Research on Cold Chain Logistics of Agricultural Products in Guangxi Based on The Perspective of the Internet of Things

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Abstract . In recent years, with the continuous improvement of people's living standards, the quality, safety, and freshness of agricultural products have attracted high attention and widespread attention. Introducing IoT technology in agricultural cold chain logistics can not only improve the quality and safety of agricultural products, but also improve the circulation efficiency of agricultural products. Based on this, this article takes Guangxi as an example and analyzes the development status of agricultural cold chain logistics in Guangxi from the perspective of the Internet of Things. It is found that there are problems with outdated infrastructure, large logistics transportation losses, and imperfect industry related policies and regulations in Guangxi's agricultural cold chain logistics. Based on the perspective of the Internet of Things, it proposes to strengthen the construction of cold chain logistics infrastructure Strict control and reduction of cargo damage rates, as well as suggestions for improving industry related policies and regulations, can provide reference value for the circulation of local agricultural products and the sustainable development of the agricultural economy.

Keywords: Internet of Things; Agricultural products; Cold chain logistics

1 Introduction

In today's rapidly developing science and technology, people's pursuit of living standards has moved towards convenience, modernization, networking, and intelligence, and the main core of these functions is based on the Internet of Things [1]. However, from a scientific and technological perspective, Guangxi is still in a stage of exploration and adaptation in terms of IoT technology. Therefore, there are still some problems that need to be improved and upgraded in the application of IoT technology in cold chain logistics in Guangxi.

At present, the cold chain logistics of agricultural products has attracted widespread attention from many scholars. Li Yaqi (2022) started from the current situation of cold chain logistics for aquatic products in China, analyzed its existing problems in depth, constructed a cold chain logistics system for aquatic products based on Internet

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of Things technology, and proposed a perfect way for the smooth operation of the system, thereby achieving full monitoring and traceability of cold chain logistics, reducing logistics costs, and improving management efficiency [2]. Zhao Zhihao (2022) and others proposed to build a "smart online+smart offline" retail model for agricultural products based on the Internet of Things technology, in order to address the current problem of asymmetric customer demand information in the cultivation of fresh agricultural products [3]. Tang Xiaohua (2022) and others analyzed the pain points of cold chain logistics for fresh agricultural products and proposed a block-chain technology based cold chain logistics information sharing model for fresh agricultural products, to improve information transparency and security, and improve the overall efficiency of cold chain operation for fresh agricultural products. In summary, some scholars have applied IoT technology to research on agricultural product logistics and have achieved certain results. Based on this, this article takes Guangxi as an example and analyzes the development status of agricultural cold chain logistics in Guangxi from the perspective of the Internet of Things. In response to its existing problems, it proposes a development strategy for agricultural cold chain logistics based on the Internet of Things technology, with the aim of playing a guiding role in accelerating the development of agricultural cold chain logistics in Guangxi, thereby stimulating the vitality of agricultural product circulation in Guangxi and improving people's quality of life.

2 Definition of Relevant Concepts

2.1 Concept of the Internet of Things

The Internet of Things is based on the Internet as the foundation and core, achieving intelligent, automated, and informationized identification, positioning, monitoring, tracking, and management of items and processes at any time and place through the interconnection and interconnection between items and people. For agricultural cold chain logistics, the application of IoT technology is crucial. The Internet of Things technology can effectively manage the entire process of agricultural products from production to sales through information technology. Sensors can measure and control the temperature and humidity inside refrigerated transportation vehicles for agricultural products in real time. Global positioning systems can accurately determine the information position of items at any time. Radio frequency identification technology includes readers and labels, which can make items "speak up", as well as infrared sensors Laser scanners and embedded system technology can be applied to various aspects of cold chain logistics.

2.2 Cold Chain Logistics of Agricultural Products

Agricultural cold chain logistics, also known as low-temperature logistics and perishable food cold chain in the industry, refers to a special professional logistics established to meet consumers' demand for fresh agricultural products (including fruits,

vegetables, aquatic products, meat, poultry, eggs, and other agricultural products). It is mainly based on refrigeration technology, and refrigeration technology is used as a means to allow cold chain agricultural products to be processed and transported after being picked in the field Every aspect of storage, sales, and even in the hands of consumers is always in a suitable low-temperature environment, that is, agricultural products with different quality assurance characteristics need to use corresponding low-temperature standards to control the temperature of the place where the agricultural products are located, in order to maximize the quality and safety of agricultural products and reduce their loss [4]. With the development of modern information technology, especially the application of representative Internet of Things technology, the management and operation of the processing, storage, transportation, distribution, and distribution of agricultural cold chain logistics have become more efficient, safe, and controllable [5].

3 The Necessity of Deep Integration Between the Internet of Things and Agricultural Cold Chain Logistics

Compared with traditional logistics, agricultural cold chain logistics has the following characteristics: firstly, agricultural cold chain logistics requires timeliness, as fruits, vegetables, and other agricultural products generally have a short shelf life, are prone to decay, and are difficult to store. Moreover, during the circulation process, the quality of agricultural products is affected by factors such as transportation time, oxygen content, temperature and humidity, and climate. Once the time is too long and the temperature is not suitable Excessive climate change and other factors can easily cause qualitative changes in agricultural products, which can lead to higher timeliness requirements for agricultural cold chain logistics [7]. Therefore, each link of agricultural cold chain logistics must have higher organizational and coordination capabilities to effectively connect, in order to ensure the freshness of agricultural products and prevent greater economic losses caused by agricultural product decay [6]; Secondly, the high cost of agricultural cold chain logistics determines that the construction and investment of agricultural cold chain logistics are much higher than that of conventional warehouses and transportation vehicles. In order to significantly improve the efficiency and management of cold chain logistics, the facilities and equipment required for agricultural cold chain logistics, such as refrigerated trucks, low-temperature cold warehouses, and temperature control equipment, are determined to be much higher, even five times that of ordinary warehouses and vehicles, The implementation of intelligence driven by the Internet of Things technology is also one of the reasons why the cost of agricultural cold chain logistics is higher than that of conventional logistics; Finally, due to the complexity of agricultural cold chain logistics, temperature control technology during transportation is the core technology of cold chain logistics[7]. Temperature control is not only cold, but mainly constant temperature. During the transportation of agricultural products, refrigerated trucks must consider various objective factors to control the temperature within a suitable range. Poor remote control signals and power supply issues may cause significant fluctuations in

the temperature during transportation, and refrigeration technology is also applied Food processing, food multi temperature co mixing, food quality monitoring technology, interlayer technology, and other technologies require some products to ensure compliance with relevant food safety standards. The market concentration of agricultural cold chain logistics is not high, and all of these factors make agricultural cold chain logistics more cumbersome compared to conventional logistics [8]. In order to ensure the quality and freshness of agricultural products, it is necessary to deeply integrate IoT technology with cold chain logistics of agricultural products, in order to ensure that agricultural products are controllable and traceable throughout the entire logistics process. The specific operations are shown in the following figure1.

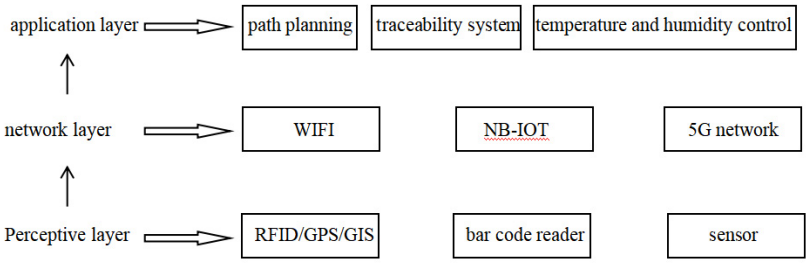

Fig. 1. Framework of Agricultural Product Cold Chain Logistics System Based on the Internet of Things

4 Problems in Cold Chain Logistics of Agricultural Products in Guangxi

4.1 Backward Cold Chain Logistics Infrastructure

The development of cold chain logistics transportation in Guangxi is relatively late, and there is still great room for progress in cold chain logistics facilities and equipment. The coastal areas are the main concentration areas of cold chain infrastructure in Guangxi, with uneven distribution. Agricultural products need to be in a low-temperature environment at all circulation links from the field to the dining table to ensure the effectiveness of cold chain logistics for agricultural products and prevent losses during the circulation process. This requires agricultural cold chain logistics companies to be equipped with sufficient cold chain logistics transportation and basic storage facilities throughout the entire process. However, due to the economic situation of agricultural cold chain logistics companies themselves, there are not many warehouses with modern functions such as preservation and refrigeration. The majority of agricultural cold chain transportation equipment uses open-top trucks and medium-sized vans, and some cold chain transportation vehicles do not have IoT information sharing functions such as temperature and humidity monitoring and real-time status monitoring of goods, which is not conducive to the information management process of cold chain transportation, Even some small enterprises do not have the ability to purchase advanced refrigerated transportation equipment, and have been

using room temperature logistics when transporting agricultural products, resulting in a high loss rate of agricultural products [9]. Building IoT infrastructure can effectively reduce costs and improve management efficiency for the transportation of agricultural cold chain logistics.

4.2 Large Logistics Transportation Losses

The lack of basic equipment for agricultural products often affects the processing, storage, loading and unloading, transportation, and other processes of cold chain logistics due to factors such as time, environment, temperature, humidity, speed of operation, and turbulence, resulting in problems such as agricultural product decay, wilting, damage, and deterioration. The proportion of consumed agricultural products is relatively large and the loss rate is high.

At present, technologies such as information tracking, temperature and humidity monitoring, and information management in the Internet of Things can play a significant auxiliary role in the cold chain transportation process of agricultural products. However, the cold chain logistics system of agricultural products in Guangxi is in its early stages, and technological development still lags behind. It has become a factor that hinders the development of cold chain logistics based on the Internet of Things, often leading to interruptions and breakpoints in cold chain logistics, This is also one of the reasons for the high loss of agricultural products [10]. If the decay rate cannot be reduced, it will become an important factor hindering the development of cold chain logistics for agricultural products in Guangxi.

4.3 Incomplete Policies and Regulations Related to the Industry

In the process of applying IoT technology to cold chain logistics, mandatory unified standardization can reduce conflicts and disagreements in application. Therefore, in order to promote the better application of Internet of Things technology in cold chain logistics, it is necessary to improve its standard specification system. This is mainly reflected in the implementation of standardization construction in multiple links of cold chain logistics transportation, and the backwardness of standardization construction has limited the main factors for the development of Internet of Things technology in cold chain logistics. At present, there is no unified standard system for the temperature and humidity control range, cold chain logistics operation process, and other aspects that can apply IoT technology in agricultural cold chain logistics. There are many reference standards, but there are still relatively few mandatory standards to be enforced, resulting in a lack of reference standards for various operational stages of agricultural cold chain logistics, and there are phenomena such as different requirements, non-standard operations, and poor management [11]. However, the introduction of IoT technology into cold chain logistics is relatively late and involves relatively few relevant specifications, so it is easy to cause problems such as difficult real-time data sharing and difficult data integration, which restrict the development of cold chain logistics in Guangxi.

5 Suggestions for Promoting the Deep Integration of the Internet of Things and Agricultural Cold Chain Logistics

5.1 Applying the Internet of Things to Cold Chain Infrastructure Construction

The rapid development of cold chain logistics for agricultural products in Guangxi cannot do without the support of IoT infrastructure and technology. Each cold chain logistics enterprise needs to strengthen the construction of IoT infrastructure according to their actual needs, accelerate the construction of a batch of efficient and energy-saving "low-carbon cold storage". In the long run, in order to cause unnecessary maintenance costs and high energy consumption in the later stage, it is necessary to abandon low-quality insulation walls and refrigeration equipment, and adopt multi-functional and low-cost cold storage and refrigeration facilities that incorporate IoT technology. In the process of cold chain logistics transportation of agricultural products, enterprises can apply Internet of Things technology to cold chain logistics systems. The introduction of Internet of Things technology greatly improves the level of cold chain logistics management in vehicle transportation scheduling, effectively monitors the entire process of cold chain logistics, and can conduct visual monitoring and traceability of cold chain product logistics to ensure the quality and safety of agricultural products.

5.2 Strict Control and Reduction of Cargo Damage Rate

The cultivation process of agricultural products is of great significance as the beginning of product control. Firstly, in terms of production management, the Internet of Things can be applied to production management. Building a production management system can achieve the management and recording of agricultural product growth process information, which can save a lot of labor costs and improve the quality of agricultural products[12] James S J , James C . The food cold-chain and climate change[J]. Food Research International, 2010, 43(7): 0-1956.

Secondly, in terms of transportation, strong cold chain logistics enterprises can configure refrigerated and frozen transportation vehicles, rely on technologies such as IoT GIS and GPS to build a vehicle scheduling system, plan transportation routes reasonably, locate vehicle positions in a timely manner, minimize turnover and handling of agricultural products during transportation, and improve the efficiency of cold chain logistics transportation. Cold chain logistics enterprises can also control the timeliness of agricultural products in real time Loss rate and loss rate [13]. Finally, in terms of packaging, we can start with the packaging design of agricultural products. In order to meet the characteristics of different agricultural products, different packaging standards and materials can be designed, and different agricultural products are strictly required to use different packaging to achieve the desired storage effect [14]. Prior to the shipment of agricultural products, pre cooling preparation should be car-

ried out to ensure that the pre cooling temperature and the required temperature of agricultural products meet the requirements, ensuring the quality of agricultural products, And RFID technology based on the Internet of Things can be used to record and feedback real-time temperature changes in cold chain transportation carriages, monitor the situation of cold chain transportation, and pay attention to the status of agricultural products at any time [15].

5.3 Improving Industry Related Policies and Regulations

Because the goods transported by cold chain logistics are closely related to people's livelihoods and the vital interests of the general public, the application of Internet of Things technology in the development process of the cold chain logistics industry and the development of policies and regulations related to the cold chain logistics industry require the full cooperation of the government, industry, and enterprises, as well as strong supervision from the perspective of administrative law enforcement.

The government can formulate more detailed, executable, and enforceable mandatory agricultural cold chain logistics industry standards and operational norms based on the specific market and industry conditions in Guangxi region, and require all cold chain logistics enterprises and personnel engaged in cold chain logistics to strictly comply with them. Law enforcement should not be ignored, and supervision and management of the cold chain logistics industry should be strengthened, and confirmed illegal behaviors should be punished in accordance with the law; The cold chain logistics industry should actively respond to the laws, regulations, and standards introduced by the government, and promote the standardization of facilities, equipment, and technical equipment in the cold chain logistics industry; Cold chain logistics enterprises should attach great importance to the application of Internet of Things technology in both their thinking and actions. They can establish standardized operational standards and requirements within the enterprise, supervise their employees to carry out operations in a standardized manner, actively promote Internet of Things technology, promote information management in the cold chain logistics process, reduce information transmission costs, and further improve the competitiveness of cold chain logistics enterprises in the market. Therefore, The application of IoT technology in cold chain logistics enterprises should be regarded as an important enterprise strategy.

6 Conclusion

Industry development, technology first. The deep integration of IoT technology with agricultural cold chain logistics can not only promote the rapid development of agricultural cold chain logistics in Guangxi, but also have a very positive effect on the quality of agricultural products and meeting market demand. Therefore, relevant agricultural product logistics enterprises must attach great importance to the application of Internet of Things technology and conduct further in-depth research on the citation

of Internet of Things technology based on actual needs, so that Internet of Things technology can play a greater role in agricultural product cold chain logistics.

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