

# ***Cold Chain Logistics Management and Operations: Problems and Suggestions in the Post-Epidemic Era***

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**Abstract:** The outbreak of the COVID-19 epidemic has brought unprecedented challenges to global food supply chains, and cold chain logistics, which involves the transportation and storage of temperature-sensitive foods, has become a key area of concern. The ongoing incidence of infections from abroad that are imported due to the cold chain, which has negatively damaged the cold chain logistics sector. In China, monitoring and maintaining cold chain logistics still presents a few challenges despite the industry's fast expansion. Therefore, it is essential to conduct a comprehensive analysis of the problems and challenges faced by the cold chain logistics industry in China and to develop effective strategies and measures to enhance the management and control of the cold chain logistics industry. The purpose of this study is to offer insightful analysis and suggestions for enhancing the security and effectiveness of China's cold chain logistics sector in the post-epidemic age.

**Keywords:** cold chain logistics, problems, suggestions, post-epidemic era

## **1. Introduction**

Online shopping has become an essential part of people's lives in the current, rising internet and information technology era, especially with the advent of the 5G era. There are an increasing number of internet users in China. However, following national policy and in response to the current crown epidemic, local governments around the nation have restricted people's freedom of movement to stop the disease's spread. Currently, the importance of online shopping has become even more apparent. Cold chain food, as an important part of online shopping, is a major food safety hazard due to its special transportation method, and cold chain-induced epidemics imported from abroad are constantly being discovered, for example, since the beginning of 2020, there have been several incidents of epidemic spread caused by "cold chain cold storage" in Dalian [1]. These incidents have caused great concern to the public and have brought the safety and reliability of cold chain logistics into focus.

In the wider context of the pandemic, the escalating cost of cold chain logistics will provide a significant obstacle. Finding a solution to increase the security and dependability of cold chain logistics has become vitally important. The improvement of cold chain logistics safety will be the main

topic of this article. This includes logistics temperature monitoring, setting up risk warning mechanisms, and utilizing information technology. This article will also examine how to fairly regulate costs and eliminate needless desperation to achieve sustainable development of cold chain logistics considering the high cost of cold chain logistics.

## 2. Literature Review

The available literature shows that the academic community has conducted relevant research in the following areas: Burnson pointed out that cold chain logistics are under more scrutiny and pressure in the pharmaceutical and medical supplies and food logistics industries [2]. Wu et al. used fault tree analysis to find that the overall cold chain logistics industry level was below par [3]. Qiu and Zhang explained that the industry's growth aligns with social development and market demand [4, 5]. Zhang et al. analyzed data related to online shopping in China after the epidemic, revealing that the epidemic brought new changes and opportunities for developing cold chain logistics in China [6]. However, through data comparison, Liu et al. showed that the scale of domestic cold chain logistics at this stage needs to catch up to that of foreign countries [7].

Liao et al. analyzed the epidemic in the cold chain industry in Dalian. They recommended reducing the import of epidemics from abroad to ensure the safety of cold chain imported products [1]. In terms of future trends, Masudin's study showed that traceability systems significantly impacted the performance of the cold food chain during the Covid-19 pandemic [8]. Meanwhile, Khan showed that 'crisis simulation', 'logistics identification and assurance', and 'digitalization of the cold supply chain' play an important role in maintaining resilience [9].

## 3. Cold Chain Logistics Problem Analysis

During the five years from 2016 to 2020, China's cold chain logistics market has been expanding, reaching a scale of RMB 372.9 billion by 2020 [3]. With the rapid development of the economy, consumers' perception of cold-chain food has also undergone significant changes. Cold-chain food has gone from being the preserve of a few to being an everyday consumer product for the masses. Since the spread of the epidemic in 2020, China's cold chain industry has entered a period of explosive growth, and cold chain food has become the choice of many citizens for purchasing necessities of life. Emerging consumer methods such as e-commerce, community online group buying, and live banding have provided convenience and strengthened the development of China's food cold chain distribution market. However, high costs, capital shortages, small business size, and the problem of "broken chains" continue to plague the Chinese cold chain market. These problems are described as follows.

### 3.1. Low Efficiency of Cold Chain Logistics Distribution

Since the outbreak of the New Crown epidemic in 2020, strict preventive and control measures have been taken across the country, including 48-hour nucleic acid testing and road closures, resulting in a significant drop in logistics operations, the suspension of some routes, and inefficient cold chain logistics circulation. For example, during the epidemic, Shaanxi, a vital fruit province, saw its fruit and produce market suffer a significant impact and influence. Agricultural products' cold chain logistics capacity was reduced, and collective stockpiling during the quarantine period led to market shortages. The flow of goods was poor following the blockade of traffic in various areas and the closure of communities. Blocked logistics could have improved the regional circulation of fruit and agricultural products. Although wholesale and retail markets are partially stocked, the phenomenon of closed management by residents has led to restricted access and shrinking sales channels. In cities such as Xi'an and Baoji, fruit and agricultural products are piled up in large quantities due to a sharp

decline in mobility and obstructed logistics. They cannot be transported to subordinate markets or pending transit to other provinces and regions [10].

### **3.2. China's Cold Chain Market Standardization System Needs to be Improved, Lack of Attention to Epidemic Prevention and Control**

Developing specifications for the cold chain logistics system is an important safeguard to ensure that all aspects of cold chain logistics are carried out smoothly and to protect consumer food safety. However, during the epidemic, cold chain logistics was plagued by problems such as improper incoming disinfection and epidemic prevention, inadequate handover, the substandard performance of packaging materials, and improper loading and unloading. These problems were mainly due to the need for industry norms to regulate and standards and guidelines for staff to rely on. During the epidemic, because of these problems, cold chain logistics became a major channel for the spread of the epidemic, resulting in several large-scale infections. To prevent similar incidents from happening again, the cold chain logistics system specification needs to be further improved, with detailed regulations on incoming disinfection and epidemic prevention, handover operations, packaging materials, and loading and unloading operations, so that staff have clear standards and requirements to follow at every step of the process.

In addition, the cold chain logistics industry needs to strengthen its global traceability management capabilities for cold chain imports to address the risks and challenges in cross-border logistics. The industry's traceability management capability still needs to improve, and many commodities are difficult to trace, exacerbating consumers' concerns and risks. Therefore, there is a need further to strengthen technology research and development and standards development to achieve full process traceability management from source to end to safeguard consumer food safety. For example, the cold chain logistics and distribution of agricultural products in Dalian are still in their infancy, and the standards for the logistics and distribution chain still need to be perfect [11]. According to relevant statistics, perishable food products account for up to 60% of the food consumption expenditure of Dalian town residents. Still, less than 10% of companies use professional cold chain trucks for distribution. One of the main reasons for this is that the cost of professional cold chain truck delivery is about twice that of an ordinary box truck, resulting in higher cost pressure on the enterprise. Therefore, the cold chain logistics industry should enhance policy support, elevate the entry threshold of the industry, optimize the distribution network for cold chain logistics, promote improvement and upgrading of logistics distribution standards, improve overall quality and safety in cold chain logistics distribution, and meet consumer demand for safe, high-quality and efficient food delivery.

### **3.3. Higher Costs due to the Outbreak**

In the general epidemic environment, cold chain logistics have been challenged as never before. Increased prevention and control have led to more difficult transportation, and quarantining and transporting goods have become more cumbersome. Rising oil prices have also exacerbated the pressure on transport costs for enterprises, which has led some enterprises not to follow the formal process and to use low-end technology, inferior equipment, and other unregulated methods for cold chain logistics to reduce costs and gain more profits. In addition, the government's support for cold chain logistics is relatively low, which puts more pressure on enterprises.

In the past, imported frozen food products were only sampled and tested. However, since the second half of 2020, each shipment has essentially required testing and decontamination, directly increasing business costs. More seriously, this testing and decontamination has increased the time goods remain in customs and supervised warehouses, leading to higher storage and capital-accounting costs. In addition, during an epidemic, imported products must undergo long decontamination, which also

increases the cost to the company. In addition, the sale of goods is subject to nucleic acid testing, a significant cost for businesses that import large volumes [12].

### **3.4. Some Cold Chain Logistics Have Broken Chains**

During the epidemic, cold chain foods were frequently found to be contaminated with the new coronavirus and had to be disposed of. Meanwhile, due to unreasonable resource allocation, the insufficient synergy between agricultural products and cold chain logistics, as well as inadequate information on fresh agricultural product logistics in the cold chain industry, some links in the cold chain have been disrupted. Frequent customer pick-ups in the sales chain can easily result in broken cold chains, and consumers should be sufficiently aware of the safety of cold-chain food. According to Lin, founder, and CEO of Frozen Food Online, the most prominent problem facing cold chain food logistics is the problem of "broken chains" in the cold chain. No corresponding temperature-sensing devices exist, so temperature changes during transportation are not easily detected. To save fuel, the cold chain logistics service providers often start chilling the food when it leaves the warehouse and then turn off the cold air during transportation until it is close to the destination, leading to "broken chains" [12]. The existence and deterioration of these problems show that the standardization, standardized management, and modernization of the cold chain logistics industry are urgently necessary.

## **4. Suggestions**

After a thorough study and investigation of the current cold chain logistics market, this study proposes the following four solutions to the problems faced by cold chain logistics.

### **4.1. Strengthen Infrastructure Development and Build an Optimized Cold Chain Network**

In recent years, the significant rise in online sales due to the new coronavirus epidemic has accelerated the growth of the cold chain logistics industry, while also highlighting the shortcomings in its infrastructure design. To address this issue, cold chain logistics must strengthen and enhance its distribution network and establish a complete cold chain logistics system. Nanchang is accelerating the establishment of national backbone cold chain logistics bases and promoting the deep integration of cold chain logistics with new business models like "fresh food e-commerce + cold chain home distribution" [13]. Meanwhile, to improve the level of cold storage construction for cold chain logistics, Rongqing Group has collaborated with Guangzhou University and Qingdao University of Technology to establish the "Rongqing Cold Chain Logistics Research Center," aiming to conduct technical research and development for the logistics industry, especially cold chain logistics, and to introduce and update existing equipment and technology [14]. Additionally, enterprises should consider upgrading their existing cold chain equipment and eliminating ineffective ones to reduce losses and improve efficiency.

### **4.2. Establishing Effective Regulatory Mechanisms to Strengthen the Integration of Warehousing and Distribution**

With globalization and the rapid development of the logistics industry, cold chain logistics plays a vital role in ensuring food quality and safety and promoting food distribution and market development. However, the New Crown epidemic outbreak has exposed problems and weaknesses in the cold chain logistics industry in terms of hygiene, safety, and regulation. To address the risk of epidemics, companies need to set up defenses at the source of sourcing or importing, exercise selective control over commodities and establish an epidemic backup mechanism to guard against outbreaks and other in-

conveniences caused by epidemic situations. At the same time, it is important to strengthen disinfection at source, establish a transparent monitoring system, clarify responsibilities and obligations, set more uniform standards and regulations, enhance disciplinary action against non-compliant companies, and establish a complete cold chain food traceability system as soon as possible.

Establishing an integrated cold chain logistics network system for warehousing and distribution is crucial in the process of advancing the modernization of cold chain logistics. For instance, Beijing's cold chain food traceability platform was introduced in September 2020 and formally introduced as "Bei-jing Cold Chain" on 1 November 2020. This platform enables electronic traceability management for imported meat, aquatic products, and other products and integrates in real-time with the national cold chain food traceability platform [15]. To create a more comprehensive cold chain logistics and distribution system, businesses must also develop their warehousing hubs, with warehouses serving as the center [16], using big data analysis to arrange inventory and warehousing resources to accomplish uniform distribution, Jingdong Logistics, for instance, has constructed its own warehousing and logistics centers and distribution stations in important cities around the nation. At the same time, by completing multiple uses of one vehicle and increasing vehicle usage, companies can save costs and improve efficiency in the cold chain logistics and distribution process. The government also needs to provide a good market environment for the cooperation between cold chain platforms and cold chain logistics enterprises, strengthen the main responsibility of the government, guarantee the economic benefits of the enterprises and platforms involved in the cold chain logistics system, and provide strong support for the development of the cold chain logistics industry [17].

#### **4.3. Operate with Light Assets, Reduce Operating Costs, and Establish a Policy Protection System**

Outsourcing terminal distribution in the cold chain logistics industry effectively improves efficiency and reduces costs. Take Bo Yuejie Transportation, for example. The company outsources most of its vehicles, with only 20 operating. Using one vehicle for multiple purposes can transport goods that require low-temperature preservation and can also be used as an ordinary truck, improving the utilization rate of the vehicle. This model not only reduces the operating costs of the enterprise itself but also can improve the transport efficiency of the whole cold chain logistics system [17]. The government also needs to strengthen the support and supervision of cooperation between cold chain platforms and cold chain logistics enterprises, provide a good market environment, strengthen the main responsibility of the government under the situation of prevention and control of the new crown epidemic, and protect the economic benefits of the enterprises and platforms involved in the cold chain logistics system. For example, the Economic Security Promotion Act enacted in Japan has strengthened the protection and support for the supply chain, helping to free Japan from excessive domestic dependence on external sources. The government's active role is crucial in achieving the efficient operation and healthy development of cold chain logistics [18].

#### **4.4. Build a Cold Chain Logistics Information Network, Increase Logistics Flexibility, Improve Consumer Safety Awareness, and Optimize Distribution**

The Alibaba model for establishing an order management system can be applied to achieve information sharing and enhance the efficiency of cold chain logistics. The system can unify and collect orders from both online and offline and then combine and reallocate charges from the same region based on order information such as customer addresses, ensuring that goods from the same area are allocated to the same delivery box or even to the same delivery person, and then optimize the delivery route through intelligent fulfillment algorithms to calculate the closest distance and most time-efficient delivery route, improving delivery efficiency. There is also a need to increase education efforts

for transport sources to clarify the concept of cost, loss, and spillage. Simultaneously, real-time monitoring of the supply chain is imperative, and companies must establish a comprehensive contingency plan along with warning and response measures for any disruptions in the chain. The government needs to educate consumers to increase awareness of cold chain risks, while companies need to optimize delivery and reduce exposure. For example, Meituan has piloted uncrewed delivery vehicles in Vanke City Garden. Bo Yuejie Transportation has adopted strict transport management and separated human and cargo delivery methods to prevent cross-contamination effectively. In addition, the application of blockchain, the Internet of Things, and other high technologies is also indispensable for the cold chain logistics industry. In the future reform of cold chain logistics, the impact of these new technologies on the industry should be explored in depth to accelerate technological upgrades and achieve intelligent operations.

## 5. Conclusion

The cold chain logistics industry faced a severe test during the epidemic. As a basic industry of the national economy, cold chain logistics has also revealed many problems after the outbreak of the New Crown epidemic, including low distribution efficiency, poor standardization, an unsound regulatory system, and lagging construction of supporting facilities. At the same time, the epidemic has also accelerated the pace of transformation and upgrading of the cold chain logistics industry. Overall, the current cold chain logistics enterprises are small in scale and low in concentration, with serious homogenization; a lack of effective supply chain management and risk prevention and control systems; and relatively lagging information technology construction, among other problems. There are various reasons for these problems, such as the industry's management needs to be standardized, and enterprises need more professional talents and capital. In response to these problems, this study has conducted in-depth research and made some proposals for improvement, including strengthening standardization, strengthening the construction of the regulatory system, promoting the construction of information technology, and strengthening the training of talents. These proposals can help the cold chain logistics industry to identify the gaps and improve the overall level of the industry when carrying out reforms. In addition, this paper has yet to cover much about the impact of some high technologies, such as blockchain and the Internet of Things, on cold chain logistics. In the future, when studying the new round of industry reform in cold chain logistics, we need to explore its impact in depth to promote further upgrading and development of the cold chain logistics industry.

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