

Research Article

The Cold Chain Logistics for Perishable Agricultural Products in China

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Abstract: This study introduces concepts of the agricultural product cold chain logistics and domestic and international researches. Also, the study discusses issues of Chinese agricultural cold chain logistics in the development process as the following aspects: the dividing of cold chain logistics market, refrigeration hardware facilities, third-party cold chain logistics development, the level of cold chain technologies, cold chain logistics professionals and the legal system and the standard system. Next, this study focuses on the countermeasures to solve problems of the agricultural cold chain logistics development by some ways as followings: increasing investments in technology, accelerating the improvement of the cold chain logistics facilities, strengthening the cultivation of third-party cold chain logistics enterprise, encouraging the training of personnel, promoting the cold chain logistics informatization and improving relevant laws, regulations and standards. Combining with the cold chain logistics of Mengniu Dairy, this study analyzes and proposes countermeasures. Finally, this study summarizes the developments in Chinese agricultural chain logistics, which needs to be strengthened in many aspects for suiting Chinese situation.

Keywords: Agriculture product, china, cold chain, logistics

INTRODUCTION

Cold Chain Logistics (CCL), also called low temperature logistics, it is a kind of special form whose main object is perishable food, so it is called the perishable food cold chain by foreign countries (Ye, 2007). The agricultural product CCL refers to fruits, vegetables, meat, poultry, fish, eggs and so on as the representative of the fresh production, acquisition, transportation, storage, loading and unloading, handling, packaging, distribution, circulation processing, distribution, information activities and a series of links are in low temperature environment to ensure the quality of agricultural products, to prevent spoilage and contamination of agricultural products and has been assured of high-quality agricultural products.

The "Food Sanitation Law" promulgated in 1982 forms the prototype of Chinese food chain logistics. Chinese agricultural products logistics has developed, in several decades and forms the core of their agricultural product cold chain system. In China, the agricultural product CCL industry is still at the starting stage and this shows that small market size, regional strong and low degree of marketization (Bu, 2011). At present, lacking of cold chain facilities and old equipment can't provide low temperature protection for some perishable agricultural products; even they might cause certain impacts on the environment. The existing cold chain facilities caused a large number of loss in the process of

transportation and storage of agricultural products and this results great hidden dangers of safe agricultural products in china. Chinese agricultural product CCL technology and the level are still far behind from developed countries.

American circulation pattern of the fresh agricultural products is the direct dominant mode. The producers classify and package the products in place of origin and directly send to the large supermarkets, retail chain stores or distribution center. Many large supermarket chains self-built distribution center and directly purchase origin. We establish a tracking system by bar code technology, backtracking agricultural product qualities in the supply chain and the distribution efficiency is very high. Agreement and contract transaction modes carry out direct sales, whose features are short circulation channel, fewer links and higher circulation efficiency. Both sides of the transaction keep credit based on autonomous transactions, so contracts and orders ensure the quantity, quality and price of agricultural products, stability. In Europe and America, the developed countries have currently formed a complete set of food cold chain system from production, processing, distribution, warehousing, distribution and after-sale. The governments have established relatively improved complete CCL systems by legislation, certification, associations and enterprises build standard system and management system and product recall (Wang and Gu, 2010).

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In recent years, with the general improvement in the consumption level of residents, the fresh agricultural product production and the circulation increase year by year and the society has put forward higher requirements for the safety and quality of fresh agricultural products in the circulation. Postpartum Chinese agricultural losses are very serious for a long time. The rot loss rate of fruits, vegetables and meat circulation reaches 20~30% and 12%; the circulation of agricultural products in China shows the characteristics of the larger, longer distances and anti-season sale.

Therefore, the rapid development of the agricultural product CCL, not only can increase the income of peasants and protects consumer safeties, but also can eliminate the export of Chinese agricultural product quality by the development of the cold chain technology. This can break trade barriers and enhance the international competitiveness of export products.

China is a large agricultural country. The agricultural logistics plays a decisive role in the national economic development. The cold chain logistics has become a key agricultural product logistics development for perishable objects. The agricultural product cold chain logistics has been an easily overlooked. This study analyzes and proposes countermeasures and summarizes the developments in Chinese agricultural chain logistics.

MATERIALS AND METHODS

The agricultural product CCL mainly has the complexity, coordination, high cost and the higher requirements on information technology characteristics.

The final quality of the agricultural product CCL depends on the cold chain storage temperature, circulation time and the product its resistant storage properties. Therefore, the management and operation of the agricultural product CCL is very difficult. The higher requirement of the logistics technology and equipment often requires specialized equipment and facilities. The production and consumption of the fresh products are scattered, the market supply, demand and

adjustment of the agricultural structure and the price are largely changed affected by various uncertain factors such as weather, traffic. The CCL involves in a wide range of areas. Since the storage of fresh fruits and vegetables are not easy and the logistics process requires each node with coordination for ensuring the stable operation of the entire chain. The complex coordination process, in particular a low temperature conditions in circulation, determine the characteristics of its high cost. We control costs, requiring logistics faster and the market reaction to be sensitive and require an integrated logistics chain to minimize costs, reduce logistics loss and take care of the interests of all parties. Thus there requires higher information technologies for the agricultural product CCL.

The cold chain includes low temperature processing, low temperature transport and distribution, low temperature storage and low temperature sales, after collecting food in the origin. Then products are pre-cooling processed, stored, packed and transported to sale terminals and are finally sold to the terminal consumers. The cold supply chain process as follows (Fig. 1).

With the development of the economy, Chinese CCL has gradually been improved, but the public awareness is low and the original equipment are behind and so on. These restrict the development of Chinese CCL industries. The following are a few problems faced the development of the CCL in china.

The CCL market needs to be subdivided: Different kinds of agricultural products require the different logistics environment for temperature, humidity. Chinese cold storage temperature is generally 0-4 and -18-22°C and few cold storage temperatures are below 28°C. The temperature is suitable to storage requirements for most agricultural products, but it is not the optimal temperature for some agricultural products. Therefore, the CCL market needs to be subdivided by improving the storage quality of the agricultural products, extending the shelf life and setting the best storage temperature for different agricultural products.

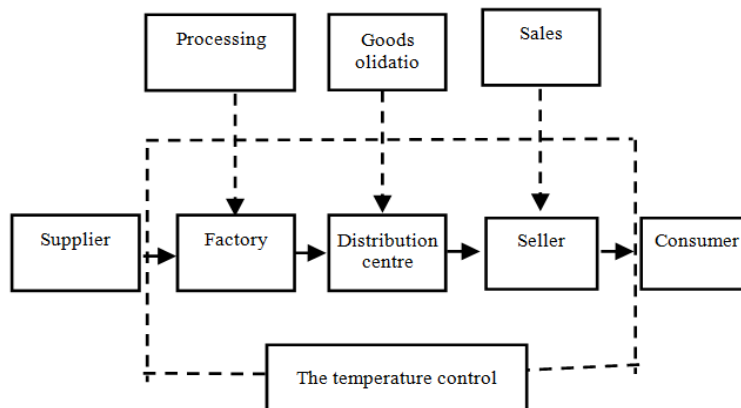


Fig. 1: The cold supply chain process

The refrigeration hardware facilities of Chinese agricultural products are short: Comparing with the developed countries, the existing refrigeration facilities with obsolescence, backward transportation tools and lag transport in China exist in a big gap and it cannot meet the requirements of the development of Chinese agricultural CCL (Wang, 2013). Meanwhile, the development and the distribution are imbalanced and the key of logistics nodes in large-scale wholesale markets of agricultural products and regional distribution center of agricultural products are lack of refrigeration facilities, so these cause Chinese CCL the big gap. In addition, Chinese current total cold storage capacity is less than 9,000,000 m³. A lot of cold storage is limited to frozen meat and fish and the function is inadequate such as outdated equipment, small scales. A lot of cold storage functions are single when production is in the off-season or insufficient raw material resources. The cold storage is often in the idle state and this causes a great waste of resources. We can say that our existing cold chain facilities and equipment cannot better provide protections for low circulations of agricultural products behind the developed countries. In the future, we should increase the construction of hardware facilities and improve transport efficiency of the agricultural CCL.

The lagged third-party CCL development: Currently, Chinese agricultural logistics and distribution business are largely done by the supplier or their own, this need to be improved the company's operating costs. Existing CCL enterprises are mainly small and medium and these enterprises are weaker, smaller range of radiation without unified service standards and the integration of resources and industry to promote the capacity of large chain logistics business and they only employ a handful of logistics suppliers of technologies and equipment to achieve the international standards. In addition, China also lacks the entire cold chain temperature-controlled logistics providers. The current logistics suppliers are evolved from the traditional refrigerated transport business, such as refrigerated logistics providers generally only provide refrigerated transport services. Comparing with the CCL services in the true sense, there is a big gap to developed countries. Therefore, Chinese third-party CCL development is lagging behind the needs of the market.

The technologies of the agricultural product CCL is backward: For a long time, Chinese exports of agricultural products are mainly fresh fruits and vegetables. However, due to the rough export packaging, preservation and backward technology, thousands of tons of fruits and vegetables rot each year and this causes serious economic losses. Some countries import agricultural products from China which are repackaged and entered into the domestic market. This causes market prices increase and weakens the price advantage of Chinese agricultural exports.

Lack of the CCL professionals: To maintain normal operations and the smooth development of agricultural cold chain, we need to develop the logistics management and technical personnel with a global understanding and expertise. The logistics industry in China started late without a complete logistics system Chinese local logistics theory and practice, training of logistics professionals and guidance and practice of teaching theory. Thus, most of the logistics staffs are adapt to the CCL industry talent requirements.

The CCL laws and regulations and standards systems are not perfect: So far, the specification of the CCL legal system has not been established, so that the government lacks theoretical basis for the agricultural logistics and system monitoring, so many undesirable businessmen will always get through them. In addition, the lack of uniform standards for facilities, equipment, temperature control and practices, so the information resources are difficult to achieve effective convergence. Meanwhile, Chinese CCL technical indicators are not perfect, resulting in the quality of agricultural products cannot be guaranteed and the quality is directly related to food safeties, these problems seriously affect the development of Chinese agricultural product CCL. So, on the hand we have to accelerate the construction of laws and regulations; on the other hand we have to improve the CCL industry standards.

Countermeasures of the agricultural product logistics development: The development of Chinese agricultural CCL is a systematic project; we should stop the long-term steady pace, mainly from the following aspects.

Increasing scientific and technological inputs: Because of the backward technology of Chinese agricultural product CCL, greatly affected the quality of export of agricultural products. We have to increase investment in science and vigorously develop and promote the use of low-temperature packaging and preservation technology, improve and enhance the improvement of the cold chain equipment. We should innovate refrigeration methods and technologies, accelerate the introduction of advanced technology and popularize all kinds of cold storage of new technologies as soon as possible. At the same time, we must implement HACCP controls to ensure the frozen produce quality assurance. We should to increase the propaganda of the agricultural products cold chain safety, fight to gain market acceptance and increase the consumer recognition of the extent.

Accelerating the improvement of the CCL facilities: According to "agricultural Cold Chain Logistics Development Plan", the state encourages the development of key investment areas including

construction of cold storage, low temperature processing and distribution center construction projects, cold chain transport vehicles and refrigeration equipment works. With the strong support of the state, China should be eliminated the old refrigerator cars and insulation models as soon as possible, developed a full control of the temperature can reduce the loss of agricultural logistics to ensure the quality and safety. We should import the cold storage technology and a warehouse management system, the vacuum freeze technology, non-destructive testing and commercialization of process technology, automatic temperature control technology and other advanced technology to improve the capacity and technical updates. Integration of existing resources establishes large national and regional low-temperature logistics center through mergers and acquisitions, equity holdings, joint ventures, etc.

Accelerating the development of the third-party CCL companies: According to the characteristics of agricultural products, Chinese traditional agricultural product logistics cannot meet the development requirements of the present logistics, so we should accelerate the development of the third-party CCL enterprises. The third-party logistics enterprises in the CCL supply chain, it should have a common interest objective with the upstream and downstream companies. Therefore, we have to cultivate a number of the CCL enterprises with strong economic, advance management philosophy and management style, strong core competitiveness and promote its transition to the third-party logistics operation mode based on integrated logistics agency. We should encourage the large-scale retail enterprises to carry out the agricultural distribution center, provide the third-party CCL services and then promote the development of the agricultural CCL.

Encouraging training and importing talents: Most logistics enterprises currently ignore the education and training for talents because of inadequate funding and emphasis. Thus, this affects the overall management level for enterprises and service qualities. In order to adapt to the competition of the international cold chain market, it is very essential to train the operations and management personnel talents for the agricultural CCL. We train the logistics market needed talents by job training and grasping of basic education, etc., especially guiding and promoting the colleges to set up the related CCL disciplines, relevant courses and vocational education. We encourage the relevant units to carry out technical training and continuing education. We also Train a group of senior logistics talents by establishing personnel incentives and flexible mechanism for the agricultural CCL industry and this will solve the problem with lack of the CCL talents.

Promoting the CCL information: Brocade Wu Xingbing investigated a lot of markets about the CCL logistics information and he pointed out that the current CCL information lack of unified platform, most of the CCL information only bear their own responsibilities for temperature and preservation control. Once the product is delivered to the next, it will no longer be tracked. Therefore, we exchange and share the information by establishing the public information platform for the regional agricultural product CCL. We encourage 3S and the application of automatic identification technology and establish a monitoring system platform for quality and safety of the agricultural products. This can promote transparency technology and integration in the cold chain transportation management and thus truly improves the efficiency of the cold chain transportation and accelerates the construction of modern logistics systems and logistics network industry.

Improving the relevant laws and standards: Developing and improving the related laws and regulations for Chinese agricultural product CCL can improve the operation and management level and can improve the quality of Chinese exports of fresh agricultural products. China should develop the guidelines and related standards with international standards of the CCL as soon as possible, includes good practices of the entire CCL nodes, such as the raw material production standards and specifications, pre-cooling and storage standards, processing standards, transportation standards, marketing standards, labeling standards and testing methods standards, environmental standards and service standards. We build Chinese agricultural CCL industry, improve the logistics service quality and management level, improve service efficiency in order to better participate international competitions.

In addition, the state should give supports and protections on macro-policy and focus on the future direction and goals of development. We need to actively take the experience of some developed countries, provide the financial support or preferential policy to the CCL enterprises (Wang, 2011).

A case study: The CCL for dairy is the whole process of the source of origin milk and their processed milk products during storage, transportation, processing, distribution and retail. The CCL always keeps logistics activities with low temperatures based on the freeze technology by refrigeration technology (Meng, 2011).

In recent years, the rapid growth of the dairy industry brings development opportunities for the cold chain logistics industry. It is well known, the dairy (e.g., Ice cream, yogurt, pasteurized milk) need to be stored with low temperatures for extremely keeping them freshness, color, flavor and nutrition, therefore, the high-quality CCL operation is important for promoting the

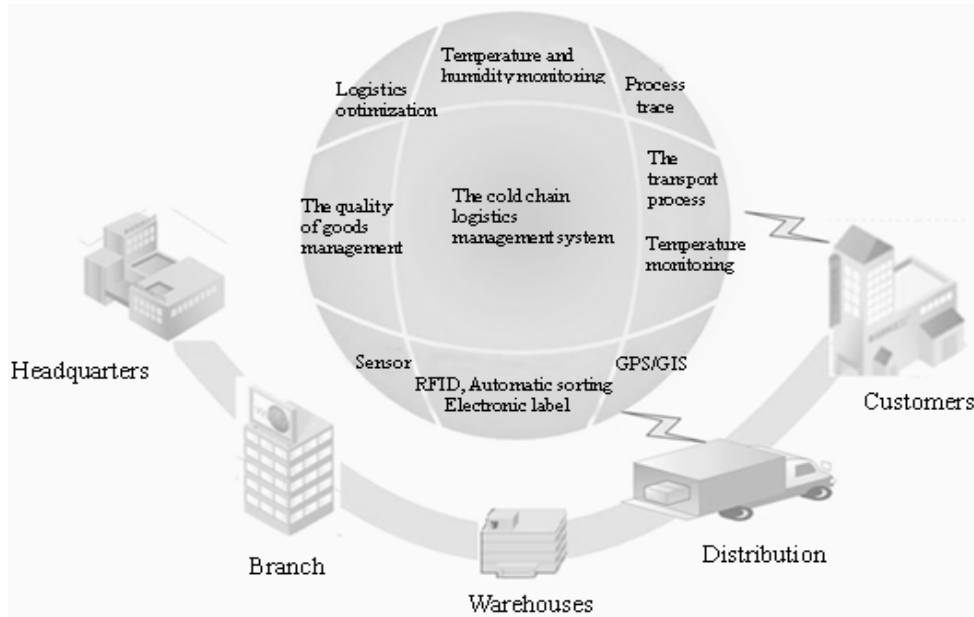


Fig. 2: Mengniu virtual cold chain logistics network

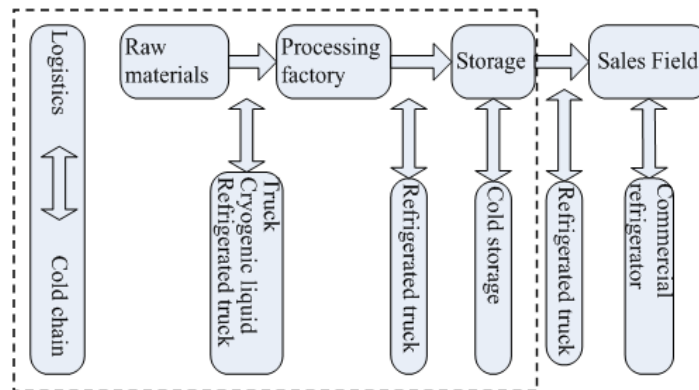


Fig. 3: Mengniu the CCL operation flow chart

milk line development (Ye, 2007). Products with low temperatures are a new challenge for enterprises' CCL. The CCL of some enterprises such as Mengniu are very good in their cold chain operations and the growth rate of the low temperatures market is more than 4 times.

The main product is yogurt in the dairy market. Operation of yogurt products, the three abilities of new product research and development, cold chain construction and channel management are a test. How to break through the cold chain distribution bottleneck for Mengniu? Yogurt shelf life is short, usually 14-21 days, but the cold chain requirements are very high. Extruding from the milk delivered to the processing plant until shipped to market, the whole process must be kept stored between 2-6°C. Construction of cold chain distribution systems requires refrigeration tank, refrigerated trucks, etc., the cost of human and material investment is very large. But some companies will also outsource this service to logistics companies, reducing

the costs of investment and operating and the relative risk can be reduced.

Firstly, putting into software facilities, then combining with software for the hardware construction. Mengniu had a comprehensive CCL network by the establishment of a nationwide virtual CCL network (Fig. 2), Mengniu branded investment, management, technical and formulations by virtual union, thus improving the CCL system naturally multiplier.

Secondly, we increase investments in hardware facilities to ensure quality and reduce losses. Mengniu puts freezers in each of its shops, retail stores, wholesale stores and other retail outlets in order to ensure the quality of its low-temperature products. The cryogenic products are sold out from Beijing all through the motor, although the cost is much higher than the rail, the time can be guaranteed. Typically, supermarkets will refuse if the production date is more than three days for Cryogenic products, so Mengniu must ensure that their

products reach the end in 2-3 days. Mengniu reduces the logistics costs approach is to make a list of each larger, after the formation of scale, it would be able to obtain concessions on all aspects of transport.

Thirdly, the manufacturers distribute by themselves, integrating resources, establishing a scientific and immobilized CCL management and operation system (Fig. 3). At present, some large supermarkets establish long-term cooperative relations with Mengniu, directly distributing to supermarkets freezers by using Mengniu transport requirements and transport, so this helps supermarkets to avoid deterioration during transport of milk. With the progress of cooperation, the CCL system of Mengniu is more perfect.

Full real-time state monitoring:

RFID, GPS, GPRS, GIS integration application: In summary, the reason why the Mengniu market shares can reach five times at the low temperatures industry, because Mengniu is more reasonable and effective in every aspect of the design. However, we put forward higher requirements on the quality of food with the improvement of living standards, especially the occurrence of tainted milk and other similar events, consumers are more willing to know whether the food they eat is safe and high quality, so the reasonable and effective CCL meets the demand.

RESULTS AND DISCUSSION

Chinese agricultural harvest for eight consecutive years, but the phenomenon of increased production without the increased income of farmers is still widespread; one important reason is that agricultural product circulation lags. So we need to extend the shelf life and marketing of agricultural products by developing the CCL technology and encouraging farmers to scientific storage and transportation, this can increase production and income for farmers. Therefore, it is very important for the priority development of the agricultural product CCL.

Therefore, we need to accelerate the development of cold chain logistics of agricultural products. It is very important to increase farms income and guarantee consumer safety. The development of the agricultural product CCL not only protect the quality, reduce the nutrient loss and ensured the food safety, but also can reduce post-harvest losses, agricultural products to led a balanced cross-season sales, increase farmers' income stability and also help to improve the export of agricultural products quality. This can break trade barriers and enhance the international competitiveness.

CONCLUSION

The agricultural product CCL is the inevitable product of a certain stage of economic development to

the market; it is the inevitable result of Chinese agricultural development. However, the current development is also not optimistic, because the time for the agricultural product logistics for is long, the loss is serious and the logistics costs are high, this becomes a bottleneck restricting the development of Chinese agriculture. Although there are lag issues in terms of equipment, technology and management for our agricultural product CCL, the related policies also keep up with market demands, China is in great progress in all respects and also has a greater progress, I believe Chinese CCL system will be gradually on the right track and constantly improving. Therefore, we need to strengthen the development of various agricultural product CCL, explore suitable method to change the development of Chinese agricultural product CCL, it meets the development needs of the community and contributing to the development for our agriculture.

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