Research on Development Environment, Problems and Countermeasures of Cold Chain Logistics

Lin Zheng a*, Ran Zhou b, Xiaojun Li c, Yisheng Wang d
Tianjin Research Institute for Water Transport Engineering, Ministry of Transport, Tianjin, China

Abstract. As the demand for fresh food products among Chinese residents grows rapidly, the development of cold chain logistics has ushered in a "golden age." Using PEST analysis tool, this paper comprehensively analyzes the development environment of cold chain logistics in China from the four dimensions of politics, economy, society and technology, analyzes the outstanding problems existing in the development of cold chain logistics in infrastructure, standard system and information construction, and puts forward countermeasures and suggestions to promote the high-quality development of cold chain logistics from three aspects: strengthening the guidance of infrastructure, standard guarantee and technology empowerment.

1. Introduction

As the "pyramid spire" of the logistics industry, China's cold chain logistics industry has entered a fast lane of development[1], with continuous improvement of cold chain logistics infrastructure, gradual expansion of market entities, and increasing strategic position. It has played an important role in ensuring people's needs and promoting industrial transformation and upgrading. Entering a new stage of development, consumers have a more diversified demand for high-quality fresh consumer goods and high-quality cold chain logistics services. The development of the cold chain logistics industry is facing new opportunities and challenges. Using the PEST analysis tool, a comprehensive analysis is conducted on the political, economic, social, and technological environment in which the cold chain logistics industry operates. The current problems that constrain the high-quality development of cold chain logistics are analyzed, and countermeasures and suggestions are proposed from three dimensions: infrastructure leadership, standard guarantee, and technological empowerment, providing guidance for stimulating new vitality in the cold chain logistics industry.

2. PEST analysis of cold chain logistics development

2.1. Political environment

In recent years, the central and local governments have paid increasing attention to the development of cold chain logistics. Since 2012, the central "No. 1 document" has mentioned cold chain logistics every year, and Hainan, Fujian, Jiangsu, Beijing and other provinces and cities have included cold chain logistics in the "14th Five-Year" development plan. Especially since 2021, over a hundred policies related to cold chain logistics have been intensively introduced, focusing on improving the layout of cold chain logistics facilities, enhancing the quality of cold chain transportation services, strengthening the construction of cold chain logistics systems, promoting efficient circulation of agricultural products, and optimizing the comprehensive service of cold chain logistics. Key tasks for the development of cold chain logistics have been proposed, including policy support, financial support, and more Multiple dimensions such as supporting facilities have created a favorable environment for the development of cold chain logistics, providing strong support and guarantee for the rapid and standardized development of China's cold chain logistics industry.

2.2. Economic environment

In recent years, China's cold chain logistics market has gradually increased in scale (as shown in Figure 1). In 2020, China's cold chain logistics market scale exceeded 380 billion yuan, with a cold storage capacity of nearly 180 million cubic meters and a refrigerated vehicle fleet of about 287,000 vehicles, respectively 2.4 times, 2 times and 2.6 times as the end of the 12th Five-Year Plan period. According to the data statistics of the Cold Chain Logistics Professional Committee of China Federation of Logistics and Purchasing, the total scale of China's cold chain logistics market in 2022 reached 491.6 billion yuan, up 7.21% year on year compared with 2021,
continuing to maintain a stable growth trend. At the same time, according to the prediction of several authoritative institutions, China's cold chain logistics market scale will continue to expand in the future.

2.3. Social environment

With the rapid development of China's economic construction and the steady progress of urbanization, residents' consumption power has been gradually enhanced and their consumption concepts have been constantly updated, and the requirements for the diversity, nutrition, freshness and safety of fresh foods such as meat, aquatic products and fruits have also been greatly improved, which has given birth to the demand for high-quality, refined and personalized cold chain logistics services, and created a broad space for the cold chain logistics industry to improve its supply level and accelerate its scale expansion [2]. In addition, affected by emergencies such as the COVID-19, consumers have higher requirements for the safety and stability of vaccines, medicines and other goods. Cold chain logistics plays an increasingly prominent role in ensuring the transportation of pharmaceuticals.

2.4. Technical environment

With the accelerated evolution of a new round of technological revolution and industrial transformation, emerging technologies such as big data, the Internet of Things, and 5G are accelerating their promotion, effectively empowering various fields and links of cold chain logistics[3]. Technological factors are increasingly becoming key influencing factors in promoting the development of cold chain logistics. By utilizing relevant technologies such as intelligent warehousing, intelligent transportation, and supply chain management, we can achieve traceability control and real-time supervision of the entire process and link of cold chain logistics, providing solid technical support and guarantee for the development of cold chain logistics. At the same time, with the deepening of China's "dual carbon" goals, cold chain logistics also faces contradictions such as expanding industry scale and carbon emission constraints. Therefore, it is urgent to strengthen the research and application of new energy-saving and environmentally friendly refrigeration, decarbonization throughout the cold chain process, and other technologies to promote the sustainable development of cold chain logistics.

3. Problems in the Development of Cold Chain Logistics

3.1. Cold chain logistics infrastructure needs to be further improved

China's cold chain logistics started relatively late. Compared with developed countries, cold chain hardware facilities have problems such as overall small scale, uneven regional distribution, and relatively scarce resources[4]. A cold chain logistics system with a full chain from production to sales has not yet been formed. According to statistical data, the per capita cold storage capacity of urban residents in China is 0.13 cubic meters, which is lower than the global average of 0.15 cubic meters. The per capita cold storage capacity of countries around the world is shown in Table 1. In addition, China's refrigerated trucks also face problems such as low inventory and relatively single types, resulting in a high loss rate of agricultural products during transportation, reflecting that there is still significant room for improvement in China's cold chain hardware infrastructure construction.

Table 1. Per capita cold storage capacity in countries around the world (Unit: cubic meters/person).

<table>
<thead>
<tr>
<th>Country</th>
<th>Per capita cold storage capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>the Netherlands</td>
<td>0.96</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.50</td>
</tr>
<tr>
<td>America</td>
<td>0.49</td>
</tr>
<tr>
<td>Japan</td>
<td>0.32</td>
</tr>
<tr>
<td>China</td>
<td>0.13</td>
</tr>
</tbody>
</table>

3.2. The cold chain logistics standard system needs further improvement

A mature and complete standard specification system is an important foundation and key link to ensure the high-quality development of cold chain logistics. Most developed countries in Europe and America have established relatively complete and sound legal regulations and standard systems for cold chain logistics. In recent years, China has gradually introduced a series of technical standards and guidelines for the cold chain logistics industry[5]. However, there are problems such as missing standards in some fields, overlapping and overlapping standards, and the need to strengthen the connection and coordination between standards. This has made it difficult to implement some of the cold chain logistics standards, and most of the standards are advisory in nature, lacking a mandatory, unified, and standard system that can cover the entire cold chain.
logistics field. Causing certain difficulties in the transportation, storage, and other aspects of cold chain logistics. In addition, many upstream and downstream enterprises in cold chain logistics often form their own set of cold chain standards or rules in practice, which have strong arbitrariness. In actual operation, cost savings often lead to non-standard operations, posing certain risks to the safety of cold chain food.

3.3. The information level of cold chain logistics needs to be further improved

Cold chain logistics products from the source of the production of pre-cooling, refrigerated storage in the middle to the end of the retail distribution, the whole process of logistics information tracking and real-time monitoring is needed. At present, with the continuous integration of China's cold chain logistics and the new generation of information technology, the information management level of cold chain logistics has been further improved. However, at the same time, some cold chain transportation vehicles in China are mainly divided into two simple functional areas: refrigeration and freezing, which cannot achieve precise temperature control of cold chain products. At present, the construction of a public information platform for cold chain logistics in China is still in its early stages, and has not achieved full process and full chain information sharing and precise traceability, resulting in the inability to efficiently gather commercial, logistics, and information flows in the cold chain logistics supply chain, which to some extent hinders the improvement of cold chain logistics efficiency and fails to effectively protect the interests of cold chain logistics producers and consumers.

4. Countermeasures and suggestions for the development of cold chain logistics

4.1. Strengthen infrastructure leadership and build an efficient and smooth cold chain logistics network

Based on the structural problems in China's current cold chain logistics infrastructure, guided by the concept of "new infrastructure", we actively promote the construction of national backbone cold chain logistics bases, accelerate the construction of multi-level cold chain logistics network systems such as regional production and sales distribution centers, and pay attention to the spatial connection and integration with national comprehensive transportation and logistics hubs. Improve the layout of cold chain logistics hub facilities, fill the gaps in cold chain logistics facilities, promote the deep integration of cold chain logistics into the modern logistics operation system of "channels + hubs + networks", and gradually solve the contradiction of uneven distribution of cold chain infrastructure between regions and urban and rural areas in China. Further strengthen the construction of key cold chain logistics elements such as modern cold storage, refrigerated vehicles, and refrigeration equipment, improve the multifunctional temperature zones of refrigerated vehicles and cold chain warehouses, enhance the level of specialization in cold chain logistics facilities, equipment, and operations, increase the deployment and use of new energy refrigerated vehicles, and provide solid support for solving the problem of high product loss rate in cold chain logistics.

4.2. Strengthen the Standard guarantee and strengthen the Construction of Cold chain Logistics Standardization system

Focusing on key elements such as "people, vehicles, warehouses, pallets, and boxes", systematically sorting out the current cold chain logistics standard system, clarifying the relationship between existing cold chain logistics standards, clearly defining each link and process of cold chain logistics, adjusting and optimizing cross overlapping cold chain logistics standards, and timely revising or abolishing standards that do not meet the development needs of the cold chain logistics industry. Accelerate the standardization and revision work in key cold chain logistics fields such as cold chain infrastructure, technical equipment, green intelligence, and information traceability, fill the gap in cold chain logistics related fields, and promote full coverage of cold chain logistics standards. Strengthen the connection between existing cold chain logistics standards and regulations, and actively do a good job in docking and mutual recognition with international cold chain logistics standards. Select typical cold chain logistics enterprises to carry out cold chain logistics standardization pilot work, summarize practical experience, and further ensure the smooth implementation of upstream and downstream cold chain logistics enterprises.

4.3. Strengthening technological empowerment and improving the level of information technology in cold chain logistics

Actively promote the application of new generation information technologies such as big data, Internet of Things, 5G, and cloud computing in the field of cold chain logistics, increase the investment and application of RFID, temperature recorders, electronic labels, and other equipment, achieve the collection and transmission of data information in various operational links of cold chain logistics such as inbound and outbound, sorting, and inventory counting, and comprehensively integrate data information on cold chain logistics sources, transportation capacity, inventory, etc. Enhance the visualization and intelligence level of the cold chain logistics industry. Accelerate the construction of a national public platform for the cold chain logistics industry (as shown in Figure 2), strengthen the comprehensive collection, integration, and analysis of data on the supply and demand of cold chain logistics.
products, as well as cold chain logistics related facilities and equipment, provide comprehensive information services for the entire process of cold chain logistics storage, transportation, and distribution, break down information barriers between various links of cold chain logistics, and promote information sharing among cold chain logistics information platforms[10], effectively improving the operational efficiency of cold chain logistics organizations. Actively carry out pilot work on digital cold chain warehouses, accelerate the formation of replicable and promotable intelligent operation experience, and do a good job in promoting it nationwide.

5. Conclusion

The high-quality development of cold chain logistics needs the cooperation of multiple parties. Through the improvement of the production and sales network of cold chain logistics, the improvement of the cold chain standardization system, and the improvement of the intelligent information level, we should accelerate the construction of an efficient and smooth modern cold chain logistics system, further improve the operation efficiency of cold chain logistics, and provide strong support for ensuring food and medicine safety. However, at the same time, this article has not yet conducted an analysis of the entire cold chain logistics industry chain. In the future, research perspectives can be further extended to propose countermeasures and suggestions from the perspective of strengthening upstream and downstream cooperation in cold chain logistics, and jointly promote the high-quality development of cold chain logistics.

Acknowledgments

This work was financially supported by “Research on Key Policies for the Operation and Management of the Pinglu Canal “ (Basic scientific research business expenses of central public welfare scientific research institutions TKS20230604).

References