

Research Article

Study on Cold Chain Logistics Operation and Risk Control of Fresh e-Commerce Products

Shenxiang Wang 

College of Intelligent Cold-chain Industries, Guangzhou College of Technology and Business, Guangzhou, Guangdong 510850, China

Correspondence should be addressed to Shenxiang Wang; v11314014@stu.ahu.edu.cn

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With the rapid development of the Internet, my country's e-commerce market has been very active in recent years, and the number of e-commerce platforms and the volume of product transactions have achieved rapid development. However, through the investigation of the main circulation products of e-commerce brands, it can be found that the output value of my country's e-commerce industry as a whole in the fresh food field is very low. Many fresh products are prone to various risks during the circulation process, resulting in large losses on the platform and online agricultural products e-commerce. There is a shortage of fresh cold chain equipment and cold chain technicians, which directly affects the stable and healthy development of fresh cold chain logistics in China. This paper analyzes the existing operation mode of e-commerce, analyzes the main bottleneck of the operation of the fresh cold chain, and puts forward corresponding suggestions to enhance the awareness of risk control, so as to better promote the benign operation of agricultural products cold logistics and provide some reference for the optimization of e-commerce fresh cold chain logistics.

1. Introduction

My country is a big agricultural country with vast land and resources. However, with the rise in people's living standards, people are not satisfied with the local food types, which makes many e-commerce enterprises and traditional enterprises smell the business opportunities [1]. In view of the characteristics of fresh, fresh-keeping cannot be done without a cold chain. The amount of fresh agricultural products entering the circulation field through cold chain logistics channels has increased year by year, and the construction of agricultural cold chain logistics systems has become more standardized [2]. The backward cold chain logistics infrastructure and advanced cold chain technology are the main reasons for the low utilization rate of cold chains in China.

People gradually tend to "experiential" consumption methods, and the number of consumers buying seasonal fresh agricultural products is increasing, that plays an important role in driving the expansion of the fresh agricultural product consumption market and the agricultural cold chain

logistics industry [3, 4]. Figure 1 shows a typical cold chain logistics industry operation model. From the perspective of environment, the impact of fuel consumption, exhaust gas pollution, and noise of transportation vehicles will be more serious.

Based on this background, this paper proposes a method for the cold chain logistics operation and risk control of e-commerce fresh products. By abstracting each element of the shunting operation into an agent model and designing the communication and cooperation mechanism between the agents, the efficient railway shunting operation can be realized. This paper has some practical significance to better promote the benign operation of agricultural products chilled logistics and for the optimization of e-commerce fresh products cold chain logistics.

2. State of the Art

All foods that are closely related to people's diets (except the standard packaged products of the grocery department) are

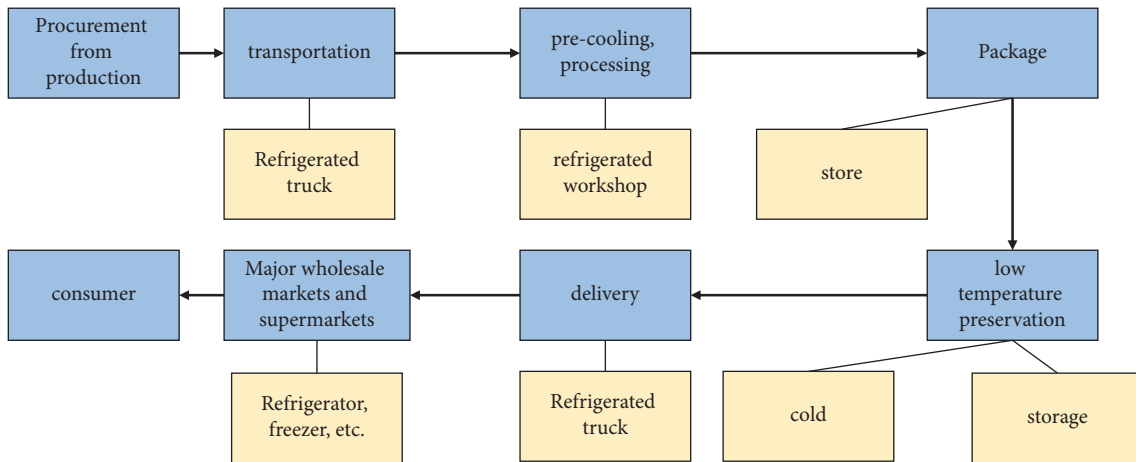


FIGURE 1: The operation mode of the cold chain service industry.

fresh products [5]. China's e-commerce market is very active, from the number of e-commerce platforms to the volume of product transactions that have been rapidly developed. Fresh food e-commerce mainly refers to the sale of fresh products, such as fruits, vegetables, seafood, and meat, on the Internet relying on the e-commerce model [6]. The development of fresh food e-commerce in China can be divided into three stages as shown in Figure 2.

2.1. The First Stage

The Initial Pathfinding Stage. This stage is mainly in the period from 2005 to 2012. Yiguo.com was first established in 2005, and the Tuotuo commune emerged in 2008. Such e-commerce platforms are small- and medium-sized e-commerce companies that achieve vertical sales in smaller areas [7].

2.2. The Second Stage

The Rapid Development Stage. Mainly from 2012 to 2013, this was an important period when China's fresh food e-commerce emerged and flourished [8]. 2012 is also known as the "first year of fresh food." More and more new e-commerce platforms have come to people's attention, and the vertical distribution model has also attracted widespread attention from the public.

2.3. The Third Stage. The Stage of Stable Development of e-Commerce. From 2013 to the present, the fresh food e-commerce market has experienced a period of rapid development, and the subsequent development process has gradually become stable [9]. The cold chain logistics resources are not enough to maintain the freshness of materials, leading to a great bottleneck in the development of China's e-commerce cold chain industry. e- At present, China has many problems in these links, seriously restricting and hindering the development of China's e-commerce cold

chain industry and unable to meet the market demand and the improvement of people's quality of life.

Cold chain logistics is a special supply chain system that combines processing, warehousing, transportation, and distribution. In each link, placing the material in a suitable low-temperature environment is the most basic requirement. Table 1 lists the basic models and typical representative companies of common e-commerce fresh food cold chain services.

Compared with traditional logistics, the risks of cold chain logistics are also more prominent. E-commerce cold chain logistics is very dependent on infrastructure construction, it is the premise of its development of it, the current cold storage outlets in China are insufficient, the distribution is uneven, and most of the cold storage equipment is old and backward; due to the lack of low temperature control equipment, it cannot meet the requirements of the whole process control of low temperature of fresh products, resulting in high losses of fresh products in the transportation process, which greatly increases the cold chain logistics cost of fresh products [10]. Casper mentioned that foreign logistics companies can comprehensively monitor and manage the temperature, fuel consumption, and door opening times of vehicles in cold chain transportation by using the Internet of Things technology and other logistics information technologies [11]. Li analyzed the problems existing in the cold chain logistics of it in my country from a macroperspective, put forward corresponding countermeasures, and conducted research on the development trend [12]. Xiang and others focused on the exploration and research of the standardization construction of agricultural cold chain logistics in combination with the needs of my country's logistics globalization development [13]. Zhang et al. analyzed the current situation of food cold chain logistics safety in my country and put forward corresponding countermeasures [14]. Bu Meilan et al. elaborated on the operational risks of it of agricultural products in my country and gave relevant solutions [15]. Jacques explained the specific meaning of the Canadian HACCP system that is conducive to food safety control, and my country urgently needs to create and learn from an excellent

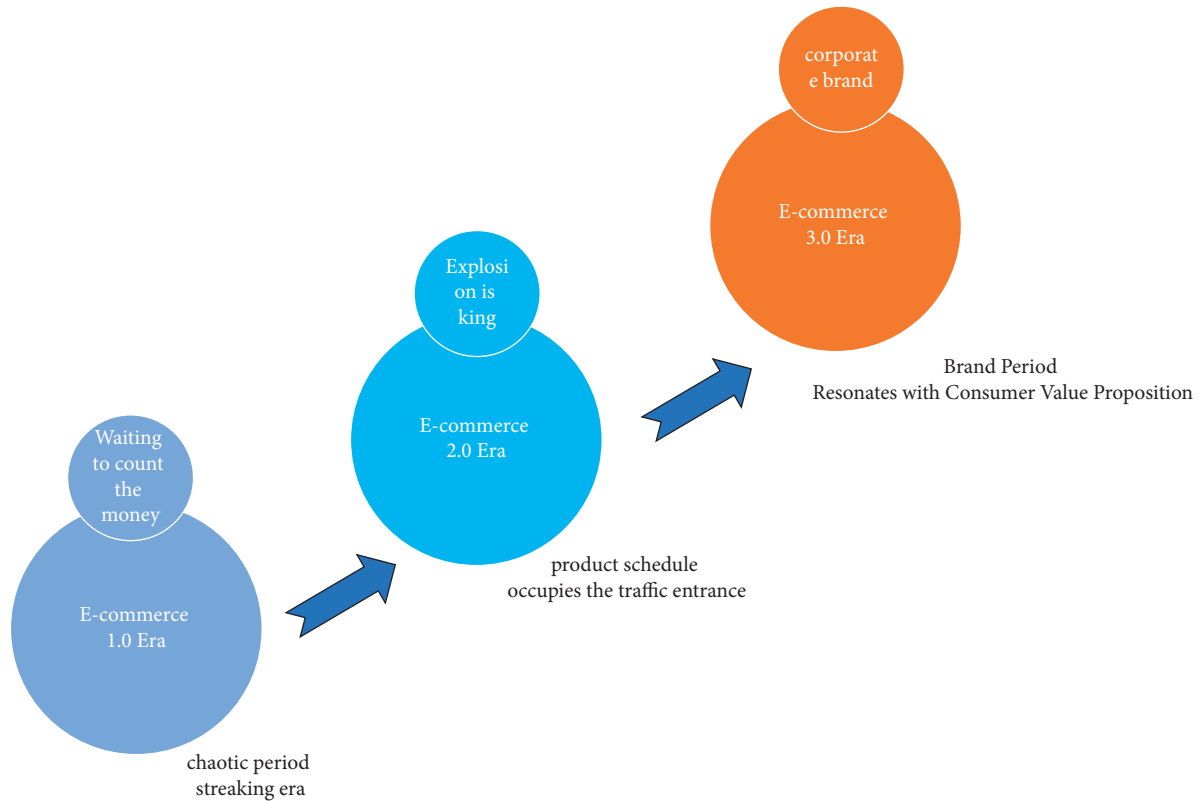


FIGURE 2: Three stages of e-commerce development.

TABLE 1: Common e-commerce fresh food cold chain service models.

| Type | Introduce | Representative enterprise |
|----------------|---|--|
| Transport type | Mainly engaged in the low-temperature transportation of goods | Shuanghui Logistics, Rongqing Logistics, Zhongrong Logistics |
| Storage type | Providing customers with low-temperature cargo storage, custody, transit, and other warehousing services | Swire Cold Chain, Pfeiffer |
| City delivery | Mainly engaged in comprehensive business such as low-temperature warehousing, trunk transportation, and urban distribution | Beijing Express Line, Shanghai Xintiantian, Shenzhen Dawning |
| Comprehensive | Mainly engaged in low-temperature storage business with the theme of agricultural product wholesale market | China Merchants America Cold, Shanghai Guangde, Beijing Zhongliang |
| Transactional | It provides low-temperature transportation, processing, warehousing, and distribution services from the beginning of procurement to the whole process of the terminal | Lenovo Baishazhou, Shenzhen agricultural products, Jiangsu Runheng, Fujian Mingcheng |
| Supply chain | Relying on big data, internet technology, and IT technology, integrating logistics, finance, insurance, and other value-added services to build a cold chain resource trading platform of "internet + cold chain logistics" | China: Wuhan Liang Zhong bank, Xianyi Supply Chain, SF Express Cold Shipping, Jiuye Supply Chain United States: SYSCO, US FOOD |
| E-commerce | Introduce | Aixianfeng, Jingdong Daojia, Aegis Express |
| Internet+ | Mainly engaged in the low-temperature transportation of goods | Cold chain vest, matching the code |

control system like HACCP [16]. In addition, Chaug et al. believed that the "multitemperature codistribution" cold chain logistics mode uses cold storage containers and media to ensure the high quality of it when using normal temperature vehicles for distribution, which can save a lot of transportation costs [17]. Du believed that from the development experience, the third-party cold chain logistics is

the main body of the future cold chain logistics market competition, and vigorously developing the third-party logistics is the industry [18].

A new fresh retail model based on the direct sales model of the origin has begun to emerge. Figure 3 presents several typical new retail business models. It can be seen from the figure that the logistics link is indispensable in the new retail.

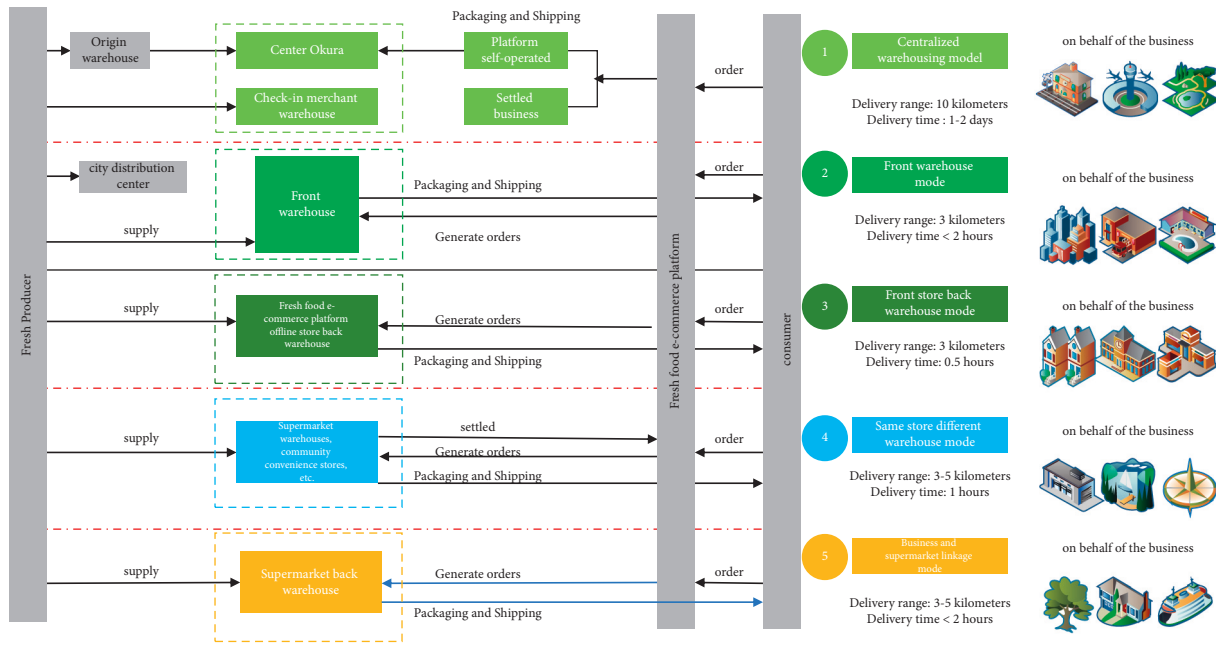


FIGURE 3: Fresh and new retail model.

In view of this problem, through the analysis of the current situation of it at home and abroad and the research on countermeasures, it can be found that a new retail model can be proposed for the operation mode of fresh e-commerce and the particularity of agricultural products, so as to solve the problem.

3. Methodology

3.1. Discussion on the Existing Cold Chain Operation Mode of Fresh Food e-Commerce. In order to truly occupy the blue ocean of fresh food e-commerce, in addition to the need to accurately choose the operation mode that suits them, the most important thing is the choice of the cold chain operation mode. The current cold chain system mainly includes several parts such as cold storage, distribution center, and cold chain transportation as shown in Figure 4. At present, the cold chain operation mode mainly includes self-operated cold chain logistics, third-party cold chain logistics, and self-operated + third party.

3.1.1. Self-Operated Cold Chain Logistics. Fresh food e-commerce enterprises build their cold storage, distribution center, purchase vehicles, transportation equipment, and so on and equip professional human resources to master the business flow, logistics, and information flow of the entire supply chain [19].

Although self-operated cold chain logistics makes up for the inflexibility of its 3PL and improves customer satisfaction, its cost and operation factors make these fresh food e-commerce companies overwhelmed. At present, some powerful vertical fresh food e-commerce companies in my country and logistics companies that “deliver and deliver excellent products” choose to build their own cold chain logistics. From the very beginning, Tuotuo Gongshe has

followed the model of farm + sales + cold chain distribution. However, due to the low awareness of fresh food e-commerce in my country and the limited traffic of Tuotuo Gongshe, the business in Beijing, Shanghai, and Shenzhen that was initially launched finally only retained the cold chain distribution in Beijing.

3.1.2. Third-Party Cold Chain Logistics. Its model refers to the mode in which fresh food e-commerce distributes fresh products. This model can integrate social resources, give full play to economies of scale, provide professional services, and save cold chain logistics costs for enterprises [20].

It is especially important to suit your own mode of operation. Alibaba’s Tmall has created a profitable operating model, the C2B presale model. It has formed strategic alliances with professional third-party cold chain logistics companies such as Kuai Xing Line and Zhongchu Logistics and efficiently delivered American cherries to consumers through the presale model + cold chain home delivery. The person in charge of the fast line said that currently only the presale model of Tmall can be operated. Ali is a professional 3PL cold chain logistics integrator, which is consistent with the rookie project under construction.

3.1.3. Self-Operated + Third Party. The development of a self-operated cold chain logistics system for fresh food e-commerce can improve the controllability of product quality and the flexibility and efficiency of distribution. However, the huge cost of additional refrigerated trucks, human resources, and cold storage facilities and equipment has become an important obstacle to the development of fresh food e-commerce.. Table 2 shows the advantages and disadvantages of the two types of logistics. The distribution

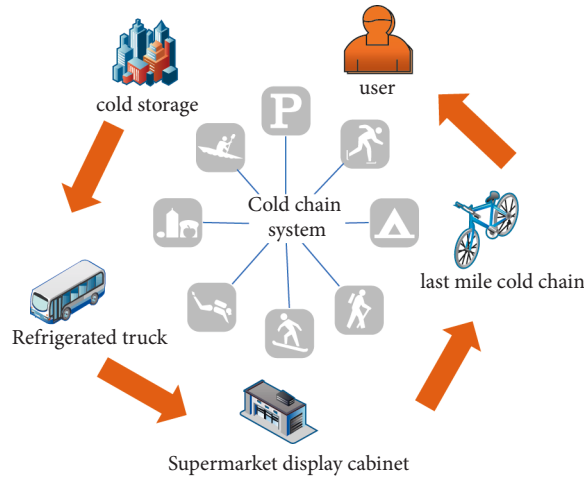


FIGURE 4: Components of cold chain logistics.

TABLE 2: Advantages and disadvantages of self-operated cold chain and third-party cold chain.

| Advantages and disadvantages | Self-operated cold chain home delivery model | The third-party cold chain distribution model |
|------------------------------|--|--|
| Advantage | Product quality controllable Scale development Provide stable service | Provide relatively professional supply, warehousing, and logistics operations Reduce upfront costs High prices for third-party logistics that meet delivery conditions |
| Disadvantage | Large initial capital investment The cost of logistics vehicles, cold storage, human resources, and so on is too high | Fresh food e-commerce companies and logistics companies need a lot of running-in time It is difficult to guarantee the delivery quality of fresh products |

of logistics enterprises is improved. In those areas, fresh food e-commerce companies can explore slowly, and handing over other areas to the cold chain 3PL will save a lot of trouble and can achieve a greater degree of resource integration and efficient use.

3.2. Risk Analysis of Fresh Food e-Commerce Cold Chain Logistics. For cold chain logistics, the risks are mainly reflected in two aspects. One is that the flow rate of goods cannot reach the demand level, resulting in delays in it and the risk of chain disconnection; the other is that the quality of goods when they reach consumers cannot meet consumption the expected level. At present, these two kinds of risks have also become bottlenecks restricting its further development of it.

3.2.1. Cold Chain Internal Risks. The internal risks of the cold chain are divided into procurement and supply risks, technical risks, and human resource risks.

- (1) *Procurement and Supply Risk.* The goal of the cold chain system is to deliver the right quantity of high-quality fresh products to consumers at the right time.

Procurement and supply risk refers to the risk of it in terms of supply quality and quantity.

- (2) *Technical Risk.* Technical risk refers to the loss of quality or quantity of cold chain food due to insufficient technology itself or improper use in the process of storage, inventory management, and use of information technology, which brings risks to the entire cold chain.
- (3) *Organizational Risk.* Organizational risk mainly refers to the risks brought to the cold chain logistics system in the entire logistics system due to the level of human resources, the risk awareness of core members, and the effectiveness of emergency logistics plans.

3.2.2. Cold Chain External Risks. External risks can be divided into the following categories:

- (1) *Market Demand Risk.* Fresh food e-commerce is an emerging trading model. Compared with the traditional market, its market volatility is also higher. Therefore, cold chain logistics face higher market demand risks.

- (2) *Environmental Risks.* Environmental risk refers to uncontrollable factors outside the logistics system due to geographical reasons such as urban traffic congestion, natural disasters, and so on, and the losses caused are also relatively serious.
- (3) *Economic Policy Risks.* The adjustment of the national economic policy will have a great impact on the investment, fundraising, and other business management activities of the supply chain, which is often further reflected in the operation and management of the cold chain.

3.3. Cold Chain Logistics Security Risk Assessment Method and Model Construction. The system has high requirements for temperature control, and temperature control runs through almost the entire process of operation. In addition, the safety of this system involves a wide range of safety, including product quality safety, processing safety, packaging safety, storage safety, distribution safety, and transportation safety. It is precise because the target products involved in the fresh cold chain logistics are special, the safety scope is wide, and the operating cost is high, which highlights the necessity of the safety risk assessment and risk control research of the fresh cold chain logistics system.

3.3.1. Triangular Fuzzy Function. Analyzing the boundaries or relationships between objective things is the basis for clustering, but often the boundaries between things in the objective world are not very clear. In terms of the safety of the fresh cold chain logistics system, what kind of logistics system is safe? The boundaries are not clear, which requires the help of fuzzy mathematics to solve such problems.

For precise ambiguity, triangular ambiguity numbers are introduced. In order to solve the problem in the uncertain environment, Zadeh proposed the concept of a Dev fuzzy set in 1965, which was applied to quality and risk management. Assuming a fuzzy set N , then N can be expressed as (l, m, u) , and the membership function of the fuzzy set N on the universe U can be expressed as follows:

$$\mu(N) = \begin{cases} \frac{x-l}{m-l}, & x \in [l, m], \\ \frac{x-u}{m-u}, & x \in [m, u], \\ 0, & \text{else.} \end{cases} \quad (1)$$

Let N_1 and N_2 be two triangular fuzzy numbers, the algorithm is as follows:

$$N_1 \oplus N_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2),$$

$$N_1 \otimes N_2 = (l_1 l_2, m_1 m_2, u_1 u_2),$$

$$\lambda N_1 = (\lambda l_1, \lambda m_1, \lambda u_1), \quad (2)$$

$$\frac{1}{N_1} = \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1} \right).$$

The probability of $N_1 \geq N_2$ is defined as follows:

$$P(N_1 \geq N_2) = \begin{cases} 1, & m_1 \geq m_2, \\ \frac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)}, & m_1 \leq m_2, \text{ and } u_1 \geq l_2, \\ 0, & \text{else.} \end{cases} \quad (3)$$

The probability that a triangular fuzzy number is greater than the other k fuzzy numbers is defined as follows:

$$\begin{aligned} d(C) &= P(N \geq N_1, N_2, \dots, N_k) \\ &= \min P(N \geq N_i), \quad i = 1, 2, \dots, k. \end{aligned} \quad (4)$$

3.3.2. Fuzzy Judgment Matrix. In order to improve the accuracy of the evaluation value, the fuzzy judgment matrix is represented by triangular fuzzy numbers, and the relative importance of elements is obtained by the operation of triangular fuzzy numbers and the logarithmic least square method so that the AHP can be extended to the fuzzy environment. It is as follows:

- (1) According to the problem to be analyzed, establish the corresponding ladder hierarchy
- (2) Invite several industry experts to set up an evaluation group, and the weight of the experts is known as W . The expert group compares the evaluation indicators (with m indicators) in pairs and uses triangular fuzzy numbers to construct a fuzzy judgment matrix A .
- (3) Calculate the comprehensive fuzzy value of the evaluation index i of the H layer

$$D_i^H = \sum_{j=1}^l (a_{ij}^H w_{fj}), \quad l = 1, 2, \dots, l; \quad (5)$$

$$H = 1, 2, \dots, m.$$

- (4) Using formula (3) and formula (4), defuzzify all fuzzy numbers and then normalize the data to obtain the final weight as follows:

$$w_i = \frac{d(C_i)}{\sum_{i=1}^m d(C_i)}. \quad (6)$$

3.3.3. Brief Introduction of Fuzzy Comprehensive Evaluation Method Based on Multilevel Evaluation Model. Establishing a model can improve the accuracy of evaluation results and help decision-makers make correct decisions.

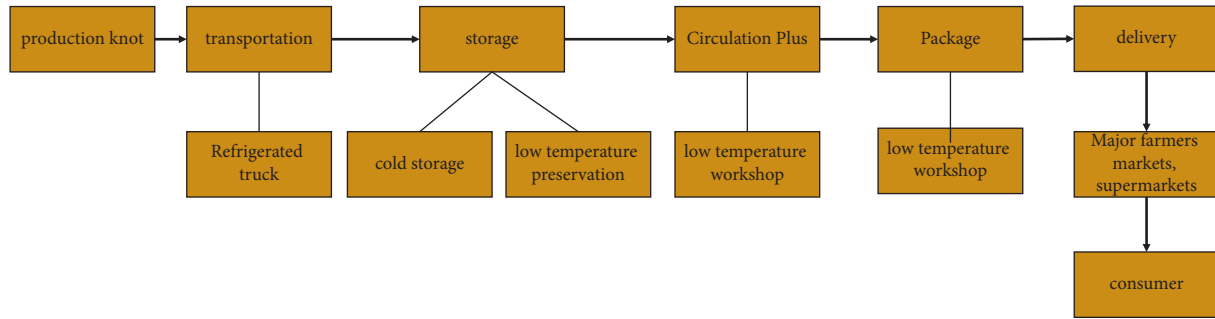


FIGURE 5: The complete process of cold chain logistics of fresh products.

The following takes the second-level indicator model as an example to introduce the steps for establishing a model:

- (1) *Divide the Factor Set.* Let the factor set be U and the evaluation scale set be V , and divide U into k parts according to the relationship between the factors in U .
- (2) *Primary Indicators.* The first-level model is used to comprehensively evaluate each U_i , and the comprehensive evaluation vector is calculated.
- (3) *Multilevel Comprehensive Evaluation.* Taking B calculated in step (2) as an independent element, construct an $N \times n$ -order judgment matrix.

$$R = (B_1, B_2, \dots, B_m)^T. \tag{7}$$

Let the weight distribution of U be W , and get the secondary evaluation vector of U as follows:

$$B = w \circ R. \tag{8}$$

Calculate the comprehensive evaluation value as follows:

$$P = B \cdot V^T. \tag{9}$$

4. Result Analysis and Discussion

4.1. Constructing Risk Assessment Indicators of the Fresh Product Cold Chain Logistics System. The complete circulation process of agricultural cold chain logistics operation is shown in Figure 5.

The following starts from each link shown in Figure 5 and lists the current problems existing in each link of the cold chain logistics of it in my country, as shown in Table 3.

4.2. Calculate Indicator Weights and Program Risk Assessment. Constructing risk evaluation indicators that affect the safety of the system is the basis and key to risk evaluation. This paper takes the operation link of its cold chain logistics (shown in Figure 5) as the starting point to build a more comprehensive and detailed risk evaluation index system as shown in Table 4.

Taking a third-party cold chain logistics company A in Linyi City as an example, three experts (expert weights are 0.4, 0.3, and 0.3) are invited to compare and evaluate the indicators in pairs, and a fuzzy judgment matrix is established based on the evaluation results of the three experts.

Using formula (5) to aggregate the data, the comprehensive fuzzy judgment matrix shown in Table 5 can be obtained.

According to the data in Table 5, the method in the previous section is used to calculate the pure measurement degree that each evaluation index is better than other indicators, and formula (6) is used for normalization to obtain the weight w^* of the criterion layer index as follows:

$$w = (0.226, 0.169, 0.154, 0.084, 0.135, 0.098, 0.133). \tag{10}$$

An expert group is established to determine the degree to which each evaluation index domain belongs to the comment level according to the expert scores and construct a fuzzy relationship matrix. Finally, the comprehensive evaluation vector of company A's cold chain logistics system is determined as follows:

$$B = (0.226, 0.226, 0.200, 0.199, 0.154). \tag{11}$$

The comprehensive evaluation value of company A's cold chain logistics system security is as follows:

$$Q = B \cdot V^T = 0.637. \tag{12}$$

The safety index of company A's agricultural product cold chain logistics system is 0.637, and the safety level is between "general safety" and "safety."

The five links of transportation, warehousing, circulation processing, distribution, and after-sales in the criterion layer have a larger weight in the entire logistics operation process, indicating that in the process of cold chain circulation of it. Therefore, in order to improve the security of the cold chain logistics system, cold chain logistics enterprises should focus on strengthening the construction of these four links, which can effectively reduce the risk index of each circulation link and improve the security of the system.

TABLE 3: Problems existing in cold chain logistics construction of fresh products.

| Operation link | There is a problem |
|---------------------------------------|--|
| Transportation | ① Lack of strict quality inspection implementation standards; ② Informal cold chain transportation tools are widely used; ③ Lack of professional transportation operators; ④ Lack of professional transportation route optimization talents, and unreasonable transportation routes increase transportation costs; ⑤ The convertibility of cold chain transportation is low; |
| Loading and unloading | ① The degree of mechanization of the loading and unloading operation is low; ② The enterprise does not have the guarantee of low-temperature environment; ③ The loading, unloading, and handling equipment is backward, which prolongs the handover time of inbound and outbound warehouses; |
| Warehousing | ① The geographical distribution of cold storage is uneven, and the capacity is very insufficient; ② The precooling setting of items is low, and the temperature control and adjustment are illegal; ③ The degree of automation of the cold storage is low, which wastes human resources; ④ The refrigeration technology is generally backward; ⑤ The cold storage has high energy consumption and high noise, which hurts the ecological environment; ⑥ There are few value-added services in the warehousing link; |
| Distribution processing and packaging | ① The processing link cannot fully guarantee low-temperature operation; ② The circulation processing equipment is lagging, the processing defective rate is high, and the waste is serious; ③ Improper disposal of processing waste; ④ The standardization of packaging is low, the packaging materials are not conducive to recycling, and the environment is polluted; |
| Delivery | ① The degree of marketization of distribution is low; ② The degree of informatization in the distribution process is low; ③ The standardized configuration of distribution vehicles is low; ④ The value-added business of the logistics distribution center is few; |

TABLE 4: Risk assessment indicators affecting the safety of fresh cold chain logistics.

| Target layer | Criterion layer | Subcriteria level |
|---|---|---|
| Agricultural product cold chain logistics system security index | Transport T | High-end transportation equipment shares T_1 |
| | | Vehicle monitoring information feedback T_2 |
| | | A reasonable degree of route design T_3 |
| | | Professional talent ownership rate T_4 |
| | Warehouse S | Fire protection system construction degree S_1 |
| | | Rationalization degree of cold storage design S_2 |
| | | Intelligent temperature control facilities S_3 |
| | Flow processing L | Warehousing operation standard S_4 |
| | | Product processing environment L_1 |
| | Packaging P | Processing flow standardization L_2 |
| | | Processing equipment standardization L_3 |
| | Delivery J | Standardized packaging process P_1 |
| | | Packaging material safety level P_2 |
| Loading and unloading Z | Vehicle dispatch management degree J_1 | |
| | Distribution route design rationality J_2 | |
| | Inventory control and tally picking J_3 | |
| Flow processing L | Standardization of loading and unloading equipment Z_1 | |
| | Standardization of loading and unloading operations Z_2 | |
| | Accident handling speed F_1 | |
| | Customer care F_2 | |
| | Information sharing ability F_3 | |

TABLE 5: Comprehensive fuzzy judgment matrix.

| | T | S | L | P | J | Z | F |
|---|--------|-------|-------|-------|-------|-------|-------|
| T | 0.500 | 0.370 | 0.585 | 0.525 | 0.460 | 0.530 | 0.455 |
| | 0.500 | 0.570 | 0.790 | 0.725 | 0.66 | 0.690 | 0.655 |
| | 0.500 | 0.750 | 0.900 | 0.860 | 0.840 | 0.860 | 0.81 |
| S | 0.265 | 0.500 | 0.245 | 0.585 | 0.575 | 0.645 | 0.545 |
| | 0.430 | 0.500 | 0.350 | 0.685 | 0.675 | 0.750 | 0.645 |
| | 0.630 | 0.500 | 0.445 | 0.790 | 0.775 | 0.85 | 0.745 |
| L | 0.100 | 0.500 | 0.500 | 0.370 | 0.500 | 0.310 | 0.525 |
| | 0.215 | 0.655 | 0.500 | 0.555 | 0.70 | 0.410 | 0.645 |
| | 0.425 | 0.855 | 0.500 | 0.710 | 0.870 | 0.510 | 0.795 |
| P | 0.175 | 0.215 | 0.345 | 0.500 | 0.275 | 0.300 | 0.220 |
| | 0.275 | 0.315 | 0.450 | 0.500 | 0.375 | 0.400 | 0.335 |
| | 0.380 | 0.415 | 0.545 | 0.500 | 0.46 | 0.500 | 0.455 |
| J | 0.145 | 0.145 | 0.115 | 0.425 | 0.500 | 0.530 | 0.290 |
| | 0.345 | 0.325 | 0.300 | 0.625 | 0.500 | 0.700 | 0.490 |
| | 0.500 | 0.480 | 0.485 | 0.810 | 0.500 | 0.870 | 0.675 |
| Z | 0.210 | 0.155 | 0.490 | 0.500 | 0.200 | 0.500 | 0.210 |
| | 0.310 | 0.255 | 0.590 | 0.600 | 0.300 | 0.500 | 0.310 |
| | 0.410 | 0.355 | 0.690 | 0.700 | 0.400 | 0.500 | 0.410 |
| F | 0.245 | 0.255 | 0.255 | 0.545 | 0.410 | 0.590 | 0.500 |
| | 0.3445 | 0.355 | 0.360 | 0.665 | 0.510 | 0.690 | 0.500 |
| | 0.450 | 0.455 | 0.455 | 0.770 | 0.610 | 0.790 | 0.500 |

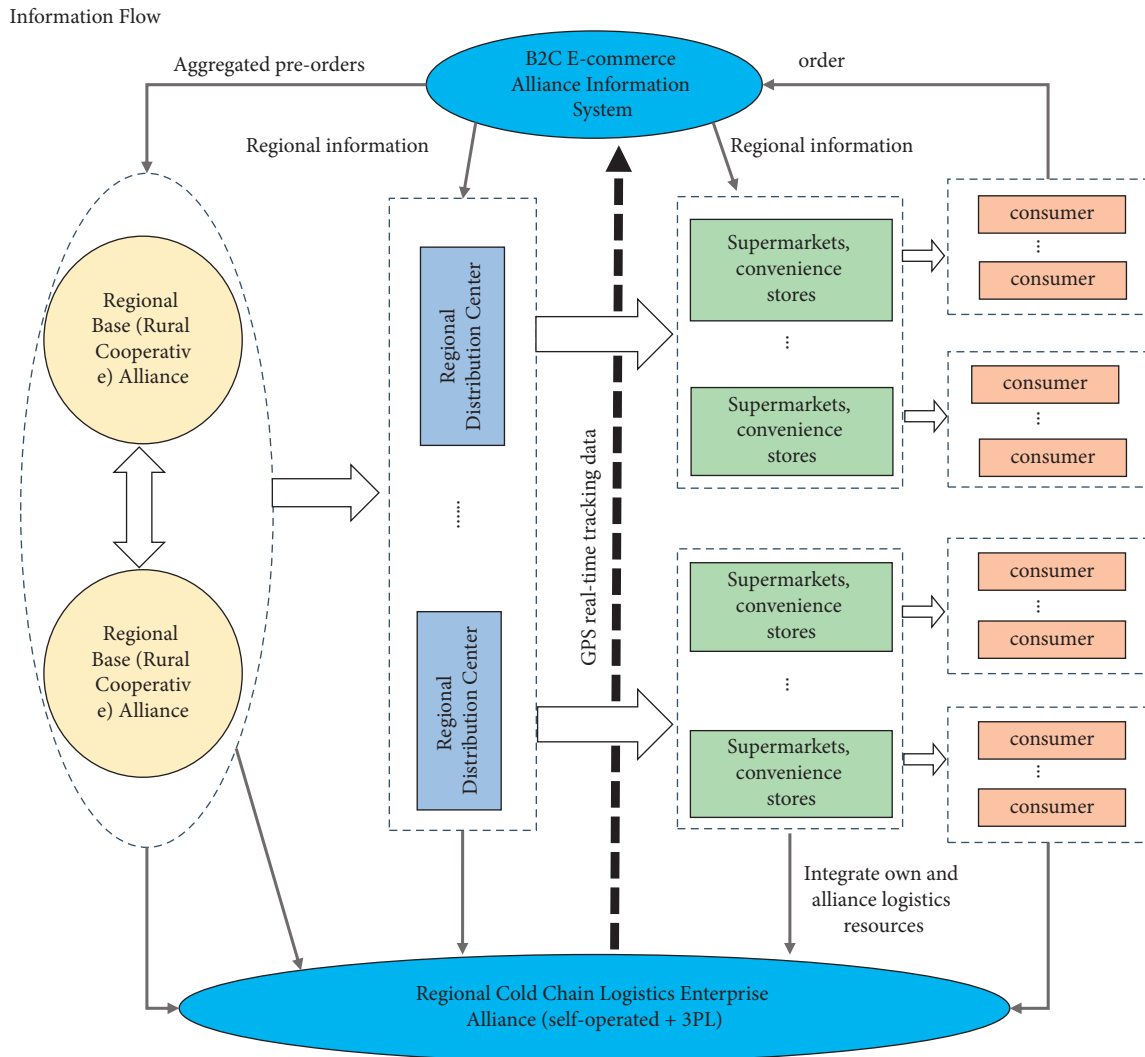


FIGURE 6: Codistribution mode of fresh food e-commerce cold chain based on the alliance.

4.3. *Development Ideas and Countermeasures of Cold Chain Logistics of e-Commerce Fresh Products.* The development potential of my country's e-commerce cold chain logistics is huge. According to the national conditions and the market, targeted countermeasures can effectively solve the restrictive factors restricting the development of my country's e-commerce cold chain logistics. Specifically, we can start from the following aspects: starting from the concept of cold chain logistics of it and combined with the theory of reliability, the risk control idea based on the four basic links of the cold chain of it is proposed.

The first is to strengthen infrastructure construction and improve cold chain facilities and equipment for e-commerce fresh products. The development of it in my country is still in its infancy, and it needs to spend huge material and financial resources for key support.

The second is to accelerate the informatization construction of the cold chain of it. It is an assembly line. To ensure the smooth operation of the assembly line, it is necessary to monitor and feedback on all parts of the assembly line in real-time. Through the information exchange platform to support

and schedule the transportation of cold chain logistics, it can realize the strategic collaborative management of all the resources of the enterprise. The cost of cold chain logistics is reduced, and market competitiveness and the management level of cold chain logistics enterprises are improved.

The third is to strengthen the training of talents in the e-commerce cold chain logistics industry. Talent is the foundation and premise of industry progress and the key to the development of it. The development of my country's e-commerce cold chain logistics industry is very dependent on the cultivation of talents. In the whole process of it, the modules of information collection are cumbersome, and the talents needed are complex and difficult. The requirements are also more comprehensive.

The fourth is to build a common distribution model for fresh food e-commerce. Coconstruction alliances can be fresh food base alliances, agricultural cooperative alliances, or agricultural cooperative alliances in the upstream of the supply chain or regional distribution center alliances with important logistics nodes. Figure 6 briefly describes the alliance-based cold chain codistribution model. The premise of this model is

the joint construction of various alliances and a powerful information processing system. With the development and application of cloud computing, it is believed that a powerful data processing information system will soon be available.

5. Conclusion

Fresh food e-commerce is a new force with bright prospects, and the industry is bound to usher in a period of rapid development. However, there are many disadvantages of my country's cold chain logistics, which can be concentrated in the fact that its risks are extremely high. Risk control and management is not an independent process; it runs through the beginning and end of its system of products and is an important process that can create direct economic benefits. To achieve real high-speed and healthy development, cold chain logistics companies must explore effective risk control strategies. This paper first analyzes my country's fresh food e-commerce and cold chain logistics industry and then analyzes its risk factors from internal and external perspectives. In order to better promote the sales and circulation of fresh products, we need to continue to make effective explorations in cold chain logistics and send more fresh products to customers with faster delivery services.

Data Availability

The labeled dataset used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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