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Development of Cold Chain Logistics for China's Fresh E-commerce in Post-Epidemic Era

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ABSTRACT

The sudden outbreak of the COVID-19 epidemic has brought a rare development opportunity for the fresh e-commerce industry, it has also put forward higher development requirements for cold chain logistics for fresh e-commerce. Based on the relevant theories of supply chain management, this paper puts forward research issues that need to be improved in the development of cold chain logistics for fresh e-commerce. This paper refers to the research literature on cold chain logistics for fresh e-commerce, the research results at this stage have been sorted out. It starts from the development status of cold chain logistics for fresh e-commerce, we have conducted an in-depth discussion on its existing problems and drawn a series of conclusions. Enterprises should pay attention to the application of emerging technologies to create smart logistics, implement lean management of the supply chain, and promote overall regional development. They should take advantage of the policy to implement industry standardization as soon as possible. The research conclusion is of practical significance to the research on the current situation of cold chain logistics for fresh e-commerce. It provides relevant theoretical and practical support basis for promoting the development of cold chain logistics for fresh e-commerce.

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KEYWORDS: Fresh e-commerce; Cold chain logistics; Post-epidemic era; Smart logistics

1. INTRODUCTION

Fresh e-commerce refers to the use of e-commerce through Internet platforms to directly sell fresh products to customers. With the development of economy and society and the improvement of residents' consumption level, People's demand for fresh food is developing towards diversity, safety and greenness.

Cold chain logistics plays a key and decisive role in the development of fresh e-commerce; it is the core foundation of its development. The outbreak of COVID-19 at the end of 2019 has promoted the surge in demand for fresh food e-commerce. The increasing attention of people to food health and safety has promoted the explosive increase in cold chain demand and the balanced resource allocation of the cold chain industry. In recent years, the State Council, provincial and municipal localities and industry associations continue to release relevant documents for the cold chain industry. However, compared with the rapidly developing fresh e-commerce, the development speed of cold chain logistics at this stage is relatively lagging behind. In order to better meet the development needs of fresh e-commerce, the cold chain logistics of fresh products urgently needs to be upgraded and transformed.

This article aims to explore the current status and development issues of cold chain logistics for fresh e-commerce through the analysis of supply chain management theories, and provide support for the development of the industry. The article will start with the development background of fresh food e-commerce and the importance of cold chain logistics to its development, elaborating on the research questions generated, and combining literature research and practical cases for analysis and discussion, and proposing a series of solutions.

Through combing the relevant research, we understand that cold chain logistics is crucial to the development of fresh e-commerce. However, there are still problems in the process of large-scale cold chain, facility utilization, standard systematization construction and informatization. In view of these problems, the optimization path of cold chain logistics for fresh e-commerce is proposed.

This article conducts thorough research on the current situation of cold chain logistics for fresh e-commerce and proposes some feasible adjustments and suggestions from the perspective of supply chain management, including applying emerging technologies to build intelligent logistics, implementing lean management of the supply chain, promoting regional coordinated development, standardization, and normalization. These adjustments and suggestions are likely to optimize the operation of cold chain logistics, reduce logistics costs, enhance logistics efficiency, and strengthen the sustainable development of the supply chain. It is hoped that this paper can provide reference for academic research and related business management.

2. LITERATURE REVIEW

Status Quo of Research

In the development of fresh food e-commerce, cold chain logistics is considered a crucial and determining factor, seen as the core foundation for the development of fresh food e-commerce. based on existing market demand data, Setyawan (2011) have used network simulation methods to predict the future five-year demand for cold chain logistics in China's fresh agricultural products. The conclusion drawn is that the development potential for cold chain logistics is enormous [1]. Leary (2014) argued that the logistics industry in China will rapidly develop under the three driving forces of market, technology, and policy, and significant changes will occur in five aspects: logistics demand, logistics supply, logistics infrastructure, logistics informatization, and logistics industry development [2]. Fu (2022) analyzed the development of cold chain logistics still faces many challenges. Currently, obstacles hindering the development of cold chain logistics in China include uneven distribution of cold chain logistics infrastructure, insufficient supporting facilities and informatization level, small enterprise scale, lack of professional talents and funding, and inadequate regulatory systems [3]. From a macro perspective, Golestani (2021) pointed out the slow and incomplete advancement of cold chain scaling processes has led to a mismatch between the development speed of cold chain logistics and fresh food e-commerce [4]. From a micro perspective, Singh (2021) found that there is room for improvement in the innovation capability, information coordination ability, and overall industry awareness of enterprise entities. The cold chain logistics industry still needs more standardized and refined industry standards. To address these issues, scholars have put forward targeted suggestions for further developing and improving cold chain logistics for fresh food e-commerce from multiple perspectives such as logistics information systems, cold chain logistics equipment, cold chain logistics standard systems, and cold chain logistics technology [5]. Qi and Hu (2020) proposed that the strengthening food traceability can be achieved through measures such as transportation monitoring platform construction, enhanced coordination and control by management departments, and improved information intelligence level [6]. Babagolzadeh (2020) pointed out that cold chain enterprises should focus on the application of technology and expand the diversity of product categories, strengthen the construction and optimization of cold chain logistics facilities to reduce energy consumption and costs. At the same time, the importance of advancing the cold chain scaling process is emphasized in the context of rapid e-commerce development, along with the necessity of establishing a standard system and increasing the level of marketization [7]. Liu *et al* (2020) noted that achieving the dual goal of low carbon footprint and intelligent innovation requires cooperation between national regulatory agencies, industries, consumers, and interdisciplinary experts. The development of the entire industry is promoted through the dual impetus of policy support and industry norms [8].

The impact of the COVID-19 pandemic has highlighted the importance of establishing high-quality cold chain logistics for fresh food e-commerce. The following is a review of foreign studies on the development of cold chain logistics for fresh food e-commerce in the post-pandemic era. By studying the impact of the pandemic on global supply chains, Liu *et al.* (2020) pointed out that enhancing supply chain resilience is a key driving factor in reducing vulnerability during chaotic periods. Additionally, attention to improved strategies for relocation and reshoring in the post-pandemic era will also shorten global supply chains [9]. In terms of technology, the application of

advanced technologies such as artificial intelligence is of significant importance. Chen (2020) emphasized the immense potential of technologies like artificial intelligence in driving logistics development. Researchers encourage the use of IoT technology for lean management to enhance the efficiency of logistics processes, such as employing blockchain, robotics, big data analysis, and cloud computing to manage cold chain logistics [10]. Giroud (2017) deemed that AI-based predictive analytics have potential in optimizing inventory management, reducing waste, and improving overall supply chain efficiency. Establishing an IoT-driven multi-level agricultural food supply chain [11], Wen (2019) pointed out that improving ant colony optimization algorithms for cold chain distribution route optimization [12], Mehralian (2012) noted that studying cold chain logistics distribution have also received research attention [13]. Li *et al.* (2016) also emphasized the importance of consumer-oriented approaches. Studies on the elasticity effects of food consumption behavior during the COVID-19 period in Italy indicate that personalized marketing strategies, reliable delivery services, and enhanced product information are crucial for building consumer trust and satisfaction. The importance of home delivery services in assisting vulnerable consumers in the digital divide and providing space for small retailers and producers is emphasized [14]. Guo *et al.* (2012) proposed that an evaluation system for food cold chain logistics enterprises is established from four aspects: financial management, cold chain logistics processes, development capabilities, and customer service [15]. McGowan (2017) pointed out that in terms of sustainable development of global supply chains, recommendations for optimizing logistics systems have been proposed [16]. Wang (2017) deemed that the importance of establishing sustainable and resilient food systems for the stability and sustainability of food supply chains is emphasized [17]. Tang (2017) argued that cooperation between cold chain enterprises is also considered a contributing factor to achieving the overall industry's sustained development in the post-pandemic era [18]. Ma *et al.* (2019) explored the development path of agricultural product cold chain logistics in a low-carbon environment [19]. Damodaran *et al.* (2014) further proposed that it helps promote the sustainable development of food cold chains in the context of global warming [20].

In summary, the findings of these studies emphasize the importance of advanced technology, robust infrastructure, data analysis, and consumer-centric approaches. These findings provide valuable insights for the Chinese government, logistics providers, and e-commerce platform-related companies to improve the efficiency, safety, and reliability of China's cold chain logistics system and achieve the timely and accurate delivery of fresh and high-quality fresh food to consumers.

Comprehensive Review

Comprehensive literature review mentioned above, domestic and foreign scholars have conducted rich research on cold chain logistics for fresh e-commerce. This paper continues, complements, expands, and even innovates research on this issue based on them.

Firstly, in the above-mentioned literature, domestic and foreign scholars have not studied cold chain logistics systematically enough. These studies lack analysis and suggestions from the macro system operation of cold chain logistics, that is, the organic combination of the entire logistics transportation, warehousing, distribution and other links. This makes it difficult to find the direction to optimize the space to reduce the cost of cold chain logistics.

Secondly, the above-mentioned literature is not rich and deep enough in the research on the third-party service platform of cold chain logistics, ignoring the role of the third-party service platform in the operation of the cold chain system. The third-party cold chain logistics service platform has long-term significance for the whole cold chain system to improve quality and efficiency, reduce cost and provide logistics operation guarantee.

Thirdly, both domestic and foreign literature have discussed and studied the technical aspects of cold chain logistics development. It points out that advanced cold chain technology plays a fundamental driving role in the innovation and progress of cold chain logistics, and provides new ideas and perspectives on how China's cold chain logistics can be better developed to meet the needs of fresh produce e-commerce.

3. DEVELOPMENT STATUS OF COLD CHAIN LOGISTICS FOR FRESH E-COMMERCE

Information Technology to Enable the Wisdom of Cold Chain Logistics

Big Data is another breakthrough information technology industrial revolution following the Internet, Internet of Things and cloud computing. Its rapid development has not only improved the cold chain logistics enterprises' ability to coordinate and make decisions, accelerated the construction of

cold chain logistics informatization, but also brought personalized and high-quality business policy for agricultural products e-commerce. The use of technology can control the cost input of the whole chain of cold chain while meeting the market demand of high-quality agricultural products.

With the intelligent digital development of cold chain, intelligent cold chain logistics is bound to become the future trend of cold chain industry. Combined with the characteristics of the fresh product field, and through the Internet of Things, big data and other intelligent means to improve the logistics system management decision-making and intelligent implementation capabilities and the level of intelligence of the entire logistics system. It has become a key means to improve the differentiation advantage of cold chain logistics enterprises.

The Epidemic Has Promoted the Continuous Expansion of the Market Scale of Fresh Products

The sudden outbreak of the new crown epidemic in 2020 forced people to turn to online shopping and consumption to meet their fresh food needs. Online purchasing through e-commerce platforms became an important channel for people to obtain fresh products. According to the GDP2020 China Supply Chain Report, China's fresh produce e-commerce market size reached 263.84 billion yuan in 2020, achieving a high growth rate of 62.9% (see Figure 1). According to Quest mobile data, fresh produce e-commerce added a net 25.42 million new users during the outbreak. People had already developed the habit of consuming fresh food online, driven by the epidemic, and retained it after the epidemic was brought under control. The hourly fresh food e-commerce in 1~3 tier cities, represented by the former warehouse, is more convenient than the traditional large supermarkets. The fresh food e-commerce in 4~6 tier cities, represented by the community group purchase, is more cost-effective than the traditional sales channels. Statistics show that 65.4% of Chinese fresh food e-commerce consumers spent more than in 2021, and 51.6% spent more money. Consumers' online spending frequency and value are on the rise.

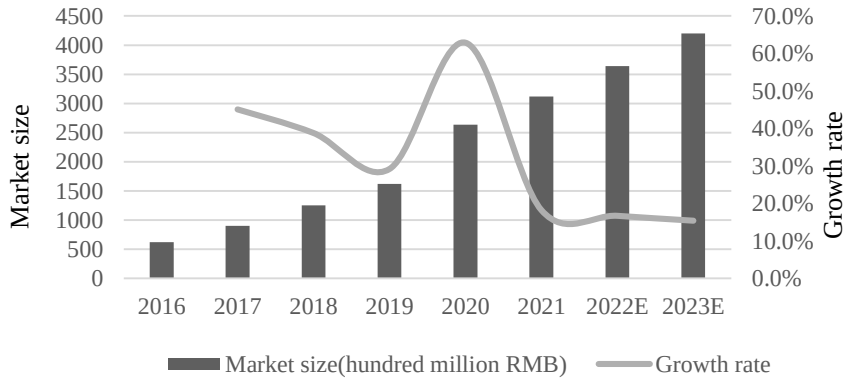

Figure 1: The scale and forecast of China's fresh e-commerce market in 2016-2023

The Development Speed of Cold Chain Logistics for Fresh E-commerce Has Steadily Improved

The demand for low-temperature preservation and distribution of fresh products under the epidemic continues to expand. China's cold chain logistics industry has ushered in its golden period of development. Data show that in 2020 China's cold chain logistics market size from 331.9 billion yuan in 2019 to 383.2 billion yuan, an increase of 13% year-on-year. Total cold chain demand exceeded 265 million tons, up 13.69% year-on-year. In cold chain logistics, the demand for food cold chain accounts for nearly 90% of the total demand. The demand for cold chain logistics industry is steadily increasing. It is enough to see the importance of the cold chain of fresh products to the development of the whole cold chain industry.

Relevant Support Policy System Is Gradually Improving

Since the epidemic, cold chain policies in various sectors are increasingly. The state issued a policy called "Notice on Further Improvement of Cold Chain Food Traceability Management" in November 2020. It proposes to strengthen the coordination and linkage of departments, implement the information registration system. And it proposes to realize the information traceability of the whole chain of key cold chain foods from customs import inspection to storage and distribution, production and processing, wholesale and retail, and food

service as well as establish a rapid and accurate response mechanism for problematic products.

In recent years, the State Council, provincial and municipal localities and industry associations continue to release relevant documents for the cold chain industry. This reflects the country's continuous promotion of the development of cold chain logistics. It also foreshadows that the country will promote the development of cold chain logistics with greater efforts in the new development pattern.

4. THE DEVELOPMENT OF COLD CHAIN LOGISTICS FOR FRESH E-COMMERCE

The Shortcomings of the Cold Chain Logistics Informatization Process Are Obvious

The core of cold chain logistics lies in the full temperature control and real-time monitoring, and the seamless connection between refrigerated containers during transportation and between different links is extremely important. However, there are deficiencies in relevant tracking and monitoring technology. The current traceability system for agricultural products' cold chain cannot cover all upstream and downstream nodes, making it impossible to achieve real-time personnel supervision and product monitoring during transportation. In the COVID-19 epidemic, one of the reasons for the wide-scale spread was the lack of monitoring of transmission pathways. Meanwhile, the integration level of China's cold chain logistics industry is low, and the phenomenon of polarization in the industry's informatization level is severe. Data formats and standard specifications differ between different companies, and product information at various stages is often scattered across various departments within supervisory bodies or cold chain enterprises, making it difficult to integrate information. For food transportation accidents that occur across regions, supervisory bodies often struggle to determine legal responsibilities due to a lack of information, and the standardization and authenticity of information is difficult to guarantee.

The Construction Cost of Cold Chain Logistics for Fresh E-commerce Remains High

According to data from China Cold Chain Logistics Network, the proportion of using cold chain transportation facilities for perishable products in China is only 10%-20%, the rate of decay for agricultural products is 25%-30%, and the average loss rate for fresh produce is above 10%. The rate of decay for fresh products in China is much higher than that of developed countries (see Figure 2). Due to the high cost of cold chain standard packaging, some businesses even choose low-cost packaging such as ice cubes and foam boxes for transportation. It is estimated that the cold chain disruptions in China cause the waste of approximately 12 million tons of fruit and 130 million tons of vegetables annually, resulting in economic losses exceeding hundreds of billions of yuan. The costs of damage to products account for 70% of the entire transportation product costs, far higher than the international standard. Furthermore, due to the pandemic, cold chain logistics enterprises have lost a significant amount of human and material resources. Data shows that, in 2020, 81.5% of enterprises experienced an increase in labor costs. The industry's inability to operate normally has resulted in the continuous losses of enterprises, directly affecting their subsequent development and improvement of the system.

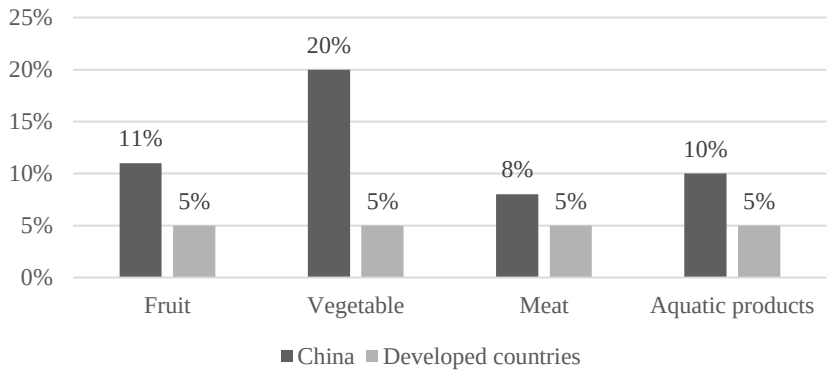

Figure 2: Comparison of the corruption rate of agricultural products in China and developed countries

Source: CCLC

The Construction of Cold Chain Logistics and Transportation Network Is Not Perfect

The economic development level is high in the eastern region of China, with relatively good infrastructure construction and low entry costs for businesses. However, the old industrial bases in the central and western regions are suffering from severe aging and lack of technological innovation, making it difficult to attract local investment and leading to significant outflow of skilled labor. Furthermore, with a lack of leading enterprises, the development of cold chain logistics in these areas is even further behind (see Table 2). Additionally, the varying levels of road construction across the country make it challenging to cover remote areas with cold chain supply chains. The scarcity of composite talents capable of coordinating and considering multi-modal transportation networks also poses a significant obstacle to supporting the development of cold chain enterprises' multi-modal transportation operations. As a result, the gap in the regional development level of China's cold chain logistics continues to widen.

Therefore, constructing a comprehensive transportation network system for cold chain enterprises is becoming increasingly urgent.

Table 1: Distribution of cold chain logistics enterprises in China in 2021

Area	Proportion of the number of enterprises (%)	Area	Proportion of the number of enterprises (%)
East China Region	32	Central China	9
North China	17	Northwest Territories	8
South China	16	Northeast China	8
Southwest Region	10		

Source: China Cold Chain Logistics Alliance

The Policy Support for the Cold Chain Logistics Industry Lacks Precision

In recent years, China has introduced many policies to support the development of cold chain logistics. However, most of these policies lack precise support. The most representative area of weakness is the "First Kilometer". Firstly, as a critical link in the pre-management of cold chain logistics, the investment policies introduced by national and local governments are not sufficiently precise, lacking guidance and encouragement for large e-commerce companies. Secondly, local governments have an inadequate understanding of the cold chain industry. Poor coordination among different departments and conflicting policies among different government agencies are common issues. Additionally, there is a shortage of grassroots-level specialized talent in cold chain logistics. Finally, the government's efforts to construct a favorable business environment are lacking. The lack of standardization, scientific, systemic, information-based, and modern pre-management practices constrain the traceability of fresh products. In the cooperation between e-commerce companies, third-party cold chain service providers, and the grassroots of production areas, the government does not provide positive guidance and push. Overall, China's guidance policy system for cold chain logistics is still incomplete. The industry's development requires more precise and powerful policies to provide support.

5. MEASURES TO IMPROVE COLD CHAIN LOGISTICS FOR FRESH E-COMMERCE

5.1 Build a Smart Cold Chain Service Platform Driven By the Internet of Things

System Design of Smart Cold Chain Service Platform

The intelligent cold chain logistics platform of the Internet of Things combines a new generation of Things technology with intelligent cold chain technology to create a system that can achieve cold chain logistics management. From sensors to IoT devices, each link has stable technical support to ensure the reliability and stability of the IoT platform. This platform hopes to connect enterprises in different links of cold chain transportation into a whole. In this way, a complete supply chain is formed from origin to sales. It aims to promote the industry standardization of cold chain logistics, the

standardization of cold chain supervision, and the integrity of information traceability.

Design of the Technical Architecture of Smart Cold Chain Logistics Platform

According to the hierarchical structure of the Internet of Things, the architecture of the platform is as follows.

Firstly, the sensor perception layer. In this layer, the platform can realize the monitoring of key indicators such as temperature and humidity in the whole cold chain logistics process by installing temperature sensors, humidity sensors and using such sensing technologies as Web GIS. Moreover, it can also use RFID WSN and other technologies to ensure that the key parameters of these fresh product environments meet the requirements and upload data to the cloud. At the same time, it can remotely view and monitor transport vehicles to optimize the distribution path.

Secondly, the cloud processing layer. The cloud processing layer can transmit the data collected by the sensor perception layer to the cloud through the Internet of Things protocol for data processing and analysis. In this architecture, it can use cloud computing and big data analysis technology to monitor the temperature, humidity, transportation speed and other related transportation environment parameters of fresh products in real time. Based on these data, the platform can make corresponding adjustments in time. At the same time, it can also provide prediction, early warning and traceability query functions, which can make cold chain logistics more intelligent.

Thirdly, the mobile application layer. Combined with mobile applications and e-commerce platforms, it can realize full-link visualization and online ordering, payment, distribution and other integrated services. The whole process of fresh product harvesting, pre-cooling treatment, packaging and transportation is willing to supervise in time through real-time transmission of information, so as to effectively collect and trace information. It can also provide consumers with APP applications to view the transportation process of fresh products in real time, which is convenient for consumers to have a clearer understanding of the quality, safety and transportation mode of fresh products.

Design of Emergency Dispatch Mechanism

The smart cold chain service platform collects and collates epidemic-related data to analyze and evaluate the risk status of logistics networks. The platform records the receiving, sending, stored and transportation routes of each cargo to provide complete and traceable cold chain transportation information for emergency response. Besides, it always maintains contact with the deployment center to update material demand information and the affected area information in real time. The most important thing is that the platform can design a reasonable distribution path and method to reduce the risk of cross-infection.

At the same time, it monitors and provides the health status of the driver of the delivery vehicle in real time. For any employee who finds a suspected disease, the platform will immediately notify the relevant departments and screen for infectious diseases. On this platform, it will make full use of the intelligent communication system to send epidemic-related information to customers and employees in a timely manner to ensure the health and safety of employees. At the same time, the platform attaches great importance to information security to prevent information leakage and malicious attacks.

5.2 Implement Lean Management of Cold Chain Supply Chain

Use Modern Warehousing Technology to Optimize Inventory Management

Fresh cold chain enterprises can optimize the existing cold chain warehousing system and update the intelligent warehousing technology and system through the intelligent cold chain platform. It can also realize the efficient and low-cost warehousing operation mode. Enterprises can predict future market demand through historical sales data, consumer purchase habits and current market trends provided by the platform, so as to formulate reasonable procurement plans and inventory management strategies. At the same time, the real-time monitoring system provided by the platform can help fresh cold chain enterprises to manage inventory and avoid excessive inventory backlog. Then, enterprises can reduce inventory costs and ensure the stable quality and supply of fresh products.

Use Big Data to Optimize the Cold Chain Logistics Path

The staff need to comprehensively consider the attributes of the goods, customer needs and other factors and choose the best choice from a variety of transportation modes. The platform will draft the transportation route plan for different logistics transportation needs according to the relevant big data. And it can use the network system to understand the traffic status of the expected route. The staff can adjust the transportation route and reasonably arrange vehicles and distribution routes

according to the real-time feedback of logistics and transportation services. In this way, the number and distance of transshipment of goods can be reduced, the transportation cost loss in the process of cargo transportation can be reduced, and the efficiency of logistics transportation can be maximized.

Focus on the Visualization of Temperature Control Monitoring Throughout the Whole Process

In the process of cold chain logistics transportation services for fresh products, the most effective intelligent technology should be selected to control the temperature of fresh products in the whole process according to the actual needs of cold chain logistics. For example, temperature sensors should be installed in each link of cold chain logistics to monitor the temperature of the goods throughout the whole process. By uploading the temperature data to the cloud, the regulatory department can check the temperature change of the entire cold chain logistics at any time. By checking it, the regulatory authorities can ensure the safety and stability of fresh products throughout the transportation process and reduce the loss rate of fresh products. The quality and efficiency of cold chain logistics services can also be improved.

5.3 Improve the Coordination and Allocation Mechanism of Cold Chain Infrastructure

Improve the Regional Coordination of Cold Chain Infrastructure Construction

Cold chain enterprises can make full use of the advantages of low land price, low labor cost and policy support in the central and western regions to increase investment in local cold chain infrastructure and the construction of characteristic cold chain industry chain. Local governments can promote the coordination of resources in the construction of cold chain logistics infrastructure through agreements, cooperative mergers and acquisitions. And ultimately local governments can achieve resource optimization and mutual benefit. In this way, the gap of regional development level of cold chain logistics in China is narrowed and enterprises can form agglomeration benefits and scale advantages.

Establish a Multimodal Transport System for Cold Chain Logistics

The formation of cold chain logistics multimodal transport system needs to give full play to the advantages of various modes of transportation and promotes the integration of multimodal transport, which can realize the efficient integration of transportation modes. Through innovation, it is necessary to accelerate the formation of a fresh cold chain multimodal transport system covering roads, railways and other ways. Cold chain enterprises should rationally plan the mode of transportation, strengthen the coordination of operation information and capacity arrangement among various modes of transportation. It should also optimize and adjust the transportation structure and transform towards the establishment of intermodal transportation and multimodal transportation system.

Strengthen the Informatization Collaboration Between Cold Chain Logistics Enterprises

Cold chain logistics enterprises share their logistics information by building a common digital platform or joining the cold chain enterprise alliance. Enterprises can open and share their spare equipment resources or build common infrastructure according to the needs of their peers on the platform. They can also strengthen academic exchanges and professional cooperation between regions to jointly study technical issues and facility innovation. Enterprises can achieve the purpose of mutual assistance and mutual benefit through the above methods, so as to realize the low cost and high efficiency operation of cold chain logistics. Only high-precision information transmission and sharing can ensure the smooth circulation of the entire cold chain logistics industry chain.

5.4 Strengthen the Government's Systematic Planning of Cold Chain Logistics

The first is to optimize the cold chain processing of storage links. The government should expand the investment of special funds to encourage the construction of warehouses and vigorously promote the construction and upgrading of cold chain equipment and facilities. And the government should simplify the process of cold storage declaration audit and speed up the speed of result feedback.

The next thing is to integrate transportation resources and improve transportation level. First, the government leads technological innovation and strengthens scientific and technological support. Relevant departments jointly research institutes and cold chain logistics enterprises to carry out technological innovation to build large-scale refrigerated transportation equipment and to form a standardized insulation transportation system. Second, third-party logistics enterprises participate in the construction of a public service cold chain logistics park where is planned by the government. This cold chain logistics park is a place of public service with the

functions of warehousing, distribution and transportation. In particular, the government should pay attention to the construction of cold chain logistics parks for agricultural products in the central and western regions to regulate the contradiction between supply and demand.

Finally, strengthen the government 's overall layout of cold chain logistics. First, the government plays a policy guidance and regulatory role to guide the effective operation of third-party cold chain logistics enterprises. The third party logistics enterprise is the main body of cold chain logistics market competition. The government should actively guide and accelerate the entry of third-party logistics enterprises and improve the marketization of cold chain logistics. Second, the government and e-commerce enterprises jointly build a rural supply and marketing integration platform. This platform can enhance the degree of industrialization of fresh products and the level of supply and marketing integration. So the overall planning and integration of the upstream and downstream of cold chain logistics can be improved.

6. CONCLUSION AND DISCUSSIONS

Conclusion

According to this study, cold chain logistics for fresh e-commerce in China is at an excellent development outlet. The surging market demand in the environment promotes its rapid innovation and upgrading to meet the demand; The rapid development of science and technology provides it with abundant technical resources; The attention of the state provides a stable and convenient development environment for cold chain logistics. At the same time, we also found the challenges behind the opportunities, the informatization of China's cold chain logistics is a key constraint to break through its own development; The high cost of fresh cold chain is one of the biggest difficulties hindering its development. The regional balance of infrastructure construction is the key to whether cold chain logistics of fresh products can cover the whole country. Whether the policy is accurate and can be implemented in place is the key factor for the standardization of fresh cold chain logistics. This study demonstrates these viewpoints from multiple perspectives.

In order to effectively improve the cold chain logistics for China's fresh e-commerce, a series of measures need to be developed. We propose the following suggestions for fresh cold chain related enterprises and the government:

Build an intelligent cold chain service platform driven by the Internet of Things;

Lean management of practical cold chain supply chain using modern technology;

Improve regional coordination of cold chain infrastructure construction;

The government should strengthen the systematic planning of cold chain logistics;

Combining the above measures with other implemented cold chain improvement measures will greatly contribute to the further improvement of cold chain logistics for China's fresh e-commerce.

Discussion

Based on the relevant theories of supply chain management and the literature, this paper puts forward the research problems that the development of cold chain logistics for fresh e-commerce needs to be improved. However, limited by my own limited knowledge level, limited energy, and limited access to data resources, there are the following aspects that need to be developed and improved:

Limited by research ability and objective conditions, this study cannot examine the level of business flow, capital flow and knowledge flow in each supply chain. It can only be based on the introduction of node enterprises and the public information of the industry on the network as the research basis, and cannot guarantee the authenticity and integrity of information data. In the future research, it is still necessary to further obtain more accurate information through a large number of investigations, and to explore and improve the perspective of the problem.

Secondly, the lack of theoretical practicality. Due to the particularity of data during the epidemic period and the influence of researchers' own conditions, this paper chooses to combine the examples of some typical fresh food e-commerce enterprises for research, and at the same time takes a large number of research results in the same field at home and abroad as the theoretical basis. The practical applicability of the research conclusions needs to be improved.

Thirdly, there is still room for further research. This study only considers the middle and lower reaches of fresh e-commerce enterprises, and does not study the upstream enterprises. The selection of upstream suppliers also plays an important role in the development of fresh e-commerce enterprises. Therefore, the scope of this study needs to be increased.

In summary, China's research on the improvement of fresh agricultural products e-commerce cold chain logistics is still in the exploratory stage. The search for problems in the development of the industry and the implementation of countermeasures still need to carry out more in-depth theoretical and experimental research in a wider range, so as to provide a reference for China's fresh cold chain logistics industry and related enterprises in the industry to further enhance their competitiveness.

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