial stage. The popularity of business model needs to be combined with the rapid development of digital technology, and also needs to rely on an appropriate market. Agricultural product suppliers should get rid of the dependence on traditional technology. Rural villages and towns should adapt to new technology as soon as possible, and bring farmers into the learning object to do a good job in technology popularization. The popularization of infrastructure and digital technology needs to be carried out simultaneously to improve the operation efficiency and development level.

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