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Cold Chain Logistics for Chinese Agricultural Products

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Abstract <p>The cold chain logistics of agricultural products in China is relatively backward, which seriously affects the income growth of farmers and the export quality of agricultural products. There are still several problems in the development of cold chain logistics of agricultural products in China. The existing problems are studied and corresponding countermeasures are found to promote the further development of China's agricultural cold chain logistics.</p> <p>Under this background and objective, this topic will study the technical information of cold chain logistics and analyze it in combination with the knowledge of transportation management. Then, try to find the measures to promote the development of cold chain logistics of agricultural products in China. This information can be obtained from the literature on the Internet.</p>		
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1 Introduction

1.1 Research background

With the continuous improvement of Chinese people's living standards, people's demand for all kinds of fresh fruits, vegetables and other agricultural products is increasing year by year. In order to meet the needs of consumers with high quality and quantity, this kind of agricultural products has the characteristics of fresh activity and easy corrosion, which determines that agricultural products have strict standards for the timeliness and safety of logistics. This brings great opportunities and challenges to the development of cold chain logistics in China. Cold chain logistics can not only meet people's demand for fresh food, but also minimize the loss and waste of food in the transportation process. However, the lack of public awareness and backward original equipment restrict the development of China's cold chain logistics industry.

According to the 2013 National Agricultural Products Cold Chain Circulation Technology and Information Seminar that opened in Jinan, Wu Maoyu, director of the Jinan Fruit Research Institute of China National Supply and Marketing Corporation, pointed out that only 5% of China's fresh agricultural products circulate through the cold chain. The cold chain circulation rate of fruits and vegetables in developed countries such as the United States, Canada, and Japan has reached more than 95% (Lu, 2009). As a result, about 12 million tons of fruit and 13,000 tons of vegetables are wasted every year, resulting in a loss of more than 100 billion yuan. In addition, the traditional low-end fruit and vegetable circulation system will cause 30% of the product loss, causing huge losses to farmers, and the irregular circulation process can easily lead to agricultural product quality and safety issues.

At present, China's cold chain logistics infrastructure capacity is seriously inadequate, and the circulation of agricultural products is consumed and costly. Most of the

third-party logistics are small and medium-sized enterprises and have not formed a large-scale operation (Zhang, 2019). However, relying on China's policy advantages, in the current cold chain logistics market in China, state-owned enterprises, private enterprises, and foreign-funded enterprises are all seizing market shares with their respective advantages. The construction of the cold chain requires a lot of funds but also better policies. In general, state-owned enterprises have policy advantages, private enterprises have flexibility and cost advantages, and foreign-funded enterprises have capital advantages. China's cold chain logistics is ushering in a great opportunity for vigorous development.

1.2 Research significance

In recent years, with the adjustment of agricultural structure and the improvement of residents' consumption level, the output and circulation of fresh agricultural products increase year by year. The whole society has put forward higher requirements for the safety and quality of fresh agricultural products. Therefore, it is of great significance to accelerate the development of cold chain logistics transportation of agricultural products to promote the continuous increase of farmers' income and guarantee the safety of consumption.

First, it is to meet the objective needs of large-scale circulation of agricultural products. After 30 years of reform and opening up, China's agricultural restructuring has achieved remarkable results. The regional and variety layout has been optimized day by day. The circulation of agricultural products has shown the characteristics of large-scale, long-distance, and off-season. Claim. Especially with the increase in regional large-scale output and off-season sales of fresh agricultural products, there is an urgent need to accelerate the development of trans-regional preservation and transportation of agricultural products.

Secondly, it is the necessary guarantee to meet the consumption of residents. With the development of society, food safety issues are getting more and more attention

from the people. In order to improve fresh and high-quality agricultural products, it is particularly important to accelerate the development of cold chain logistics. Third, it is an important way to promote farmers' income. Every year, about 12 million tons of fruits and 13,000 tons of vegetables are wasted due to improper transportation and storage of Chinese agricultural products, with losses of more than 100 billion yuan (Dai, 2009). At the same time, restricted by the storage and transportation capacity of fresh agricultural products after they are concentrated on the market, the contradiction between "difficult selling" of agricultural products and seasonal fluctuations in prices is prominent, and farmers often increase production but not income. Developing the cold chain logistics of agricultural products can not only reduce the loss of agricultural products, but also stabilize the sale of agricultural products in all seasons and increase the income of farmers.

Fourth, it is an important measure to improve the international competitiveness of China's agricultural products (Yu, 2001). China is a big producer and consumer of agricultural products, but it is not a strong producer of agricultural products. One of the important reasons is that China lacks a modern cold chain system. As a result, fresh agricultural products, which China has a strong comparative advantage, lack competitiveness in the international market (Fang, 2013). In particular, as developed countries have continuously improved the access standards for imported agricultural products in recent years, related quality, technical and green barriers have become important obstacles restricting China's agricultural exports. Accelerating the development of cold chain logistics of agricultural products is conducive to improving the quality of export agricultural products, breaking through trade barriers and enhancing international competitiveness.

Therefore, our research questions focus on the following aspects:

First of all, the basic concepts of China's agricultural cold chain logistics industry, including the definition and characteristics of agricultural cold chain logistics, and the

composition of cold chain logistics. Secondly, The main focus is on the development of agricultural cold chain logistics industry, including the origin of the cold chain logistics, the development of cold chain logistics in some developed countries, agricultural products and agricultural products cold chain logistics development. In the third part, the subject mainly compares the development of cold chain logistics of agricultural products at home and abroad. The main research questions of the whole subject focus on the influencing factors of the development status and the challenges to China's agricultural cold chain logistics industry, and analyze the operation mode of domestic agricultural cold chain logistics, then put forward the development countermeasure of the cold chain logistics and the research of the optimal distribution route.

1.3 Research methods

The reason why this article chooses the cold chain logistics of agricultural products is because it has both macro and micro significance. From a macro perspective, in China, a complete and independent food cold chain system has not yet been formed. From the perspective of the whole cold chain system, China's food cold chain has not yet formed a system (Hong, 2007). At present, about 90% of the meat, 80% of the aquatic products, a large number of milk and bean products are basically transported and sold without cold chain protection. Other data show that China's fruit planting area has accounted for 18% of the world's fruit planting area, and annual output accounted for 13% of the world's total output; vegetable planting area accounted for 35% of the world's vegetable planting area, and annual output accounted for 40% of the world's total output (Wang, 2020). However, due to the backwardness of China's fruit and vegetable harvesting and distribution facilities, the post-harvest rot of the fruits and vegetables is serious and the logistics cost is high. Authorities estimate that nearly 12 million tons of fruit and 130 million tons of vegetables are destroyed each year, with economic losses of more than 100 billion yuan per kilogram (China

Logistics Products Network, 2006). The lag of cold chain logistics development has greatly affected the development of food industry. From a micro point of view, China is a big country, food cold chain logistics involving thousands of households (Song, 2007). In order for more than one billion people to be able to eat and moisturize every day, one must satisfy the quantity, and the other must emphasize quality. By strengthening the research of agricultural products cold chain logistics, we hope to bring a certain level of improvement to the people's living standards, and provide the necessary guarantee for building a socialist harmonious society. Cold chain logistics develops with the progress of science and technology and the development of refrigeration technology (Fan, 2017). It is a logistics phenomenon under low temperature by means of refrigeration technology and refrigeration technology. Therefore, the construction of cold chain needs to consider the production, transportation, sales, economy, technology and other aspects comprehensively, coordinate the relationship between them, and ensure the safety of perishable food in the process of processing, transportation and sales (Jin, 2008). This is a high-tech cryogenic system project.

At present, China's production of meat, poultry and eggs, aquatic products, vegetables, and fruits ranks first in the world, but the distribution channels of most products do not have a strict cold chain environment (Lu, 2012). 80% of perishable foods do not have temperature monitoring during transportation, resulting in agricultural the loss of by-products before final consumption also ranks first in the world (Li, 2019). The fresh-keeping, processing, storage and transportation of agricultural and sideline products are the continuation of agricultural production. The construction of cold chain logistics is an important part of agricultural industrialization and the only way for the standardized development of agricultural products. The establishment of cold chain logistics, from food production to consumption of all links in a suitable low-temperature environment, to improve the

safety and quality of Chinese food, improve people's lives of great significance. At the same time, it will also play a positive role in promoting the development and expansion of the technology and equipment market.

This research mainly uses the methods of literature retrieval and literature integration analysis to analyze the development status of the agricultural product cold chain logistics industry, and compare the development of domestic and foreign agricultural product cold chain logistics. We searched the literature on the domestic and foreign literature database websites, using terms such as agricultural product cold chain logistics, agricultural product logistics development status and trend, and agricultural product cold chain logistics the most effective distribution path, etc., to summarize the literature and analyze the development status of my country's agricultural product cold chain logistics industry. The influencing factors and challenges faced by the company, and analyzed the operation mode of domestic cold chain logistics of agricultural products, and finally put forward the research of cold chain logistics development countermeasures and optimal distribution path.

2 Basic Concepts of China's Agricultural Cold Chain Logistics

Industry

2.1 Definition and characteristics of agricultural cold chain logistics

2.1.1 Definition of agricultural cold chain logistics

Cold chain logistics generally refers to a systematic engineering carried out by quick-frozen food and quick-frozen food in a specific low-temperature environment at each stage of production, storage, transportation, sales and pre-consumption to ensure food quality and reduce food loss (Chen, 2006). It was established with the development of science and technology and refrigeration technology. It is a low temperature logistics process based on refrigeration technology and by means of refrigeration technology. With the rapid development of the cold chain logistics industry of agricultural products in China, the country must formulate and implement scientific and effective macro policies as soon as possible (Zhang, 2006). The requirements of cold chain logistics are higher, and the corresponding management and capital investment are larger than that of normal temperature logistics.

Cold chain logistics of agricultural products refers to the fact that fresh agricultural products, such as meat, poultry, aquatic products, vegetables, fruits, eggs, etc. are harvested (or slaughtered or harvested) at the place of production and are always in the right position in product processing, storage, transportation, distribution, and retail, 2014). Special supply chain systems maximize product quality and quality safety, reduce losses and prevent contamination in low-temperature controlled environments.

2.1.2 Characteristics of agricultural cold chain logistics

In recent years, due to the continuous improvement of logistics environment, cold chain logistics of agricultural products has made considerable progress. At present,

the survival and development environment of China's agricultural cold chain logistics industry is constantly optimizing. As a part of the logistics industry, the importance of agricultural products cold chain logistics has been gradually recognized by the community (Yu, 2012). On the one hand, China's agricultural products cold chain logistics has developed to a certain scale, but there are still many problems to be solved. Compared with developed countries, the development of China's cold chain logistics industry is still relatively backward. On the other hand, the disconnection of cold chain logistics of agricultural products is more serious.

Experts believe that the development of China's agricultural cold chain logistics has the following characteristics:

1. Agricultural products cold chain logistics infrastructure has been continuously upgraded and improved. Due to the good development prospects of fresh agricultural products logistics, some retail enterprises and large agricultural enterprises actively invest in the construction of low-temperature supply chain distribution system and fresh food distribution center (Wang, 2020). Some large chain enterprises set about establishing fresh food, fruit and vegetable distribution centers with high technical difficulty, and preliminarily constructed green food supply chain and logistics system, which created important material conditions for the operation of agricultural cold chain logistics system.
2. The scale of cold chain logistics of agricultural products is growing rapidly, and the expansion momentum is strong. With the continuous improvement of people's consumption level and the recognition of agricultural products cold chain logistics by consumers, more and more people like fresh fruits, vegetables and other agricultural products (Liu, 2019). The demand of fresh agricultural products increases year by year, which provides a good prospect for the cold chain logistics of agricultural products in China.

3. The refrigeration equipment is constantly updated and the refrigeration technology is becoming more and more diversified. In order to achieve a low-carbon, environmentally friendly and green economy, China's refrigeration equipment is constantly updated and replaced on the road of sustainable development in China. Food freezing technology has made rapid progress. It mainly uses fast and continuous freezing devices to speed up the freezing speed and improve the quality of frozen products. In addition, liquid supply methods and refrigeration systems gradually tend to diversify.

Because the agricultural cold chain is a supply chain system designed with the core requirements of ensuring the quality of perishable agricultural products and maintaining a low temperature environment, it has higher requirements and more complex construction investment than the ordinary normal temperature logistics system. It is a huge system engineering with the following outstanding characteristics: complexity. The final quality of the cold chain logistics of agricultural products depends on the storage temperature, circulation time and durability of the cold chain itself. The quality of the produce in circulation varies with temperature and time. Different products must have corresponding temperature control and storage time. This greatly increases the complexity of agricultural cold chain logistics. Coordination, because fresh fruits and vegetables are not easy to store, the cold chain logistics of agricultural products must operate efficiently, and every link in the logistics process must be coordinated, so as to ensure the stable operation of the whole chain. It's too expensive. In order to ensure that fresh fruits and vegetables in the circulation of each link is always in the required low temperature conditions, must install temperature control equipment, must install refrigerated vehicles or low temperature warehouse. In order to improve the efficiency of logistics operation, it is necessary to adopt advanced information system. All these determine that the cost of cold chain logistics of agricultural products is higher than that of other logistics

systems. Generally speaking, in addition to the above basic characteristics, agricultural cold chain logistics also has the following characteristics and the general logistics system at normal temperature: First, the management and operation of each link of agricultural cold chain logistics need large-scale special logistics equipment and facilities, investment and long-term investment payback period; Second, the production and consumption of the cold chain logistics of agricultural products are relatively dispersed, and the market supply, demand and price change greatly. In terms of weather, there are many uncertainties, such as transport, which has relatively high operating and energy costs and is relatively volatile; Third, the cold chain logistics of agricultural products requires a high degree of organization and coordination of each link of the cold chain to ensure logistics. The cold chain logistics of agricultural products has high requirements for information technology, and real-time monitoring and tracking of the safety situation of agricultural products is needed.

2.2 Composition of Cold Chain Logistics of Agricultural Products

The cold chain logistics of agricultural products basically consists of five parts: production, transportation, storage, distribution, retail and consumption. It mainly includes four links: frozen processing, frozen storage, refrigerated transportation and distribution, and frozen sales.

1 freezing processing: including meat, poultry, fish and eggs cooling, freezing and freezing, and low temperature processing. It also includes pre-cooling of fruits and vegetables. Cold chain equipment is mainly involved in this link is cooling, freezing and quick-freezing equipment.

2. Refrigeration: including refrigeration, freezing of agricultural products, and air-controlled storage of fruits and vegetables. This section mainly involves all kinds of refrigerators/processing rooms, refrigerators, freezers and household refrigerators.

3. Refrigerated transportation: including long-distance transportation and short-distance distribution of agricultural products and other logistics links. This link mainly involves railway refrigerated cars, refrigerated cars, refrigerated ships, refrigerated containers and other low-temperature transport vehicles. Temperature fluctuation is the main factor that causes the quality decline of agricultural products in the process of refrigerated transportation. Therefore, the transport vehicle must have good performance, while maintaining the specified low temperature, but also to maintain a stable temperature. This is especially important in long distance transportation.

4. Frozen sales: including the frozen storage and sales of all kinds of cold chain agricultural products entering the wholesale and retail links. This section mainly deals with refrigerators/freezers and storage cabinets.

3 Development Status of Agricultural Products Cold Chain

Logistics Industry

3.1 The origin of world cold chain logistics

The cold chain originated with the invention of refrigerants in the first half of the 19th century. By the 1930s, the European food cold chain system had been initially established. The United States began to promote it after World War II. In 1958, the United States, Assad and others on the quality of frozen food assurance, depends on the food Freezing Time, Temperature, and Tolerance, that is, the "3T" concept; Zoll then added that freezing Food quality also depends on factors such as Produce, Processing, Package and other factors, namely the "3P theory"; there are also "3C" principles: cooling, cleaning, Care; "3Q" requirements: Quantity, Quality, and Quick of equipment in the cold storage chain; "3M" conditions: tools and methods for Means and Methods, Management(Liu,2016). These theories have not only become the theoretical and technical basis for low-temperature food processing, circulation and cold chain facilities, but more importantly, they have laid a solid theoretical foundation for the development and improvement of low-temperature food and cold chain facilities(Li, 2018).

3.2 The development of cold chain logistics of agricultural products in some developed countries in the world

3.2.1 Cold chain logistics of agricultural products in the Netherlands

The Netherlands is located in the center of Europe and has a very favorable location advantage. The Netherlands has established a vertically cooperative integrated market operation system, and the logistics of agricultural products are highly specialized. For example, the flower gardening center in the Netherlands has developed into the world's largest flower auction market. The refrigeration industry

in the Netherlands is very developed, and the level of cold chain logistics development is high. The per capita refrigeration and refrigeration volume ranks first in the world. The advantages of Dutch agricultural cold chain logistics are as follows: (1) the infrastructure of agricultural cold chain logistics is developed, especially the Dutch air transport network. The Port of Rotterdam is close to important vegetable and fruit growing areas. Highways criss-cross the harbour area, leading to the inland waterway transport network is very developed, adjacent to the European Union National Fruit Import and Export Center Ballendre.

(2) Shorten the cold chain logistics chain of agricultural products and realize the value-added logistics. Take flowers as an example. Through the procedures of collecting, sorting, storing, auctioning and packaging, commercial flowers from all over the world are collected and distributed to countries around the world. There are thousands of flower varieties, almost all of which are standardized production. The transacted flowers are quickly transported by containers to airports or ports for distribution all over the world, and some are shipped to the market on the same day.

(3) Developing electronic cold chain logistics of agricultural products with high informatization. The Dutch Flower Centre has a state-of-the-art auction system, a new electronic information exchange and ordering system, and serves customers and consumers in a number of countries around the world through e-agricultural logistics parks and distribution centres.

3.2.2 Cold chain logistics of American agricultural products

At present, the United States has formed from the production, processing, distribution, warehousing, distribution, after-sales complete food cold chain system. The government has passed the legislation, the examination and the authentication, the association and the Enterprise through the establishment standard system, the management system and the product recall, has established the quite perfect cold chain logistics system (Lu, 2012). The advantages of cold chain logistics of American

agricultural products are as follows: (1) The logistics infrastructure is developed, the logistics special equipment is advanced, and the logistics information level is high. The transportation facilities are very complete, with roads, railways and water transportation extending in all directions. Fresh agricultural products loading and unloading and conveying equipment mainly include screw conveyors, removable belt conveyors and low-capacity bucket elevators, and have advanced information technology. (2) Cold chain logistics of agricultural products has a high degree of scale, specialization and socialization. The main body of American agricultural production is mainly small and medium-sized farmers. A large amount of contiguous land facilitates the use of mechanized operations, thereby saving labor in agricultural production and achieving large-scale operations in agricultural production logistics. In terms of logistics channels, the United States has a complete social service system. Most agricultural products are sold by farmers to factories through wholesalers in origin markets or central markets, followed by retailers, with few direct sales.

3.2.3 Cold chain logistics of Japanese agricultural products

Japan's agricultural product logistics industry has a long history of development. In recent years, due to the implementation of relevant policies, Japanese agricultural products logistics has developed rapidly. Cold chain logistics of agricultural products. As a branch of agricultural products logistics, under the implementation of these policies, natural development is good. Japan attaches great importance to the preservation and circulation of industrial technology and agricultural products. In order to increase the added value of fresh produce and rationalize the production and marketing process, Japan established processing plants, pre-cold storage, refrigeration, transportation centers, local wholesale markets, supermarkets, retail stores, and so on, up to 100% of fresh produce is commercialized post-harvest, with distribution systems including pre-cooling, finishing, storage, freezing, transport and

generally using logistics information. The government Macroeconomic regulation and control through laws and regulations and public services.

3.2.4 Cold chain logistics of Canadian agricultural products

As early as the end of the 19th century, Canada started vegetable refrigerated transportation. After more than 100 years of development, the socialized, professional, and standardized vegetable cold chain storage and transportation has replaced the "point-to-point" transportation between the vegetable garden and the vegetable market, enabling vegetable storage and transportation. The cost is lower, the efficiency is higher, and it is easier to detect and monitor(Wang, 2020). In order to better ensure the safety of vegetables, the Food Inspection Agency has also established 6 general models for the quality inspection of vegetable and other plant foods, and promoted them nationwide. In order to ensure food safety, Canada has also adopted a base breeding and planting model. There are 247,000 farms in the United States, and national sales account for half of total production. The characteristics of the cold chain in Canada is to keep the vegetables fresh at low temperature in the whole process, so that the vegetables must be stored and transported through the cold chain logistics to reduce pollution and loss. Vegetables have been kept in a low temperature environment from the field, effectively controlling the breeding and spreading of harmful microorganisms, ensuring food safety. The data show that only 5% of vegetables are lost in Canada and less than 30% of the cost of logistics is lost through the storage and transport of vegetables at low temperatures.

3.2.5 Experience enlightenment of successful agricultural cold chain logistics in developed countries

Based on the development of cold chain logistics of agricultural products in advanced countries and regions abroad, it can be seen that they have many

similarities in common. For example, the government supports a lot, the government has passed legislation, audit and certification, and associations and enterprises have established a standard system. The management system, product recall and other links have also established a relatively perfect cold chain logistics system. Agricultural cold chain logistics has a high degree of organization, high management level of agricultural supply chain, and high standardization level of agricultural cold chain logistics. Agricultural cooperative organization is the main force of agricultural cold chain logistics. The development of agricultural products electronic cold chain logistics has a high degree of information. Pay attention to the development of refrigeration, refrigeration industry is very developed. Most companies that sell fresh, frozen, and perishable goods require modern refrigeration technology and equipment for storage and transportation. The establishment of a complete cold chain logistics system, the formation of inter-regional chain and organic integration.

3.3 The development status of Chinese agricultural cold chain logistics

In China's 2006 national standard "logistics terms", "cold chain" is defined as: in order to maintain the quality of fresh and frozen food, the logistics network is equipped with special equipment and facilities, from production to consumption is always in a low temperature state. The scope of application of the industrial chain includes: primary agricultural products, processed foods and special commodities. Research on cold chain logistics is mainly limited to fresh and perishable agricultural products such as fruits, vegetables, meat and aquatic products (Fang, 2003). The cold chain originated in the first half of the 19th century. With the invention of refrigerants and the use of refrigerators, a variety of fresh and frozen foods emerge in an endless stream, leading to the rapid development of the food industry and accompanied by the rapid development of food cold chain forms. With the continuous improvement of people's living standards and the continuous progress of science and technology, the food cold chain has been

rapidly developed. In the early 1930s, the refrigeration technology in developed countries developed rapidly. The United States and Europe have established food cold chain system. Frozen food appeared as a commodity in the 1950s. In the following decades, Europe and the United States have basically completed a variety of low-temperature food cold chain. Frozen Food in China started late, the first production in the 1950s. At that time, due to the export of meat products, the use of improved insulation vehicles. In the 1960s, frozen foods such as meat, poultry and aquatic products appeared. In order to ensure market supply, the state has set up large cold stores in major cities and major production areas. In the 1980s, China promulgated the "Food Hygiene Law" to further promote the development of the food cold chain, and then the cold chain of agricultural products began. Since the 1990s, supermarket chains have sprung up in Beijing, Shanghai and Guangzhou. These supermarkets sell a variety of frozen foods according to market demand, and agricultural cold chain logistics has also started to develop (Hong, 2007) . In 2008, China's agricultural cold chain logistics market has reached 1.35 trillion yuan, with an annual growth rate of 26% .

The development of China's agricultural product logistics is in its infancy both in theory and practice, and the development is relatively backward. At present, the research of China's agricultural product logistics theory is mainly at the macro level, and most of them are descriptive introductions around concepts, circulation conditions, necessity, feasibility, and policy systems, which belong to the initial stage of theoretical research.

(1) In terms of logistics channels, the current circulation of agricultural products in China mainly flows through the supply chain of farmers-intermediate agents-origin wholesalers-sales wholesalers-retailers-consumers.

(2) On the main body of logistics, each supply chain link has its own different main body. The main body of farmer households in China is mainly small farmer

households with scattered operations, but some economically developed areas also have some large-scale farmer household associations; the main body of the intermediate agent link is relatively diversified, and there are various types of cooperative organizations (including government-led and There are various professional associations organized by themselves), and there are also various private acquisition agency companies of different sizes; the main body of wholesalers of origin and wholesalers is mainly a group of buyers and sellers with various agricultural product wholesale markets as the core; at present, the Chinese agricultural product retailers The situation is the most complicated, including various farmer's markets, large and small supermarkets, and comprehensive retail stores and street stalls.

(3) In terms of the quantity of logistics, the quantity of domestic agricultural product logistics is directly related to the degree of marketization of agriculture. According to estimates, the degree of marketization in China is about 50% according to the latest calculation in 2002. That is to say, 400 million tons of China's approximately 800 million tons of agricultural products each year are circulated through the market. Therefore, the quantity of China's agricultural product logistics is huge.

3.4 Comparative Research on the Development of Cold Chain Logistics of Agricultural Products at Home and Abroad

3.4.1 Comparison of agricultural cold chain logistics infrastructure

The refrigerated and fresh-keeping vehicle in the cold chain logistics transportation facility of agricultural products is the key link in the process of agricultural products transportation. Combined with relevant data, in 2008, the comparison of the number of refrigerated preservation vehicles between China and developed countries and the comparison of the proportion of refrigerated preservation vehicles in freight vehicles, China and the United States, Japan, and other developed

countries have a large gap in the number of refrigerated preservation vehicles. As of 2008, China With a population of more than 1.3 billion, there are only nearly 30,000 refrigerated preservation trucks, while the number of refrigerated preservation trucks in Japan is four times that of China, and the number of refrigerated preservation trucks in the United States is nearly seven times that of China. Not only is the number of refrigerated preservation trucks in China far smaller than the United States and Japan in absolute terms, the per capita share of refrigerated preservation trucks is even far behind. China's refrigerated transportation rate is also far lower than that of developed countries such as the United States and Japan. The total transportation rate is only in the range of 10% to 20%, of which air transportation is less than 1%, and waterways, roads, and railways are all less than 30%. Japan and other developed countries have a refrigerated transportation rate of over 80%, while Japan has a refrigerated transportation rate of nearly 100%. In addition, due to the small number of refrigerated preservation vehicles in China and the backward refrigeration preservation equipment, the loss rate of Chinese vegetables after picking is much higher than that of developed countries. The loss rate of Chinese vegetables after picking is as high as 25% to 30%, while developed countries only maintain below 5%. The pre-cooling insurance rate in China is also much lower than that of European and American countries. All in all, there is a big gap between China's agricultural products transportation and developed countries in terms of facilities and transportation efficiency.

The cold chain logistics and storage facilities of agricultural products in China are not only lagging behind those of developed countries in Europe and America, but also seriously inadequate. Cold storage is an important part of the cold chain logistics of agricultural products, and it is the basis of the development of cold chain logistics. In 2008, the global total cold storage capacity was 247.77 million cubic meters, China was about 15 million cubic meters, Japan was 27.69 million cubic meters, and the

United States was as high as 70.74 million cubic meters (Li, 2018). At the same time, many cold storages in China have been converted from other building uses, and there are a series of defects and safety problems. Many cold storages are only used for the storage of meat and fish, and the storage capacity of fruit and vegetable cold storages is relatively small. Due to the lack of multi-functional, highly professional, and suitable for fruit and vegetable cold storage, China's annual fruit and vegetable loss is large.

3.4.2 Comparison of marketization degree of agricultural cold chain logistics

In China, the agricultural cold chain logistics industry is still in its infancy. Small market scale, strong regional, low degree of marketization, less third-party logistics talents. The services provided by China's third-party logistics companies are less than 5% of the overall required services (Zhu, 2016). In addition to some foreign trade exports, the domestic circulation of fresh agricultural products in the logistics and distribution business mostly rely on the manufacturer's own transportation or distributors direct distribution, the third party logistics personnel are less. The development of the third-party logistics of the cold chain logistics of agricultural products in China is very slow, which not only affects the circulation quality of agricultural products, but also hinders the timely and accurate arrival of agricultural products to consumers and affects the quality of consumer goods. In contrast, the foreign cold chain logistics market has been very mature. Developed countries such as Japan and the United States have contracted a number of excellent cold-chain logistics companies outside perishable agricultural products, which not only makes the specialization of market division of labor and the most important thing of specialization is to ensure the freshness and safety of agricultural products, but also reduces the logistics cost.

3.4.3 Comparison of relevant regulations and standardization of agricultural cold chain logistics

In recent years, the Chinese government has enacted the law of the People's Republic of China on the quality and safety of agricultural products and the food hygiene law, and formulated a series of standards and regulations for the production and processing of agricultural products. However, under these laws and regulations, China's policies are too lenient compared with those of developed countries. The processing of meat food is as a example. The developed countries have stipulated the requirements for the supervision and control of the production operation process, not only strictly requiring the sanitary conditions, temperature conditions and packaging of each meat manufacturer. It also carries out a series of places. However, the processing control of meat products in China is much looser. Most meat products on the market are processed under normal temperature conditions. Moreover, there is a lack of control over the hygiene problems in the meat production process. Some developed countries have formulated a series of laws, regulations and standards in cold chain logistics of agricultural products. In order to ensure the quality and safety of food cold chain logistics, Canada has formed a complete cold chain logistics system of agricultural products. Canada has 46 organic product certification frameworks, 2,500 organic farms and 150 food processing companies certified by the agency, while China has about 3,000 quality standards for agricultural products and just over 100 related to agricultural logistics (Wei, 2014). If it is not perfect, there is very little information about cold chain logistics of agricultural products. There is no comprehensive standard for cold chain logistics of agricultural products. Comparing domestic and foreign countries, it is not difficult to find that the domestic agricultural product cold chain logistics standardization still needs to be in line with developed countries.

4 Influencing factors and challenges facing the development status of Chinese agricultural cold chain logistics industry

4.1 Influencing factors of the development status of Chinese agricultural cold chain logistics industry

In general, compared with developed countries, the development of cold chain logistics for agricultural products in China is still in its infancy, and a large-scale and systematic cold chain logistics system has not been formed. Compared with the development of modern agriculture, the consumption of residents and the export of livestock products need to be expanded. The proportion of fresh agricultural products circulating through the cold chain is still low, and most fresh agricultural products are still circulating at room temperature. Cold chain logistics infrastructure capacity is seriously inadequate; Regional distribution is unbalanced, and cold storage in central agricultural and pastoral areas and characteristic agricultural areas in the west are seriously insufficient; key logistics nodes such as large agricultural product wholesale markets and regional agricultural product distribution centers lack freezing and refrigeration facilities; the post-production pre-cooling technology of fresh agricultural products, the classification and grading in low-temperature environments, packaging and processing and other commercial processing methods have not been popularized, and the transportation links The temperature control methods are primitive and extensive, and the full-process temperature automatic control widely used in developed countries has not been widely used; The development of third-party cold chain logistics enterprises lags behind. In the development of agricultural cold chain logistics, the mechanism of high quality and low price has not been formed, the service system of cold chain logistics has not been completely established, the service level needs to be further improved, and the legal system and standard system of cold chain logistics are not perfect. The legal and

regulatory system to regulate the behaviors of market players in each link of cold chain logistics has not been established. There is a lack of unified standards for facilities, equipment, temperature control and operation in each link of cold chain logistics, so it is difficult to realize the effective connection of information resources in each link.

The specific manifestations are as follows:

4.1.1 The cold chain logistics of agricultural products lacks overall planning

Due to the low level of industrialization of China's agriculture and the low level of integration of production, supply and marketing. From the perspective of agricultural primary products, although the production and sales are huge, there is still a lack of food cold-chain related issues in the supply chain of primary agricultural products and perishable food. Issues such as standards, laws and regulations, comprehensive professionals, and the promotion of food cold chains have seriously affected the integration of agricultural products cold chains and hindered the development of China's agricultural cold chain logistics industry. The cold chain logistics market needs to be subdivided. Different types of agricultural products have different requirements for temperature and humidity in the logistics environment, while the cold storage temperature in China is generally $0^{\circ}\text{C}\sim 4^{\circ}\text{C}$ and $-18^{\circ}\text{C}\sim -22^{\circ}\text{C}$. A few cold storage rooms have a temperature of- Below 28°C . The storage temperature is suitable for most agricultural products, but it is not the best storage temperature for some agricultural products. In order to improve the storage quality and prolong the shelf life of agricultural products, the cold chain logistics market is subdivided and the optimal storage temperature is set for different agricultural products.

4.1.2 The degree of marketization of agricultural cold chains is not high, and third-party cold chains are rarely involved

Except for the export part, most of the agricultural products logistics and distribution business in our country is completed by the distributors. The development of the third party logistics in the agricultural cold chain is very backward, and third-party logistics companies that can provide comprehensive full-service services also Less than 5% of the overall demand, and the logistics services specifically for fresh and perishable agricultural products are even minimal. Lack of influential national third-party cold chain logistics industry leaders. The imperfect service network and Information System greatly affect the on-orbit quality, accuracy and timeliness of agricultural products logistics, and the cost of agricultural products cold chain and commodity losses are high.

4.1.3 Insufficient construction of hardware facilities for agricultural cold chain

China's refrigerated and refrigerated transportation industry is far from international standards. The overall scale of China's facilities is inadequate. The per capita cold storage capacity is only 7 kg, and the proportion of refrigerated vehicles in trucks is only 0.3% , which is quite different from developed countries. Existing cold storage facilities are generally outdated, aging, nearly half of the state-owned cold storage has been used for more than 30 years. About 70% of freight vehicles in the Mainland are of open-top design, and only about 30% are of sealed or van-type design, while refrigerated vehicles equipped with refrigerators and incubators are less than 10%. Railway refrigerated transportation facilities are very old. Most of them are mechanical quick-frozen wagons. They lack standard insulation-type fresh-keeping refrigerated transportation carriages. The transportation of refrigerated food accounts for only 1% of the total cargo transportation(Li, 2018). In the road transportation, the perishable and fresh-keeping agricultural products frozen, frozen

transportation only accounts for 20% of the total transportation. The remaining 80 per cent of poultry, aquatic products, fruits and vegetables are transported mainly by truck. According to the statistics of the National Development and Reform Commission, the cold chain circulation rate of meat and poultry in Europe, the United States, Canada, Japan and other developed countries reaches 100%, and the cold chain circulation rate of vegetables and fruits reaches more than 95%. China accounts for about 15-20 per cent. At present, China's cold chain facilities and cold chain logistics equipment are insufficient, the original facilities and equipment are obsolete, and the development and distribution are uneven. There are two immediate consequences. The first is the loss of perishable food, especially primary agricultural products. The total cost of logistics accounts for 70% of the cost of perishable goods. According to international standards, the logistics cost of perishable goods does not exceed its total cost. 50% of the cost. Second, there are huge hidden dangers in food safety (Wei, 2018).

4.1.4 Agricultural cold chain logistics software technology is backward

Food cold chain logistics software technology includes cold storage expertise, logistics technology and organization technology. At present, China's food cold chain logistics lacks expertise in refrigeration, resulting in high cold chain costs; backward logistics technology, low automation, intelligence, and information technology, so that operation efficiency is not high; organization technology is low and cannot be established a strategic alliance cannot achieve mutual benefit and win-win results for upstream and downstream enterprises. The development of third-party cold chain logistics is lagging behind. Most of the logistics and distribution business of China's agricultural products are completed by suppliers or themselves, which greatly diversifies the energy of enterprises and increases their operating costs. The existing cold chain logistics companies are mainly small and medium-sized enterprises, with weak strength, small coverage, inconsistent service standards, and large-scale cold

chain logistics companies with resource integration and industry promotion capabilities have just started. Only a few logistics providers have technology and The equipment can meet the requirements of international cold chain standards. General third-party logistics companies can only provide refrigerated transportation, not cold chain logistics services in the true sense.

4.1.5 The agricultural product cold chain system is not perfect

Our country cold chain logistics each link lacks the system, the standard, the coherent operation. Some products processed at low temperature during slaughter or storage have "broken chain" phenomenon in transportation and sale, and the cold chain rate is too low. The existing cold-chain logistics enterprises are mainly small and medium-sized enterprises with weak strength, small distribution scale, inconsistent service standards, and large cold-chain logistics enterprises with the ability of resource integration and industry promotion are just starting, it's not a market leader yet.

4.1.6 Lack of cold chain logistics professionals

In order to maintain the normal operation and smooth development of the cold chain of agricultural products, it is necessary to have the management and technical personnel with comprehensive knowledge and professional knowledge of logistics development. However, China's logistics industry started late, has not yet formed a complete logistics system, the theory and practice of China's local logistics lack of research. In the training of logistics professionals, there is a lack of theoretical guidance and practical teaching. Therefore, most logistics talents cannot meet the requirements of the cold chain logistics industry.

4.1.7 The cold chain logistics legal system and standards are not sound

The legal and regulatory system that regulates the behavior of market entities in various links of cold chain logistics has not yet been established, which makes the government lack the theoretical and institutional basis for the supervision and

control of agricultural product logistics, and many unscrupulous businesses have opportunities to take advantage of this. In addition, cold chain logistics lacks unified standards of facilities, equipment, temperature control, operation specifications, etc., which makes it difficult to realize the effective linkage of information resources. At the same time, China's cold chain logistics technical indicators are not perfect, leading to the quality of agricultural products can not be guaranteed, and food quality is directly related to the safety of the broad masses of people. Therefore, on the one hand, we should speed up the construction of laws and regulations; On the other hand, we should improve the standards of the cold chain logistics industry.

4.2 Challenges facing the development status of Chinese agricultural cold chain logistics industry

The future development of China's agricultural cold chain logistics contains huge opportunities, but we must not ignore some potential threats in its development, which can be seen from the following aspects. The influx of foreign venture capital will increase the barriers to entry in this industry and even threaten national security. In recent years, the financial market has been sluggish. The agricultural product market, which was previously unconcerned, has been sought after by many venture capital funds. As an emerging industry, cold chain logistics has attracted the attention of global capitalists. As one of the largest private equity funds in the United States

The Blackstone Fund has controlled more than 100 wholesale markets in China through capital operations such as mergers and acquisitions. On the one hand, the introduction of foreign capital does play a certain role in promoting the rapid development of the industry, but if large-scale mergers and acquisitions occur, it will squeeze the domestic market and threaten the survival of 3 million domestic logistics companies. It can be said that control If the channel is established, the

pricing power is controlled. If the situation is serious, it will affect the national economic security.

Second, third-party logistics companies may have integrity risks, and the entire temperature control cannot be ensured. Therefore, the third party logistics enterprises must adhere to the principle of good faith, establish their own good reputation, in order to promote the healthy development of the entire industry. A third short-term cost increase will be passed on to consumers. In recent years, domestic cold chain logistics companies have sprung up like mushrooms, but there are many problems behind the "prosperity". Self-built refrigerated warehouses, purchase of refrigerated trucks and other costs will bring certain financial pressure to logistics and distribution companies in the short term, and this part of the investment will be passed on to consumers through product price increases.

4.2.1 More complicated

The management and operation of cold chain logistics of agricultural products are difficult, and the requirements of logistics technology and equipment are high, so special equipment and facilities are often needed. And the construction of distribution center investment larger, long return period. The production and consumption of fresh agricultural products are relatively dispersed, market supply and demand and price changes are also large, affected by the weather, traffic and other uncertain factors are more, so it is easy to cause the increase of agricultural products logistics costs, thus increasing the logistics chain operating costs(Li, 2012). In addition, the quality of agricultural products in circulation will change with the change of temperature and time, and different agricultural products have different requirements of temperature and storage time in circulation, the storage temperature and cycle time of agricultural cold chain logistics products and the durability of the products themselves lead to the complexity of agricultural cold chain logistics and logistics process.

4.2.2 High cost

In order to ensure that fresh fruits and vegetables in the circulation of all links are always in the required low-temperature conditions, it is necessary to install temperature control equipment, must use refrigerated vehicles or low-temperature warehouse (Wei, 2014). At the same time, in order to improve the efficiency of logistics operation, we must adopt advanced information system and advanced technology, which determines the cost of agricultural products cold chain logistics is higher than other products.

4.2.3 Higher requirements for information technology

Agricultural cold chain logistics demand faster, the market reaction to the sensitive and requires the logistics link comprehensive cost minimization, and agricultural products logistics system complex, more participation main body, high degree of information asymmetry(Zhu, 2016), the quality of agricultural products in circulation process to make real-time tracking or quality control, and information technology requirements for cold chain logistics of agricultural products is higher.

5 Analysis of Operation Mode of China's Agricultural Products

Cold Chain Logistics

In recent years, China's cold chain logistics industry has developed rapidly, extending from the Pearl River Delta and Yangtze River Delta economic zones to the figure skating championships in the central and western regions. With the rapid development of national economy and the improvement of residents' living standards, people's understanding of frozen fresh agricultural products is getting higher and higher, which rapidly stimulates the consumption of frozen fresh agricultural products. The development of cold chain logistics enterprises is further expanded, the market concentration is significantly improved, and the development of supply chain management is accelerated. The increase in demand has intensified the competition in the domestic cold chain logistics market. In order to improve the efficiency of agricultural products circulation, reduce the cost of agricultural products circulation, ensure the supply of fresh agricultural products in cities and towns, and promote farmers' income, the National Development and Reform Commission recently released the Development Plan for Agricultural Cold Chain Logistics to speed up the construction of integrated "field table" cold chain logistics. Obviously, by 2015, a number of cross-regional cold chain logistics distribution centers will be highly efficient, large-scale and technology-oriented, the core technologies of cold chain logistics will be widely promoted, and a number of enterprises will form a strong ability of resource integration and international competitiveness. Core cold chain logistics company (Zhang, 2019). Due to the different natural conditions in different regions of our country, the degree of economic development and infrastructure construction in different regions are also different. According to the development status of cold chain logistics of agricultural products, multiple modes can be considered for joint development to realize

complementary advantages and promote the development of cold chain logistics of fresh agricultural products.

5.1 Taking the "wholesale market" as the leading

Large-scale agricultural product wholesale market operators connect with agricultural product distribution companies and professional cooperatives to form an integrated logistics model for agricultural product production, purchase, processing, storage and preservation, distribution and market information. In this model, the agricultural product wholesale market operators accept the pull of user demand and the push based on profit demand, establish a comprehensive and integrated logistics service system, and act as the main chain of the supply chain to drive all participating entities to implement the logistics supply chain Management has established an operating mechanism of benefit sharing and risk sharing.

5.2 Taking "supermarket chains" as the leading

The cold chain logistics of fresh agricultural products for chain supermarket companies extends upstream, through investment in the construction of bases or joint product distribution companies and processing companies, and establish long-term cooperative relationships with large-scale stable supply and base product manufacturers, and through self-built fresh agricultural products The logistics distribution center may use third-party logistics to provide pollution-free vegetables, fresh fruits, and multi-variety side dishes to the store(Wang, 2020). This model is helpful to realize the standardization of product quality, processing and management, and can effectively control and reduce store inventory and loss, which is beneficial to the supermarket own brand, for a long time in the future, it will be the mainstream mode of cold chain logistics of fresh agricultural products.

5.3 Leading by "leading enterprises"

The "leading enterprise" in this model mainly refers to large agricultural product processing enterprises or sales enterprises, such as Shuanghui, Mengniu, etc., according to their own resources through self-built or joint construction of community monopoly mushrooms, control sales terminals, and organize fresh agricultural product logistics. This mode of logistics links less, timely information feedback, high market sensitivity, can speed up the logistics, help fresh agricultural products added value. At present, some large-scale agricultural and sideline products processing enterprises have started to establish their own logistics supply chain system (Song, 2016).

The construction of a cold chain logistics center not only requires a large amount of capital, but also a large amount of technical support. The investment recovery cycle is long, and the maintenance capital requirements during operation are also large. Therefore, only relying on the government or only relying on enterprises can not fully meet the construction needs of cold chain logistics hardware facilities, which requires enterprises and the government to unite, invest and manage together. Strengthen the improvement of the cold chain logistics supervision mechanism(Jin, 2008). At present, some domestic laws and regulations are not restricted from the perspective of the whole process of cold chain logistics. Even if there are regulations, there is a lack of uniform and scientific standards. The relevant national departments shall formulate relevant laws and regulations conducive to the development of the cold chain logistics industry, establish food cold chain standards as soon as possible, incorporate the food market access system, establish an effective supervision mechanism, and strictly monitor the operation status of each link of the perishable food cold chain. We will accelerate the cultivation of third-party cold-chain logistics enterprises. Cultivate a number of large cold-chain logistics enterprises with strong economic strength, advanced business philosophy and management methods, and

strong core competitiveness. Enterprises are encouraged to set up low-temperature storage facilities in production and sales areas to realize low-temperature control from the source, establish a cold-chain logistics system centered on production enterprises, and realize efficient connection of cold chain logistics between production and sales areas. Accelerating the development of agricultural cold chain logistics is of great significance for increasing farmers' income and ensuring consumption safety. China's existing cold chain logistics enterprises should take active measures to adapt to the development requirements of the cold chain logistics industry.

6 Countermeasures to develop cold chain logistics

Based on the analysis of the current situation of the cold chain logistics of agricultural products in China, various factors restricting the development of the cold chain logistics of agricultural products in China and the successful experience of foreign countries, the author believes that China should take the following countermeasures to develop the cold chain logistics of agricultural products in China.

6.1 Strengthen education and cultivate professional talents in agricultural cold chain logistics

Strengthen logistics basic education and training, and cultivate professional talents who adapt to the development trend of modern logistics. Based on the current level of agricultural development in China, we must allow cutting-edge logistics theories to guide China's cold chain agricultural product logistics practice, establish the disciplinary status of the logistics industry, encourage logistics vocational education, and change the current low-level and low-level issues of agricultural cold chain logistics . Western countries started logistics education in the 1970s, and modern logistics education and training are very developed. According to statistics, "about 92% of American logistics managers have a bachelor's degree, 41% have a master's degree, and 22% have formal warehousing engineers, distribution engineers and other qualification certificates." All logistics operators in the Netherlands must have an approved employment qualification certificate(Zhao, 2021). However, China is relatively short of logistics management professionals. A group of high-quality logistics management professionals familiar with agricultural product logistics and various operations should be cultivated as soon as possible. At the same time, support and encourage enterprises, industry associations and private educational institutions to organize training.

6.2 Increase investment in cold chain facilities to realize the integration of supply chain information

6.2.1 Strengthen the infrastructure construction of cold chain logistics facilities

Combining with China's actual market demand, increase investment in research and development of refrigerated trucks, refrigerated containers and related refrigeration and storage equipment to promote the improvement and improvement of refrigeration equipment. Constantly innovate the refrigeration method and technology, accelerate the introduction of advanced technology, as soon as possible to popularize all kinds of new refrigeration technology. Cold chain logistics information system planning, including inventory control system, customer service system, warehouse management system and transportation management system planning of four subsystems. Through the introduction of POS technology, EDI technology, GPS technology and other advanced information technology, the integration of supply chain information is realized, the information sharing between upstream and downstream enterprises is realized, and the cost of cold chain logistics is reduced.

6.2.2 Strengthen the construction of information platform

The future cold chain logistics center should be an open logistics information center that can process all kinds of information generated in cold chain logistics, so that the information can be quickly and accurately transmitted to other related departments and institutions through the platform. The logistics information processing center collects information from all related units, performs certain processing, and then shares it with all the constituent units. Customers can use the information platform to transfer business information such as warehousing, shipping, booking, picking up, contracts, and expenses. Import and export business information can also be

transmitted to the customs, inspection and quarantine, taxation and other government supervision departments in the form of EDI through the information platform.

6.3 Increase government support to establish a green channel for cold chain logistics of agricultural products

From a national perspective, China's agricultural cold chain has developed rapidly in the past two years, especially in terms of cold chain infrastructure and scale, which has made remarkable achievements. But on the whole, China's agricultural cold chain logistics "six modernizations" (integration, chain, information, scale, network, efficiency) is still relatively backward. Therefore, it is necessary to promote the development of cold chain logistics of agricultural products in China and realize the "six modernizations" of the cold chain, the government can focus on deployment from the following four aspects (YU, 2007):

1. Strengthen departmental coordination, improve regulations and supervision. The cold chain of agricultural products has many logistics links and a long industrial chain. It is a cross-department, cross-industry and cross-regional system engineering. The development of the industry requires cooperation and support in many aspects, forming a joint force, uniformly organizing the implementation of planning, coordinating and solving outstanding contradictions and major problems in the development of cold chain logistics, and ensuring the realization of planning goals. Therefore, it is necessary to accelerate the improvement of cold chain logistics laws and regulations system, and further strengthen the formulation of mandatory national standards; Give full play to the role of existing departments and institutions, establish the whole-process quality control system based on hazard analysis and critical control point (HACCP), and formulate the operation norms and technical standards of cold chain logistics in line with international standards, supplement and

improve testing items and content, and establish and improve quality inspection and supervision mechanisms(Chen, 2006).

2. Integrate existing resources and cultivate key enterprises. Encourage logistics companies to integrate existing fresh agricultural product production and processing companies, wholesale markets, cold chain logistics companies, and cold chain logistics resources in ports, docks, and air shipping and transportation hubs through mergers and acquisitions, equity holdings, joint ventures, and other methods. In this process, it is necessary to increase the government's financial support and policy guidance, give preferential treatment in taxation and loans, and promote the integration of resources. The government invests funds to support the cultivation of key enterprises to build some large wholesale markets and logistics distribution centers, and processing enterprises in production areas that can play a leading role, and develop and support a group of third-party logistics enterprises that can provide public services to the society and achieve "door-to-door docking" .

3. Increase support for infrastructure construction, encourage innovation and cultivate talents. In order to promote the construction of cold chain logistics, it is necessary to give full play to the role of market mechanisms, greatly increase the government's support for infrastructure construction, and further encourage enterprises to increase investment. In order to overcome the problem of insufficient R&D and innovation capabilities of a single enterprise, the government needs to take the lead in enterprises and universities to conduct concentrated research and development, and strengthen the innovation and research and development of key technologies and equipment. In order to cultivate professional talents, the government needs to guide higher education institutions to set up relevant disciplines, offer relevant courses, promote vocational education, technical training and continuing education, and create a talent incentive and flexible mechanism for the agricultural cold chain logistics industry.

4. Promote the concept of cold chain logistics and develop third-party cold chain logistics. As mentioned above, the development of cold chain logistics is of great significance. In order to improve the public's understanding of the freshness and quality of fresh agricultural products and create an atmosphere, it is necessary to publicize the importance of the whole cold chain and promote the application of cold chain logistics concepts and technologies in relevant enterprises.

The state has promulgated relevant laws and policies to encourage the development of agricultural logistics, regulate the organizational behavior of agricultural logistics, establish and improve the agricultural logistics system, create a good external environment for the development of agricultural logistics, and promote the healthy and rapid development of agricultural logistics. At the same time, the government should also provide information guidance, technical support and other services. We will increase investment in transportation and other infrastructure. The improvement of rural logistics level needs the support of good infrastructure construction. The level of transportation infrastructure directly determines the speed and efficiency of logistics. The government should raise funds through multiple channels and means to increase input in transportation construction. Accelerate the renovation of railway subgrade, intensify the repair of expressways, increase the capacity of cargo ships and cargo planes, and improve the construction of ports, docks, airports, stations and other facilities (Bao, 2020). Logistics industry as a basic industry, need a lot of capital investment. The government can increase the investment of national debt in rural infrastructure construction, or consider adopting a series of preferential policies to attract foreign investment and encourage private investment. In order to seize the market opportunity, promote the balanced, reasonable and sustainable development of agricultural cold chain, relevant cold chain companies and institutions can proceed from the following aspects:

1. Based on the supply chain, realize scientific construction and operation. Cold chain crops are a supply chain system. When operating a cold chain, companies should start from the overall supply chain, rather than just focus on the gains and losses of a certain link. In recent years, a large number of cold storages have been built across China, which initially alleviated the lack of cold storage capacity. However, in some places, the cold storage utilization rate is insufficient due to lack of planning. In addition, pre-cooling and cooling capacity, and refrigerated transportation capacity are still very lagging, which has severely restricted the development of China's cold chain logistics. Therefore, the development of agricultural cold chain logistics needs to focus on these links.

2. Seize the huge market opportunities that have been overlooked in the pre-cooling and cooling links. Under the influence of the traditional concept of heavy refrigeration and light pre-cooling, the huge business opportunities contained in pre-cooling and cooling have not attracted enough attention. Pre-cooling and cooling are the most critical links in preservation technology. With the rapid development of cold chain logistics of agricultural products in China today, the huge business opportunities contained in pre-cooling and cooling have begun to emerge.

3. Let the cold storage section of the cold storage become a new fulcrum for leveraging the entire cold chain. The investigation found that whether it is a cold storage at a production area or a cold storage at a sales area, it is currently mainly competing for a limited number of cold chain customers and competing in a zero-sum manner. In view of this situation, considering the huge market space of cold chain logistics, agricultural cold chain logistics related enterprises should not only pay attention to the scale and capacity of cold storage, but also need to take cold storage as the fulcrum and extend to the two ends of the chain when constructing cold chain. In order to improve the utilization of cold storage space and cold chain

circulation capacity. Make scientific overall planning to achieve balanced development of all links in the cold chain.

6.4 Fresh food e-commerce activates cold chain logistics of agricultural products

The national e-commerce agricultural product transaction volume has rapidly increased from 3 billion yuan in 2010 to 50 billion yuan in 2013(Liu,2020). E-commerce has entered a period of accelerated development. According to statistics, there are more than 3,000 agricultural product e-commerce platforms across the country, and the growth rate of fresh food online shopping in 2013 It quickly exceeded 300%(Bao, 2020). Agricultural product e-commerce is considered to be the last fertile ground for e-commerce. In addition to platform e-commerce such as Alibaba and JD.com, food companies such as COFCO and express delivery companies such as SF Express have also entered the field of agricultural e-commerce. However, the penetration rate of agricultural e-commerce is less than 1%, which is far behind that of clothing and electronic products. No. 1 Fresh Food has expanded its categories again in Beijing, with more than 110 types of frozen foods on the line, and will provide consumers who purchase this part of the food with a "full cold chain" delivery service. So far, Beijing residents can not only buy fruits and vegetables at the No. 1 store, but also refrigerated food.

6.4.1 E-commerce is frequently involved in the entire cold chain

It is understood that the domestic agricultural product sales market accounts for no more than 30% of the market. The traditional farmer's market terminal sales with less cold chain demand still occupy a major position, and the rise of fresh food e-commerce has brought some changes to the agricultural product terminal. The contradiction between terminals and logistics has brought new directions and propositions for the development of agricultural cold chain logistics. In the

transaction of agricultural product e-commerce, consumers will ask for cold and fresh logistics. Because e-commerce cooperative logistics companies cannot achieve national cold chain distribution, and because of the small scale, cold chain transportation costs will greatly increase. In view of the rapid development of fresh food e-commerce, third-party cold chain logistics companies have also begun to consider cooperation with e-commerce platforms. Some professional cold chain logistics companies have also begun to "walk in person" with their own professional cold chain distribution networks and set foot in the field of fresh food e-commerce in order to achieve a virtuous cycle of e-commerce and logistics. After SF Express and Zhongtong successively set foot in fresh food e-commerce, Xianyi.com, a subsidiary of Henan Zhongpin Group's temperature control supply chain, was fully launched in October. Zhongpin's involvement in fresh food e-commerce is hoping to activate its huge cold chain transportation network.

6.4.2 Development problems encountered by agricultural product e-commerce

Technical obstacles, in addition to product standardization and trust between the parties to the transaction, logistics are also a major bottleneck restricting the development of agricultural products e-commerce. The logistics of agricultural product e-commerce mainly faces two problems: one is the high cost of single delivery. If the customer unit price (that is, the single transaction amount) in an e-commerce transaction is 100 yuan, then the logistics cost of agricultural products will account for 25% to 40%. Secondly, due to the lack of cold chain logistics, China's cold chain logistics is relatively backward (Wang, 2020) . Consumption, causes the agricultural product circulation loss rate to be as high as 25%-30% , also becomes our country agricultural product electronic commerce development one big challenge.

6.4.3 The development of agricultural product e-commerce remains

unstoppable

Although agricultural product e-commerce faces many difficulties, its development is still unstoppable. An important reason is that the traditional agricultural product circulation model has many links and low efficiency. In contrast, the current agricultural e-commerce logistics costs, although very high, but still has a strong appeal and vitality. Breaking through the bottleneck of logistics is not only related to the ultimate success or failure of e-commerce mode of agricultural products, but also of great significance to the transformation of the circulation mechanism of agricultural products and the solution of the problems concerning agriculture, rural areas and farmers.

6.4.4 Improve the logistics of agricultural products e-commerce

First, increase investment in infrastructure, vigorously promote the construction of agricultural products cold chain logistics. Second, from the perspective of supply chain management to optimize the overall logistics network of agricultural products. Third, actively encourage, and in tax, finance and other aspects of the special support policy. Encourage the market to continue to explore the agricultural products e-commerce logistics innovation model. Fourth, the development of Agricultural E-commerce is a new thing, can not do without the active support of consumers. Only with the active participation of consumers, can the e-commerce of rural household products realize economies of scale, and the entire industry will emerge from the stage of "losing money and earning praise" as soon as possible.

6.4.5 Enterprises have carried out active explorations on agricultural products

e-commerce

At present, many companies are actively exploring the e-commerce of agricultural products, launching the e-commerce business of fresh food, and Cainiao Logistics has

formed a new type of logistics resources by integrating cold chain road freight, cold chain transfer centers, and landing distribution companies. The "two-stage distribution" logistics model effectively controls costs(Yu, 2001).

6.5 Overall optimization of agricultural cold chain logistics

6.5.1 Establish a cold chain combined transport mechanism

Under the background of economic globalization, multimodal transportation can reduce transportation costs and increase the speed of cargo transportation. The development of trade has increasingly increased requirements for refrigerated transportation multimodal transportation, and the adoption of refrigerated containers and related information technology is the development of multimodal transportation. Provided strong support. Refrigerated transportation should actively develop a combined transportation network of railways, highways, and waterways to form a multimodal transportation system. In order to achieve the purpose of keeping fresh, frozen and refrigerated products are required to enter the consumption link quickly and in time. The fewer circulation links, the better, so as to ensure the freshness and edible safety of frozen and refrigerated products. However, the dispersion in the production and consumption of agricultural products makes it inevitable that fresh commodities must be collected and dispersed once or more in circulation. In view of this, commercial formats such as stores, chain supermarkets, and convenience stores should centrally purchase frozen and refrigerated products from agricultural product production bases or wholesale markets of origin, reduce operations, and establish direct and effective distribution channels. The cold storage supply chain is a cross-industry, multi-sector organic integration of system engineering. The construction of cold chain support system can not be effectively promoted by any party alone. This needs the linkage mechanism between the government, the industry organization and the enterprise to work together. We should integrate China's national conditions, learn from the experience of developed

countries, improve technology management methods and regulatory measures. The government should formulate policies and incentives for food cold chain development, including tax policies, and charge high environmental fees for non-cold chain waste caused by perishable foods. At the same time, it should also strengthen the direction and guidance of industry planning; industry organizations should play Communicate and coordinate the role, formulate and implement the overall industry plan and industry specifications; establish cold chain food standards and food cold chain standards as soon as possible to ensure the quality of refrigerated food in all links.

6.5.2 Make full use of third-party logistics companies

Low-temperature logistics is a high-end logistics with high infrastructure, technology and operation requirements. It is often a weak link for enterprises because of large investment and slow return. More and more manufacturers are willing to choose the third party logistics company to outsource the cold chain logistics business. They pay attention to the construction of core competitiveness, and use the scale benefit of third-party logistics to reduce logistics costs. Such market demand will surely promote the rapid development of third-party cold chain logistics companies (Zhang, 2020).The use of third-party logistics can reduce the logistics of fresh agricultural products in the middle link, shorten the logistics time, reduce the loss of logistics.With the support of the information network system, the inventory can be reduced, the inventory time can be shortened, and the cost can be further reduced.The third party logistics enterprise can rely on its highly specialized operation, reduce the cost of cold chain logistics system, the third party logistics enterprise can improve the fresh agricultural products production and marketing information collection and processing speed, set up information network system, and use the information network system to improve supply chain each link between direct, fast information transmission, promote the balance between production and

marketing. In foreign countries, the third party logistics has become the pillar of modern logistics industry. In view of this, we should vigorously promote the third-party logistics enterprises to enter the cold chain logistics market.

7 Research on Optimal Distribution Route

As China's fresh agricultural products cold chain logistics distribution faces many interference factors and problems, we should fully learn from the experience of foreign logistics and distribution, combine the special situation of fresh agricultural products distribution and the current situation of China's cold chain logistics system, and actively find ways to optimize distribution . Specifically, a large-scale cold chain logistics distribution center should be actively built, and based on this, it will play its basic supporting role in cold chain logistics distribution; build a joint cold chain logistics distribution alliance for land sales, and play the role of the current agricultural product wholesale market. ; Build a "one-stop" cold chain distribution network information platform, use modern Internet, Internet of Things and other information technologies to optimize distribution paths; in addition, the government should also create a good political environment for the smooth development of cold chain logistics and distribution.

7.1 Build a large-scale cold chain logistics distribution center

In order to optimize the path of fresh agricultural products cold chain logistics, it is necessary to strengthen the "agriculture super" docking, through optimizing the agricultural products supply chain to improve the efficiency of distribution.

Therefore, it is necessary to establish a large-scale cold-chain logistics distribution center with a higher degree of organization capable of refrigeration functions, processing, packaging and distribution of fresh agricultural products to meet the demand for supply and demand, reduce logistics and distribution costs, to help create economies of scale. In general, the construction of a large cold-chain logistics distribution center, need to pay attention to the following points:

One is to continuously enhance the system and unity of distribution. The cold chain logistics distribution center helps to improve the shortage of small-batch and multi-variety purchases in traditional agricultural cooperatives and chain supermarkets.

The distribution center needs to purchase in large quantities, and conduct unified inspection and packaging of fresh agricultural products. The demand of the store is uniformly distributed, and the logistics and distribution path of fresh agricultural products is optimized.

Second, reduce the loss of agricultural products, to achieve the link between production and circulation. The production and circulation of fresh agricultural products requires high technology, easy to wear and tear, but also to the enterprise in the production and circulation of a certain loss. In order to improve this situation, cold chain logistics distribution center should actively construct cold storage supply chain. The refrigeration of each link in the processing and transportation of fresh agricultural products, on the one hand, helps to reduce the loss of agricultural products in logistics distribution, on the other hand, it also helps to ensure the freshness and security of agricultural products.

Third, to meet the supply and demand of agricultural products. The sale of fresh agricultural products has a certain seasonal character, which is greatly influenced by the change of demand. For this reason, cold-chain distribution centers should forecast and analyze market demand, while cross-seasonal agricultural sales with their own storage and preservation capabilities will help stabilize agricultural prices in different seasons, protect the rights and interests of farmers.

7.2 Constructing a joint distribution alliance for land-selling cold chain logistics

In recent years, China has done a lot of work on the optimization of cold chain logistics distribution path of fresh agricultural products. The scale of wholesale markets for agricultural products in many large and medium-sized cities has been expanding, but there is still a big gap compared with the comprehensive cold-chain logistics parks. Therefore, it is necessary to strengthen the combination of

agricultural products wholesale market and distributor organization to form the cold chain logistics joint distribution alliance.

The wholesale market of agricultural products can give full play to its own advantages, implement the joint distribution of agricultural products, integrate the resources of existing and surrounding logistics companies, especially in view of the deficiency of the current dispersed cold chain logistics network, unite with a number of small logistics companies to jointly establish the joint distribution alliance of agricultural products. On the one hand, to provide better services for the cold chain logistics of fresh agricultural products, optimize the supply chain of fresh agricultural products. On the other hand, it will help alleviate various problems encountered in the transportation of fresh agricultural products and break through the logistics and distribution problems. "Last Mile." The establishment of joint distribution alliance cold chain logistics, promote the transformation and upgrading of agricultural products wholesale market, form a unified distribution system, and the improvement of fresh agricultural products comprehensive logistics park, will not only improve the efficiency of logistics distribution, but also help to promote the standardization and systematic development of cold chain enterprises logistics distribution.

7.3 Building a "one-stop" cold chain distribution network information platform

The particularity of fresh agricultural products determines the importance of its circulation. Optimizing the distribution path is to reduce the unnecessary loss of fresh produce due to spoilage. Logistics distribution is an important link connecting production and distribution, which puts forward high requirements for the timeliness and cold storage function of logistics distribution. In the context of "Internet +", the optimization of cold chain logistics distribution cannot be separated from the support of information technology. The use of real-time information sharing

can realize the effective connection of logistics activities of enterprises, and realize the intellectualization of cold chain logistics and fresh agricultural products distribution. The "one-stop" cold chain distribution network information platform is built to realize the integration of logistics data collection, transmission and distribution management. The Internet of Things technology is used to understand the transportation status of fresh agricultural products, and ensure that they are within the appropriate temperature range and improve their preservation. In the distribution management, big data analysis, path optimization, process tracking and other technologies are used to realize the automatic management of logistics and transportation of fresh agricultural products.

The so-called "one-stop" cold chain logistics distribution is the whole process service from the vegetable garden to the vegetable basket. Intelligent management realized by using modern Internet of Things, big data and other technologies avoids the multi-step, complexity and disadvantages of distribution path optimization, which is in line with the development trend of current distribution path optimization. Therefore, it is necessary to actively build a distribution information sharing platform, expand its coverage and logistics network, realize the seamless connection of each link of logistics and distribution, and strictly guarantee the quality of agricultural products.

7.4 Build a good environment for cold chain logistics of fresh agricultural products

In addition to the optimization of the above links, the government's macro-control and policy guidance should also be played to create a good environment for the optimization of the cold chain logistics distribution path of fresh agricultural products. The following points should be considered:

First, strengthen the macro guidance of cold chain logistics distribution. In view of the imperfection of China's current cold chain logistics network construction, the

construction of a comprehensive cold chain logistics system cannot be separated from the government's financial input and policy support (Wang, 2007). Therefore, in order to optimize the distribution path, the government should pay more attention to the construction of the cold chain logistics system, and plan and layout the construction of the cold chain logistics system scientifically and systematically. On the one hand, the government should strengthen the standardized construction and management of cold chain logistics and transportation by formulating relevant standards. On the other hand, through the introduction of relevant supporting policies, to provide support for the development of third-party cold chain logistics enterprises.

Second, strengthen the research and development of cold chain logistics technology. From the perspective of the government, scientific research institutions and enterprises should be encouraged to research and develop cold chain logistics technology, and establish a good cold chain logistics distribution infrastructure. For example, the current transportation and infrastructure conditions in some remote rural areas are still very inadequate. Therefore, increase financial input, strengthen infrastructure construction. At the same time, the development and application of cold chain logistics technology cannot be separated from the cultivation of innovative talents. Innovation should also be made in the talent cultivation mode, and colleges and universities should be guided to open relevant majors and courses, and social forces should be encouraged to jointly cultivate cold chain logistics technicians.

Third, we will improve relevant standards and step up policy enforcement. The optimization of agricultural products cold chain logistics distribution path should pay attention to the operation efficiency by improving the distribution efficiency, improving the circulation speed of fresh agricultural products, reducing transportation costs and other ways. Therefore, from the national level, it is

necessary to strengthen the construction of laws and regulations related to cold chain logistics, formulate corresponding standards, clarify operational norms, improve the service level of cold chain logistics enterprises, and regulate their distribution behavior. In the specific operation process, the different types of fresh products are subdivided, specific standards are formulated, and then carried out in strict accordance with the standards. At the same time, the circulation of fresh agricultural products to carry out strict supervision of each link, the violation of safety standards of enterprises must be severely punished. In addition to the above work, local governments should also strengthen the construction of cold chain logistics information platform for fresh agricultural products and build a platform for information sharing, communication and cooperation among enterprises, which is of great practical significance for optimizing the cold chain logistics system. To sum up, with the continuous improvement of people's living standards, people's demand for fresh agricultural products is more and more large, fresh agricultural products quality and safety also put forward higher requirements. At present, the cold chain logistics distribution system of fresh agricultural products in China is still in the initial stage of construction, and there are still some deficiencies in the construction of logistics distribution technology and management platform. With the rise of third-party cold chain logistics enterprises, the optimization of the distribution path of cold chain logistics comes into being. Development opportunities. At the same time, should be fully integrated network technology, the Internet of things technology, big data technology and so on, to form joint agricultural cold chain logistics distribution platform, realize the distribution of each link in the process of seamless integration, so as to reduce the risk of fresh farm products also helps to improve the efficiency of distribution, provide better service for customers, for each node of the supply chain enterprise to create better benefit.

8 Conclusion and Discussion

The cold chain logistics of agricultural products is of great significance to the economic and social development of China, and it has great potential to develop the cold chain logistics of agricultural products. The development and promotion of agricultural cold chain logistics needs the long-term support, cooperation and efforts of the government, enterprises and other social forces.

First of all, enterprises are the main body of agricultural cold chain logistics operation. Cold chain logistics of agricultural products is a complicated system engineering. In order to ensure the speed, high equipment investment, high technology application and efficient operation of each link of logistics, the coordination of supply chain nodes is necessary. In order to meet a higher level of customer service, at the same time, when planning cold chain logistics, enterprises must pay attention to the characteristics of cold chain logistics, and plan the components of the logistics system by paying close attention to the market demand and product characteristics of fresh food.

Second, the cold chain involves several upstream and downstream enterprises in the supply chain. Government intervention is especially necessary at a time when most food companies are unable to set up cold-chain systems on their own. For the government, it should actively guide the development of the cold chain and play the role of macro-control. To strengthen the study of food cold chain, including refrigeration technology, refrigeration equipment, logistics company performance targets, circulation legislation, such as environmental monitoring, food temperature as well as the overall planning and study of cold chain circulation, especially strengthen weak links, cold-chain management measures to promote coordinated development of the industry, at the same time to strengthen the construction of logistics infrastructure, such as push the logistics center in production area to build the new products, increase investment in refrigerated vehicles, etc., introduce advanced cold-chain logistics technology and management methods, draw lessons from foreign mature experience, set up food cold-chain public information system, improve the circulation of fresh food cold storage process, Cooperate with international cold-chain logistics organizations in education, management, consulting, technology and other fields to accelerate the development of cold-chain

logistics. Cold chain logistics of agricultural products is the outcome of the development of modern market economy. There are still some problems in the development of cold chain logistics of agricultural products in China. Compared with developed countries, there is still a gap in hardware facilities, logistics standardization, technical personnel and other aspects. We should take active measures to solve these problems, narrow the gap with developed countries, so that the cold chain logistics of agricultural products can meet the needs of social development and contribute to the development of agriculture in China.

List of References

- National Standard logistics Terminology of China, 2006, 《中华人民共和国国家标准：物流术语(GB/T 18354-2006)》. Accessed on 30 September,2020.
Retrieved from <https://wenku.baidu.com/view/0c9eab27bcd126fff7050b13.html>
- Lu Chuanlai, 2009, Queuing theory, Beijing University of Posts and Telecommunications Press.
- Zhang Xicai, 2019, Research on economic characteristics, difficulties and countermeasures of cold chain logistics of agricultural products in China. Accessed on 30 September,2020. Retrieved from
<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=JJTL201912016&v=mCci3dYuvEdC6mA%25mmd2BVUFB6DibKtEHdOZxYtkFHmoRGbhHSYpKmfhvnkYY5%25mmd2BcW4LTj>
- Dai Ying, Wang Zhenfeng, 2009, Formation and Development of port logistics Service Supply Chain . Accessed on 30 September,2020. Retrieved from
<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2009&filename=LTKJ200911018&v=%25mmd2FyG6h7h%25mmd2BiAN97VlIk9d%25mmd2B%25mmd2Bm8tDOyVzXqvyqeAQtcFT19bmNhEFyFwRehJSUqPeEt>
- Yu Hongsheng, 2001, Constructing port service supply chain to Provide port logistics efficiency. Accessed on 30 September,2020. Retrieved from
<https://kns.cnki.net/KNS8/Detail?sfield=fn&QueryID=21&CurRec=1&recid=&FileName=GKKJ200805003&DbName=CJFD2008&DbCode=CJFD&yx=&pr=&URLID=>
- Fang Kai. 2013, Research on the development of agricultural products cold chain logistics in China. Accessed on 30 September,2020. Retrieved from
<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CDFD&dbname=CDFD1214&filename=1014213488.nh&v=lxXH6UrQnzB%25mmd2BDheJjyLfz1Vn3ijGdzxf3DttXuHRAuZzeai%25mmd2BQgnktF%25mmd2F4dSQSOgxz>
- Hong Yulan, Xiao Qirong, 2007, Analysis and Optimization of cold chain logistics of Agricultural products in China Research. Commodity Storage. Accessed on 30 September,2020. Retrieved from
<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2007&filename=SPCY200703015&v=p6B5rifTUA76kiBVb1Aome86N73rPX%25mmd2BphkRaE7UQ6IRdaEHWuYxITu28LDlw%25mmd2BVP1>

Wang Chunyan, 2020, Analysis on the development status and countermeasures of agricultural cold chain logistics in China. Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=ZGGP202011003&v=OrtUoAt2ypmQFV6Jmrd2jRTWMUknKDbbQSXEpa3kQa7PtzeCFOF%25mmd2Fa6EdApqiWtQg>

Song Hanli, YU Yong, 2007, Application of safety Monitoring in cold chain logistics of Agricultural Products, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2016&filename=DPJY201606023&v=NJW9j0Gc5iy2IpfWDRt0%25mmd2B46lqsXTp6qLweed0YC%25mmd2FFRWPbB7gQaXpaRiBjLfhkut>

Jin Shengnan, 2008, Analysis of cold chain logistics and its application in food, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2018&filename=SCXH201813026&v=f0UfDn8VD%25mmd2Fp6i6TeNGVDfJZd0HYZVQNpBC1Ff5Jk7nkmP3knuUTGQaHJxtLLR4ZY>

Lu Yafeng. 2012, Research on the Development of Agricultural Products Cold Chain Logistics in China. Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CMFD&dbname=CMFD201401&filename=1013173142.nh&v=vyuLa0hn4I1MjfVSrpA00ds17ntO%25mmd2FdqEt4J85LzD524%25mmd2FHKFtxnpnqgjV9qgGu9At>

Li Gui 'e. 2019, Study on Optimization of Cold Chain Logistics Distribution Path of Fresh Agricultural Products. Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2019&filename=LTKJ201910021&v=VVLd%25mmd2Ftd9gQo2VZxnEBNQNAQrspwC7CvG9%25mmd2BJZiScR0CkDLgrBDPFGkj3gWsaSsOvx>

Wang Qiang, 2007, Development practice and main experience of foreign cold chain logistics, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2007&filename=WLJY200702019&v=Rxy9TRT6y5CrF0KKDLThOnEL7cK8w5rz0ajrvBaW6Rw5mkyHM%25mmd2FsKSMDJiCbkiWII>

Chen Fangjian, 2006, Food logistics in China should be vigorously developed, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2006&filename=WLJS200605034&v=LI5aOczb0fB8axBSUATXfLEBRTARxSarHp3QvgHUUbSzqnMxnXk0OstuViWqo4RM>

Zhang Ying, 2006, Cold Chain Logistics based on HACCP Monitoring, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2006&filename=WLJS200601033&v=LI5aOczb0fDZDHvHko4ySj%25mmd2FKC6C6BMgostyGPDMPf2EhKDOV%25mmd2Bf4%25mmd2BvKd2SI30bOPU>

Fan Linan, 2017, Cold chain logistics distribution path optimization based on fresh agricultural products. Journal of Shenyang University, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2017&filename=SYDA201702009&v=Vj8yTOaoA4d6Xl6BA0%25mmd2BKddeo3Sr1QAoOE8ZinLJzbPiEa9oarFyLQYgTXsr80ojr>

Xiao Ding. 2014, Research on cold chain logistics mode and cost optimization of fresh agricultural products, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2014&filename=NYJJ201402051&v=hM%25mmd2FPTRvS3KTJD3FOjO%25mmd2Fugc%25mmd2FhnmuQ%25mmd2BOVQPyE%25mmd2FZvNCWiCohByvpyqjKeFYxn2Hxi9>

Yu Liping.2012, Discussion on accelerating the development of cold chain logistics in my country, Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2012&filename=WLJY201202016&v=fWeR8%25mmd2Fwyn27CCR1fKsXQ32AZKf76cWdVIOVB%25mmd2Bb7AubNbfFeVOSfWyWzKEwR5CbzN>

Wang Chunyan, 2020, Development Status and Countermeasures Analysis of Cold Chain Logistics of Agricultural Products in China. Accessed on 18 October,2020.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=ZGGP202011003&v=OrtUoAt2ypmQFV6Jmrd2jRTWMUknKDbbQSXEpa3kQa7PtzeCFOF%25mmd2Fa82VSAPMzlwY>

Liu Da-miao, 2019, Development Status and Countermeasures of Agricultural Cold Chain Logistics in China. Accessed on 18 October,2020. Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2019>

<https://kns.cnki.net/kcms/detail/detail.aspx?filename=ZGGP201906005&v=EuZ9tFW72chkZ%25mmd2B%25mmd2BJ8Q%25mmd2Bzq85BXvdDxDwfCoTD5WpjCG2jQe7NbH%25mmd2FnKMNIKW0jNnE3>

Li Xiaojuan, Liu Qing. Current Situation and Development Analysis of Food Cold Chain Logistics. Food Science and Technology and Economy. 2018(04).

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?filename=LSKJ201804035&dbcode=CJFQ&dbname=CJFDTEMP&v=C%25mmd2BT93nR4eU7BYdl72Ia2BBLssillCJFp1DGh83jxWc kwQK4PdzmcjPBtWQzU90yP>

Zhu Qin. Research on the Development Status and Countermeasures of Cold Chain Logistics in China. Science, Technology and Economy Guide. 2016(21).

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?filename=ZGGP202011003&dbcode=CJFQ&dbname=CJFDTEMP&v=OrtUoAt2ypmkysyenJQJczgpdpxSwSyc3X5meyGfuWzhLFn %25mmd2FtEeUWP3c3Cp4iLLfI>

Wei Guochen, Dang Yijun. Research on Quality Control of Cold Chain Distribution of Agricultural Products in China. Logistics Technology. 2014(13).

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?filename=WLJS201413003&dbcode=CJFQ&dbname=CJFD2014&v=4zUYpZbrnh5HIccPGiOZ%25mmd2FPwTunDNUa5s0AIRRD55 M6GkH8PjMpN5vAjFVDZ1N1u3>

Zhao Shuai. Analysis of cold chain logistics and its application in food. Modern Marketing (Business Edition), 2021.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDAUTO&filename=XIXJ202101091&v=zGp%25mmd2BbgY0Ac812ukPhZ6WqCw4cl5lvkLGjahxrIFX 19%25mmd2BmNuTir9OppwgM4l0Ltc39>

Bao Wenjun. Research on problems and countermeasures of cold chain logistics development in China. Logistics Engineering and Management, 2020.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDAUTO&filename=SPCY202112009&v=4DBAIKGLwDcDungPFlq4PewSfMdwDYOM0iRcE2FeelFdw VP2UaxQQy43epWTmlyN>

LIU Rui. Analysis and Suggestions on Current Situation of Cold Chain Logistics of Agricultural Products. Jiangsu Agricultural Sciences, 2020.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=JSNY202022057&v=CxKdwp1gw9P%25mmd2BwgByF%25mmd2F2tAn2oWdSLNAF0jhxzOAmzkP%25mmd2BdRz7iidD2qwKyaCVRi8Es>

Wang Chunyan, Dong Shasha, Wei Xiaoxia, Zhao Changsheng. Analysis on the development status and countermeasures of cold chain logistics of agricultural products in China. China Fruits and Vegetables, 2020.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=ZGGP202011003&v=OrtUoAt2ypmQFV6Jmrd2jRTWMUknKDbbQSXEpa3kQa4PbxzrJD8H7HJUrm%25mmd2FaTghl>

Zhang Yu, Zhang Fengxuan, Zhou Jiaqi. Research on the development of agricultural cold chain logistics under the new situation. Logistics Engineering and Management, 2020.

Retrieved from

<https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2020&filename=SPCY202006013&v=lu%25mmd2FLCj8t3psEehI4I09f8rZgbFxyjAW8iFq1%25mmd2B%25mmd2B6P3PyhXr%25mmd2Bzghy%25mmd2FiqJmBkAmwuQ%25mmd2B>