

# Research on the Development Strategy of Fresh Agricultural Products Cold Chain Logistics in Tai'an City

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**Abstract:** With the continuous improvement of people's living standards, green and safe fresh agricultural products are increasingly favored by consumers. Higher demands are also being placed on the quality and safety of fresh agricultural products, which in turn poses more severe challenges to the application and development of cold chain logistics systems. Tai'an City, as an agricultural powerhouse, also faces many problems in the development of cold chain logistics for fresh agricultural products. Therefore, this paper mainly explores the development strategies for cold chain logistics of fresh agricultural products in Tai'an City. By analyzing the current development status and existing problems, this paper proposes improvement strategies from six aspects: infrastructure construction, the informatization level of cold chain logistics, market entities, cold chain logistics service system, talent cultivation, and local standard construction. These strategies aim to promote the rapid development of the cold chain logistics industry for fresh agricultural products in Tai'an City and to truly leverage the important role of cold chain logistics in promoting consumption and improving social well-being.

**Keywords:** Fresh agricultural products; Cold chain logistics; Development strategies

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## 1. Introduction

Cold chain logistics for fresh agricultural products is an essential link in ensuring the quality and safety of agricultural products, reducing losses, and enhancing market competitiveness<sup>[1]</sup>. With the development of the economy and the improvement of living standards, the demand for fresh agricultural products is increasing, and higher requirements are placed on cold chain logistics<sup>[2]</sup>. Tai'an City, as an important base for agricultural production, holds significant importance in perfecting its cold chain logistics system to ensure the quality and safety of agricultural products and promote agricultural modernization.

In recent years, the Tai'an municipal government has introduced a series of policies, such as the "Implementation Plan for the Construction of Tai'an as a Demonstration City for Cold Chain Logistics

Development” and the “Tai’an 14th Five-Year Plan for Modern Logistics Development.” These policies clearly propose to improve the refrigeration and preservation facilities at agricultural product origins, build regional cold chain logistics centers, and support large-scale trade and logistics enterprises in deploying cold chain logistics facilities in rural areas. By 2025, Tai’an plans to build 300 refrigeration and preservation facilities for agricultural products, significantly enhancing the storage and preservation capabilities <sup>[3-4]</sup>. Under the strong policy stimulus and promotion, if Tai’an’s fresh agricultural products cold chain logistics can seize the opportunities of the times and achieve high-quality development, it will undoubtedly reduce waste in agricultural product circulation, expand the supply of high-quality markets, and thus increase farmers’ income and contribute to rural revitalization.

## **2. Current status of fresh agricultural products cold chain logistics in Tai’an City**

### **2.1. Continuous growth in the output of fresh agricultural products**

Tai’an City, located in the central part of Shandong Province, is an important base for agricultural production. The main fresh agricultural products include vegetables, fruits, and livestock products. In recent years, with the adjustment of agricultural industrial structure and changes in market demand, the output of fresh agricultural products in Tai’an City has continued to grow. In 2022, the city’s vegetable output reached 5.2 million tons, an increase of 4% year-on-year; fruit output was 2.1 million tons, up by 5% year-on-year; and the output of livestock products was 1.6 million tons, up by 6.7% year-on-year. The main varieties include local specialties such as Tai’an chestnuts, Feicheng peaches, and Ningyang jujubes <sup>[5]</sup>.

### **2.2. Gradual improvement of infrastructure**

In recent years, Tai’an City has made significant progress in the infrastructure of cold chain logistics. The government has increased its investment in rural cold chain logistics infrastructure, supporting the construction of facilities for agricultural product storage, preliminary processing, terminal delivery, and public cold storage. For example, projects such as the Xintai Qingyun International Cold Chain Logistics Park and the China Supply and Marketing (Ningyang) Agricultural and sideline Products Logistics Park are being accelerated. Currently, Tai’an City has built two comprehensive cold chain logistics parks, located in Tai’an District and Feicheng City, respectively. The construction of these facilities has effectively enhanced the storage and preservation capabilities of agricultural products <sup>[6]</sup>.

At the same time, Tai’an City has also focused on upgrading cold chain transportation facilities, promoting the application of new cold chain equipment such as mobile cold stores and temperature-controlled refrigerated vehicles. By the end of 2022, the city’s cold storage capacity had reached approximately 550,000 tons, up by 10% year-on-year. Among them, high-temperature cold stores accounted for 60%, and low-temperature cold stores accounted for 40%. There were about 1,200 refrigerated vehicles in total, up by 20% year-on-year. Among these, light-duty refrigerated vehicles accounted for 50%, medium-duty refrigerated vehicles accounted for 30%, and heavy-duty refrigerated vehicles accounted for 20% <sup>[7]</sup>. Through these measures, the modernization level of Tai’an City’s cold chain logistics infrastructure has been continuously improved.

### **2.3. Enhancement of cold chain logistics informatization level**

Tai’an City has actively promoted the informatization of cold chain logistics, building a regional public information platform for cold chain logistics to facilitate data exchange among enterprises in various links of the cold chain logistics industry. For example, the “Tai’an Cold Chain Logistics Information Platform” uses

the Internet of Things (IoT) and big data technologies to achieve full-process transparency and traceability of cold chain information <sup>[8]</sup>. In addition, some enterprises have established intelligent monitoring and traceability platforms for cold chain logistics, enhancing the intelligence level of cold chain transportation.

## **2.4. Diversification of market entities**

The market entities in Tai'an's cold chain logistics industry have gradually diversified, with the emergence of several cold chain logistics companies, such as Tai'an Guangmao Cold Chain Logistics Industry Development Co., Ltd. These companies have played an important role in the construction of cold chain logistics infrastructure and transportation and distribution. At the same time, postal express and supply and marketing logistics have also actively participated in the cold chain logistics of fresh agricultural products, leveraging their network advantages <sup>[9]</sup>.

## **2.5. Improvement of cold chain logistics service efficiency**

Tai'an City has focused on strengthening the pre-cooling, preservation, and other commercial processing at the "first mile" of agricultural product origins. It supports the establishment of small and medium-sized logistics nodes in various advantageous agricultural product production areas across the city. At the same time, it accelerates the construction of pre-cooling, preservation, and other commercial processing at the "first mile" of agricultural product origins and low-temperature processing and distribution facilities facing urban consumers at the "last mile." These measures have effectively enhanced the service efficiency of cold chain logistics and reduced the losses of agricultural products during transportation and storage.

# **3. Problems in the development of cold chain logistics in Tai'an City**

## **3.1. Infrastructure construction still needs to be strengthened**

Although Tai'an City has made progress in the infrastructure of cold chain logistics, there is still a significant gap compared with market demand. The distribution of cold storage facilities is uneven, mainly concentrated in urban areas and large wholesale markets, with a severe shortage in rural areas. The number of refrigerated vehicles is insufficient, and some of the existing vehicles are old, with poor refrigeration effects that fail to meet the new situation and standardization requirements. The construction of cold chain logistics facilities still needs to be further enhanced.

## **3.2. The level of informationization needs to be improved**

Despite some progress in the informationization of cold chain logistics in Tai'an City, the overall level remains low. The informationization level of cold chain logistics enterprises in Tai'an City is generally low, with about 70% of enterprises still using traditional manual recording and telephone communication methods, lacking a unified information management platform. The application of new information technologies, such as the Internet of Things and big data in cold chain logistics, is limited, with only a few large enterprises beginning to experiment with technologies such as temperature monitoring and vehicle positioning. The phenomenon of information silos is severe in each link of the cold chain logistics, lacking an effective information sharing mechanism. This makes it difficult to achieve full-process temperature and humidity monitoring and traceability, resulting in low efficiency in cold chain logistics.

### **3.3. Insufficient competitiveness of market entities**

The main operators in Tai'an's cold chain logistics are small enterprises and individual households, which are characterized by small scale and weak strength. They also have poor financing capabilities and are unable to achieve economies of scale. The circulation channels for fresh agricultural products in Tai'an are dominated by wholesale markets, accounting for about 60%. Farmers' markets and supermarkets are the next most common channels, with respective shares of 20% and 15%. E-commerce platforms and other emerging channels are developing rapidly but still have a relatively low share of around 5% <sup>[10]</sup>.

Moreover, the service models of cold chain logistics are relatively monotonous, primarily focusing on transportation and warehousing, with a lack of value-added services such as processing, packaging, and delivery.

### **3.4. High costs of cold chain logistics**

Cold chain logistics require substantial capital investment in facility construction and operation maintenance, which leads to high costs. Due to the incomplete cold chain logistics system, the post-harvest loss rate of fresh agricultural products in Tai'an City is relatively high, averaging around 20%. Among them, the loss rate of vegetables is the highest, reaching 25%, while the loss rates of fruits and livestock products are 18% and 15%, respectively <sup>[11]</sup>. In addition, the tolls for cold chain logistics vehicles are relatively high, further increasing the operational costs of enterprises.

### **3.5. Policy support and talent training status**

In recent years, the Tai'an municipal government has introduced a series of policies to support the development of cold chain logistics. However, more efforts are still needed in terms of financial investment, land security, and tax incentives. Cold chain logistics require specialized personnel for management, but Tai'an City currently faces a shortage of professional cold chain logistics talents. There are few relevant programs offered by colleges and vocational schools, and the talent development system is not well established.

## **4. Development strategies**

### **4.1. Optimizing policy support for cold chain logistics**

#### **4.1.1. Financial reward policies**

For cold chain logistics enterprises registered in Tai'an City that are awarded national three-star, four-star, and five-star ratings for the first time, one-time rewards of 200,000, 400,000, and 600,000 yuan, respectively, will be granted.

#### **4.1.2. Land use support**

Increase land planning for cold chain logistics facilities to address the difficulties and high costs associated with acquiring land for cold storage parks and fresh produce logistics distribution centers.

#### **4.1.3. Transportation preferential policies**

Increase the number of green permits issued, relax urban access restrictions for vehicles delivering fresh agricultural products, and implement preferential policies for the passage of cold chain logistics vehicles.



## **4.2. Strengthening infrastructure construction**

### **4.2.1. Refrigeration and preservation facility construction at origins**

The government should continue to increase investment in cold chain logistics infrastructure, especially at key nodes of production and sales <sup>[12]</sup>. Support the construction of refrigeration and preservation facilities for agricultural products at origins by county-level and above model family farms, model farmers' cooperatives, and other rural collective economic organizations. Increase subsidies for cold stores and refrigerated vehicles to reduce enterprise operating costs.

### **4.2.2. Optimizing facility layout**

Guide the rational layout of cold chain logistics facilities to avoid low-level repetitive construction. Build two high-standard food cold chain logistics centers that serve the entire city and radiate within a 300-kilometer radius. Additionally, construct multiple cold chain logistics distribution bases in food industry parks across counties (cities, districts) and functional zones.

### **4.2.3. Enhancing cold chain transportation capacity**

Promote the use of full-process temperature and humidity automatic monitoring systems and control equipment. Support enterprises in purchasing cold chain vehicles to enhance cold chain transportation services.

## **4.3. Improving the informatization level of cold chain logistics**

### **4.3.1. Building information platforms**

Further improve the public information platform for cold chain logistics to achieve full-process transparency and traceability of cold chain information. For example, use IoT technology to enable real-time monitoring of cold chain facilities <sup>[13]</sup>.

### **4.3.2. Promoting intelligent applications**

Encourage enterprises to adopt intelligent sorting and full-process temperature control technologies. For example, increase investment in video collection and temperature and humidity sensing devices to enhance the intelligence level of cold chain logistics.

### **4.3.3. Enhancing data sharing**

Promote data sharing among enterprises in various links of the cold chain logistics industry to improve collaborative efficiency.

## **4.4. Cultivating and strengthening market entities**

### **4.4.1. Supporting enterprise development**

Encourage cold chain logistics enterprises to expand their scale and enhance market competitiveness through mergers and acquisitions. For example, provide one-time rewards to enterprises awarded national star ratings for the first time.

### **4.4.2. Attracting large enterprises**

Attract large cold chain logistics enterprises to Tai'an through policy incentives to elevate the overall market level.

#### **4.4.3. Strengthening industry self-discipline**

Establish and improve cold chain logistics industry associations to regulate market order and strengthen self-discipline.

### **4.5. Improving the cold chain logistics service system**

#### **4.5.1. Building cold chain logistics information platforms**

Promote the construction of regional public information platforms for cold chain logistics to facilitate data exchange among enterprises in various links and achieve full-process transparency and traceability of cold chain information <sup>[14]</sup>.

#### **4.5.2. Developing intelligent monitoring for cold chain logistics**

Encourage enterprises with the capability to develop intelligent monitoring and traceability platforms for cold chain logistics and establish full-process cold chain delivery systems.

### **4.6. Improve the cold chain logistics standard system**

#### **4.6.1. Develop local standards**

Develop local technical solutions and operating procedures that are high-standard, practical, and operable. Accelerate the alignment of standards for logistics information, facilities, and equipment to improve the standardization system of cold chain logistics and regulate the behavior of market entities in all links of the cold chain.

#### **4.6.2. Enhance standard promotion**

Increase the awareness and implementation of cold chain logistics standards among market entities through training and publicity. Support cold chain enterprises in introducing advanced technologies and equipment to enhance the automation and intelligence levels of cold chain logistics <sup>[15]</sup>.

#### **4.6.3. Strengthen regulatory oversight**

Establish and improve regulatory mechanisms for cold chain logistics and strengthen supervision and inspection of cold chain logistics enterprises.

### **4.7. Strengthening talent team building**

#### **4.7.1. Industry-academia-research collaboration**

Promote cooperation among universities, research institutions, and cold chain logistics enterprises to conduct research and application of cold chain logistics technologies and enhance the overall technical level of the industry.

#### **4.7.2. Talent training and introduction**

Intensify the training and education of specialized cold chain logistics talents to increase the supply of composite talents in the cold chain industry. Attract high-end talents to Tai'an through policy incentives to improve the management level of the cold chain logistics industry <sup>[16]</sup>.

## 5. Conclusion

The cold chain logistics for fresh agricultural products in Tai'an City has made significant progress in infrastructure construction, informatization level improvement, and diversification of market entities. However, it still faces challenges such as insufficient infrastructure, low informatization levels, weak competitiveness of market entities, high costs, an incomplete standard system, and a shortage of professional talents. By strengthening infrastructure construction, enhancing informatization, cultivating market entities, improving the service system, perfecting the standard system, and strengthening talent training, Tai'an City is expected to build an efficient and intelligent cold chain logistics system for fresh agricultural products. This will drive the modernization of agriculture and the high-quality development of the cold chain logistics industry.

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## Disclosure statement

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