

# Analysis on Influencing Factors of Development of Agricultural Product Cold Chain Logistics in Jilin Province, China

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## 중국 길림성 농산물 콜드체인 물류 발전의 영향요인 분석

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**Abstract** Jilin province has a rich variety of agricultural and sideline products. The circulation of agricultural products needs the support of cold chain logistics. The development of cold chain logistics in Jilin province is lagging behind, which leads to waste of agricultural products and decrease of farmers' income. As a result, this article from the perspective of cold chain logistics development, extracted the influence factors of fresh agricultural products cold chain logistics development in Jilin province, using the analytic hierarchy process (AHP) on the degree of restriction factors, weight analysis found that agricultural products cold chain logistics costs, information technology application and market-based degree of cold chain logistics is the three main factors for the development of Jilin province agricultural cold chain logistics, and puts forward the development plan, in order to guide the development direction of Jilin agricultural cold chain logistics.

**Key Words** : Jilin province, Agricultural products, AHP, Cold chain logistics

**요약** 중국 길림성은 농산물이 풍부하며, 농산물을 이용한 부제품이 많이 생산되고 있다. 농산물의 유통은 원활한 콜드체인 물류의 지원이 필수적이지만 중국 길림성의 콜드체인 물류는 비교적 낙후되어 농산물의 낭비되는 원인이 되고 있으며 농가소득 향상에 도움이 되지 못하고 있다. 본 연구는 중국 길림성의 신선 농산물의 콜드체인 물류 발전에 영향을 미치는 요인을 도출하고, 계층구조분석기법(AHP)을 이용하여 도출된 요인들이 농산물 콜드체인에 미치는 영향에 대하여 분석하였다. 계층구조분석기법(AHP)을 이용하여 제약요인의 가중치를 분석한 결과 농산물 콜드체인 물류 원가, 정보기술응용 및 시장기반 콜드체인 물류가 길림성 농산물 콜드체인 물류 발전에 영향을 미치는 3대 주요 요인으로 나타났다. 본 연구는 중국 길림성 농산물 콜드체인 물류 발전방향을 제시하는데 의의가 있다.

**주제어** : 길림성, 농산물, AHP, 콜드체인물류

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## 1. Introduction

Jilin province is a big agricultural province, cold chain logistics prospects are very broad. The development of cold chain logistics can guarantee the quality of agricultural products to the greatest extent, improve the value of agricultural products in the circulation market, so as to realize the income of farmers. Compared with other provinces, Jilin's development of cold chain logistics lags behind. Most of the agricultural products that need to enter the cold-chain logistics system are still in circulation in the cold-chain logistics system at room temperature, resulting in great losses. According to statistics, about 5 million tons of fresh agricultural products enter the circulation field in jilin province every year, among which about 90% of meat, 95% of fruits and vegetables and 80% of aquatic products do not enter the cold chain logistics system, resulting in huge losses[1]. Therefore, we need to analyze the influencing factors of the development of cold chain logistics in Jilin province, so as to solve the development problems of cold chain with direction and focus and promote the rapid development of fresh agricultural products cold chain.

## 2. Theory background

In consumer dietary structure meat, egg, milk, fish, fruit, vegetables and other fresh agricultural products consumption proportion is increasing, the role of cold chain logistics is also increasingly prominent. The development of cold chain logistics is beneficial to improve the circulation quality of agricultural products, reduce the waste of post-production resources of agricultural products, and promote the income of farmers. Therefore, cold chain logistics receives more and more attention[2]. Jilin province is a big agricultural province, facing great opportunities and challenges

in the future development of cold chain logistics. In the development of cold chain logistics, Jilin province has been exploring and advancing, but in terms of the current development state, there are still many unfavorable factors hindering the development process of cold chain.

## 3. Literature review

In order to enrich the connotation of entrepreneurial In cold chain logistics research abroad, Michael Olin lattice points out that different types of cold chain technology can make the egg quality of agricultural products, in order to analyze the influence of the new technology of production in the process of product improvement, he put the successful application of the cost function in this study, it is concluded that high and new technology can not only have the effect of acceleration running in production, also can effectively save the production cost[3]. Aust et al. pointed out that in the practice of agricultural products logistics, if a reasonable vertical integration system can be established in the logistics system, it can not only reduce the quality loss of circulating materials, but also significantly reduce the cost in the whole chain[4]. Kirezieva, k., Luning, P.A, & JaxsensL compared to developing countries and the European Union countries food supply chain, studies the influence factors of affecting the safety of the raw product quality the results showed that the standardization is the vast majority of countries (including the eu) of common problems in the fresh agricultural products supply chain, and fresh agricultural products production, processing and purchasing, also lack of corresponding product safety training[5]. Singh believes that as a chain in market economy, a supply chain not only has a commodity flow from producer to consumer, but also has an information flow from consumer to

producer, which is a two-way flow of supply and demand[6]. In terms of domestic research on cold chain logistics, Liang Bo believes that fresh agricultural products have the biological characteristics of perishability, which determines that the requirements of cold chain are higher than the general logistics chain and have a very prominent timeliness. However, it also leads to high logistics costs and high business risks[7]. Applying the idea of system engineering, Zhao Xu and Pan Hufei used ISM method to model and analyze the factors restraining the development of rural cold chain logistics. Finally, it is concluded that each influencing factor has different hierarchical status in its inhibition, that is, different levels of inhibition in the problem[8]. Xing-jian Zhou using analytic hierarchy process (AHP) to the development of cold chain logistics of agricultural products at home and abroad are compared, and according to the comparison results put forward the development of Chinese agricultural cold chain logistics several Suggestions, but its strong subjective evaluation process, lack of the concept of quantification, the result has certain one-sidedness[9]. Cao Ying aiming at the particularity of cold chain logistics, analytic hierarchy process (AHP) is used to establish the comprehensive evaluation of cold chain logistics system, and based on the balanced scorecard, to build the management system, advanced technical equipment, logistics efficiency, cost, time, degree of food quality, inventory environment of agricultural products cold chain logistics enterprise performance evaluation index system, finally through example proves the scientific nature and rationality of index system[10]. Balanced scorecard makes up for the defect of single qualitative index of analytic hierarchy process, but it is difficult to implement in practice and cannot provide the method of process improvement for enterprises. In addition, wei yafei combined ahp with fuzzy comprehensive evaluation method to evaluate the performance of Chinese cold chain logistics

enterprises. Although this evaluation method is rigorous and scientific, it lacks quantitative data and is not convincing and cannot provide new solutions for enterprises[11]. In terms of the development and construction of agricultural products logistics cold chain logistics, Zhao Xiurong and Cui Jia made a detailed analysis of the current distribution system of China's cold chain logistics, and proposed to establish a unified logistics distribution platform to give full play to the guiding role of the government[12]. Du Fengrui should transform the existing traditional cold storage equipment and upgrade the traditional cold storage and cold storage equipment into modern cold chain logistics cold storage equipment. The storage of goods and the control of cold storage temperature should be diversified and low temperature[13]. Zhu Jichuang proposed that a unified standard information management system should be established to scan and track the agricultural products plate with the combination of radio frequency technology, bar code technology and satellite positioning technology, and monitor the real-time monitoring and tracking of the whole process of agricultural products from planting, picking, processing, packaging, transportation and distribution to sales and consumption[14,15]. S. H. Kim proposed the designing method and architecture which can be used to implement a smart cold-chain monitoring automation systems[16]. K. S. Ahn proposes a method of activating the cold-storage cluster using the CFPR methodology[17].

#### 4. Empirical Analysis

AHP was used to analyze the influencing factors of the development of agricultural products cold chain logistics in Jilin province, China. Through the analysis of the main problems of the cold chain logistics transportation of agricultural

products in jilin province and the supplement of related experts, the index system of influencing factors of the cold chain logistics transportation of agricultural products was constructed. The index system established three levels, the total index layer for jilin province agricultural cold chain logistics development affecting factors, E index layer include economic factors  $F_1$ , social environment  $F_2$ , government policy  $F_3$  and industry technology  $F_4$  four factors, and index layer under a total of 10 factors, the degree of marketization of economic factors contained in the circulation  $G_{11}$ , cold-chain logistics costs  $G_{12}$  and market development  $G_{13}$  of three indicators, the social environment in which the third party cold chain  $G_{21}$  and cold chain logistics talent  $G_{22}$  two indicators, government policies include industry standards  $G_{31}$  and regional development policies  $G_{32}$ . industry technology includes three indicators, namely, the processing of agricultural products  $G_{41}$ , the degree of refrigeration  $G_{42}$  and the application of information technology  $G_{43}$ .

#### 4.1 Establish hierarchical sub-structure

Based on the analysis of the main problems of the cold chain logistics transportation of agricultural products in Jilin province and the supplement of relevant experts, the index system of influencing factors of the cold chain logistics transportation of agricultural products was constructed (figure 1).

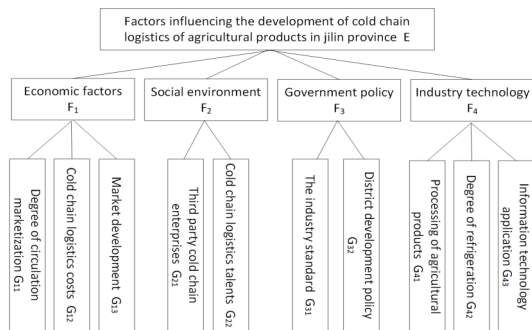


Fig. 1. The hierarchical structure model of influencing factors of cold chain logistics of agricultural products

#### 4.2 Construct the judgment matrix

According to the hierarchical structure model diagram, combine the knowledge learned with the judgment of experts in cold chain logistics industry, compare factors  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$  one by one, and get the judgment matrix A. Judgment matrix  $A_1, A_2, A_3, A_4$  and  $A_5$  between the target layer and the indicator layer.

#### 4.3 Hierarchical single sorting and consistency test

Then use the summation method to find out the corresponding eigenvalues and eigenvectors of each matrix, carry out normalization processing, get the corresponding element vector matrix  $E=(e_1, e_2, \dots, e_n)^T$ . Then carry out consistency test on the obtained vector matrix, as shown in Table 1.

#### 4.4 Total rank and consistency test

By calculating the above data, the comprehensive importance of the listed influencing factors to the target layer can be obtained, as shown in Table 2.

As can be seen from the consistency test results in Table 3,  $CR < 0.1$  in the judgment matrix indicates that ahp consistency test has passed. At the same time, we found that among the constraints on the development of cold chain logistics of fresh agricultural products in jilin province, the constraints on target layer E are different. From the high to the end of a  $G_{12}$  policy support, not enough  $G_{11}$  and related laws and industry standards,  $G_{21}$  low traffic capacity,  $G_{43}$  third party cold chain logistics enterprise development is slow, the low degree of  $G_{31}$  this information transferring,  $G_{42}$  professional cold chain logistics talents, the construction of logistics node  $G_{13}$  sent less,  $G_{32}$  refrigeration freezing technology needs to improve,  $G_{41}$  cold-chain logistics industry organization development lag, low consciousness of  $G_{22}$  cold

**Table 1. Single ranking of influencing factors**

Weight value of criterion layer		Weight value of indicator layer		Consistency test result
G <sub>1</sub>	0.5676	G <sub>11</sub>	0.3333	$\lambda_{max}=2.0000$ C.I.=0 C.R.=0
		G <sub>12</sub>	0.6667	
		G <sub>13</sub>	0.1667	
G <sub>2</sub>	0.2184	G <sub>21</sub>	0.8333	$\lambda_{max}=2.0000$ C.I.=0 C.R.=0
		G <sub>22</sub>	0.1066	
G <sub>3</sub>	0.0710	G <sub>31</sub>	0.6333	$\lambda_{max}=3.0387$ C.I.=0.0194 R.I.=0.5800 C.R.=0.0344
		G <sub>32</sub>	0.2605	
G <sub>4</sub>	0.1430	G <sub>41</sub>	0.0964	$\lambda_{max}=3.0867$ C.I.=0.0433 R.I.=0.5800 C.R.=0.0747
		G <sub>42</sub>	0.2842	
		G <sub>43</sub>	0.6194	

**Table 2. Total hierarchy sort**

F-G	F1	F2	F3	F4	Weight	Sorting
F Weight	0.5676	0.2184	0.0710	0.1430		
G <sub>11</sub>	0.3333	0	0	0	0.1892	2
G <sub>12</sub>	0.6667	0	0	0	0.3784	1
G <sub>13</sub>	0	0.1667	0	0	0.0364	7
G <sub>21</sub>	0	0.8333	0	0	0.1820	3
G <sub>22</sub>	0	0	0.1066	0	0.0075	10
G <sub>31</sub>	0	0	0.6333	0	0.0450	5
G <sub>32</sub>	0	0	0.2605	0	0.1085	8
G <sub>41</sub>	0	0	0	0.964	0.0138	9
G <sub>42</sub>	0	0	0	0.2842	0.0406	6
G <sub>43</sub>	0	0	0	0.6194	0.0885	4
CI=0.0025	RI=0.0044	CR=0.0044				

chain logistics. Among the 10 factors, the weight of G<sub>12</sub> government policy support is 37.84%, with the highest degree of importance. Secondly, the incomplete G<sub>11</sub> laws and industry standards with the weight of 18.92% ranked second. The weight of G<sub>21</sub> transportation capacity level is 18.20%, ranking the third most important position. The weight analysis result of G<sub>43</sub> third-party cold chain logistics enterprise with slow development is 8.85%, ranking in the fourth important position. The weight of the low degree of G<sub>31</sub> information construction is 4.50%, and the restriction degree is the fifth highest for the target level. The other

factors in the weight analysis of fresh and fresh cold chain constraints in jilin province are, in order, fewer G<sub>42</sub> professionals in cold chain logistics, poor construction of G<sub>13</sub> logistics nodes, G<sub>32</sub> refrigeration and refrigeration technology to be improved, backward development of G<sub>41</sub> cold chain logistics industry organization, and low awareness of G<sub>22</sub> cold chain logistics. Their weights are, in order, 4.06%, 3.64%, 1.85%, 1.38% and 0.75%. According to the above comprehensive important degree of comparison, we can draw the following results.

First, the cost of cold chain logistics of agricultural products, the application of information technology and the marketization degree of cold chain logistics are three major factors that affect the development of cold chain logistics of agricultural products in Jilin province.

Second, the government should take the lead in the public development mechanism and cooperate

**Table 3. Summary table of consistency inspection**

Judgment matrix	CR
E-F	0.0362
F1-G1	/
F2-G2	/
F3-G3	0.0334
F4-G4	0.0747

with industry associations and large leading enterprises to form a development situation involving multiple parties. In order to promote the development of agricultural products cold chain logistics in Jilin province.

Third, the government introduced policies and measures to promote development, accelerate the development of third-party cold chain logistics enterprises, and improve the cold chain information management system, in order to train "high, fine and top" talents in the cold chain.

## 5. Conclusions and suggestions

Due to the limitation of internal resources, Jilin province should seek long-term development and overcome the restrictive factors. Therefore, in the development of cold chain logistics of fresh agricultural products in Jilin province, we should pay close attention to the costs of cold chain logistics of agricultural products, the application of information technology and the degree of marketization of cold chain logistics.

First, the construction of cold chain logistics infrastructure should be strengthened, and enterprises should be encouraged to make the best use of resources. At the same time, the existing traditional cold storage equipment should be transformed and upgraded, and the storage should be developed into shelf type, pallet type and compartment type. Secondly, special funds should be increased to strengthen the financial sector's investment support for the development of cold chain logistics of agricultural products through multiple guidance. Third, the government introduced preferential policies to guide and support major development projects, build a social environment to promote the development of the cold chain of agricultural products, and reduce the logistics cost of the cold chain. Fourthly, we should actively cultivate third-party cold chain logistics enterprises and

support farmers or agricultural products processing enterprises to cooperate with third-party cold chain enterprises for common development. Finally, an electronic information system with functions of market monitoring, forecasting, supply and demand docking, circulation monitoring and other functions should be established, and information such as quantity of supply and demand of agricultural products, storage of relevant characteristics and prediction of sales market should be timely and accurately released through this board, so as to carry out supply and demand docking and develop to order type production.

In the previous study of the efficiency of cold chain logistics, the concept of subjectivity is stronger, lack of quantification evaluation process, the result has certain one-sidedness, the proposed suggested that there are difficulties in the implementation, this study constructed the performance evaluation index system, adopted the quantitative data analysis, more scientific and rigor, also for China's cold chain logistics enterprise's efficiency to provide a new train of thought.

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