Analysis on the Influencing Factors of Cold Chain Logistics Development of Fresh Agricultural Products in Sichuan Province

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Abstract: In recent years, with the development of social economy, cold chain logistics has developed rapidly in China. Fresh agricultural products are one of the main objects of cold chain logistics. Cold chain logistics is closely related to the production, processing, transportation and sales of fresh agricultural products. Sichuan Province has a good agricultural industry base and is the third largest grain producing province in China. However, the level of cold chain logistics of fresh agricultural products in the province is not high and needs to be further improved. In order to make the development of cold chain logistics of fresh agricultural products in Sichuan Province more perfect, a set of cold chain logistics evaluation index system was established, and the relevant data of Sichuan Province from 2015 to 2020 were used to study the influencing factors of its development by using the grey correlation model.

1. Introduction

Fresh agricultural products refer to fresh and viable agricultural products. It refers to the whole process of picking, sorting, packaging, freezing or refrigerated transportation, wholesale and retailing near the origin, which is always in a low temperature state. In today's era, the production and consumption level of fresh agricultural products is getting higher and higher, which puts forward higher requirements for cold chain logistics of fresh agricultural products. Sichuan Province has superior agricultural environment, rich agricultural resources, complete agricultural industrial structure and developed agricultural product processing system. At present, Sichuan Province has formed a new type of agricultural product processing belt and characteristic agricultural industrial belt with Chengdu as the center. As an important symbol of the development and application of modern logistics technology, cold chain logistics technology has become the core means to improve the efficiency of social resource allocation, and has a huge impact on modern logistics industry and agricultural production. With the continuous development of cold chain technology and equipment, especially in the context of the information age, new technologies such as e-commerce and the Internet have developed more rapidly. However, due to the large population density, insufficient rural labor force, underdeveloped economy and backward infrastructure in Sichuan Province, the construction of cold chain logistics infrastructure for agricultural products is relatively weak[1-5]. From the current research situation, although many scholars have paid some attention to the development of cold chain logistics industry of fresh agricultural products in Sichuan Province, there are still many problems and deficiencies. Therefore, by constructing a grey correlation model, this paper analyzes the influencing factors of cold chain logistics of fresh agricultural products in Sichuan Province, understands some problems and problems to be solved in the cold chain logistics of fresh agricultural products in Sichuan Province, and puts forward targeted solutions[6].

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2. Sichuan Fresh Agricultural Products Cold Chain Logistics Development Indicators

2.1 Index Selection

In order to reflect the influencing factors of the development of cold chain logistics of fresh agricultural products in Sichuan Province, this paper finds that there are many factors affecting the cold chain logistics of fresh agricultural products through field investigation and literature review. This paper will analyze the influence of the following factors on the cold chain logistics of fresh agricultural products by grey correlation analysis. The reference sequence of the basic characteristics of the cold chain logistics of agricultural products is the development of agricultural products logistics, and the total amount of agricultural products logistics is used as the reference sequence[7].

Taking the development level of cold chain logistics of fresh agricultural products in Sichuan Province as the first-level index, the second-level index is studied from four aspects: regional GDP, agricultural product development, infrastructure and residents' living standards. The third-level indicators are further subdivided, and the evaluation index system of cold

chain logistics development level of fresh agricultural products in Sichuan Province is constructed accordingly,as shown in table 1-2:.

Table 1 Evaluation index system of fresh and agricultural products cold chain logistics development level

FIRST-ORDER	Second order	Third-order	sequence
The development level of cold chain logistics of fresh agricultural products in Sichuan Province	Total output value	The output value of agriculture, forestry, animal husbandry and fishery (billion yuan)	X_0
		Regional GDP (billions）	X_1
		Gross agricultural production (billion yuan)	X_2
		The output of major agricultural products (ten thousand tons)	X_3
		The output of main fresh agricultural products (ten thousand tons)	X_4
	Level of living	Total urban and rural population at the end of the year (10,000)	X_5
		Per capita disposable income of urban residents (yuan)	X_6
	Infrastructure	Highway route mileage (km)	X_7
		Road freight transport (ten thousand tons)	X_8

Table 2 Statistics of influencing factors of cold chain logistics of fresh agricultural products in Sichuan

Particular year	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
2015	6377.84	30342.01	3315.51	13834.40	47491.92	8196.0	17221	315000	138622
2016	6816.92	33138.48	3701.64	15519.69	52359.81	8251.0	18808	324000	146046
2017	6955.55	37905.14	4004.20	17404.45	59313.79	8289.0	20580	330000	158190
2018	7195.65	42902.10	4153.71	19340.75	66396.56	8321.0	22461	332000	173324
2019	7889.35	46363.75	4395.04	21342.98	72101.77	8351.0	24703	337000	162668
2020	9216.40	48598.76	4701.88	20824.87	74125.51	8371.0	26522	394000	157598

3. Grey Correlation Analysis of Influencing Factors of Cold Chain logistics of Fresh Agricultural Products in Sichuan Province

3.1 Grey Relational Degree Model

Grey correlation analysis refers to the quantitative description and comparison of the development trend of a system. The basic idea is to determine whether the relevant factors are closely related by determining the geometric similarity between the reference data column and several comparison data columns. Usually, this method can be used to analyze the influence degree of each factor on the result, and this method can also be used to solve the problem of comprehensive evaluation changing with time. The core is to establish the parent sequence changing with time according to certain rules, and the change of each evaluation object with time is taken as the subsequence, and the correlation degree between each subsequence and the parent sequence is obtained. Therefore, this paper evaluates the influencing factors of the development of cold chain logistics of fresh agricultural products in Sichuan Province by constructing a grey correlation model.

The specific steps of grey correlation analysis include :

(1).Determine data series, including reference series, reference series, and comparison series

①Reference sequence (parent sequence)：y(k)={y (1),y(2),…y(m)} ，

②Comparison sequence (subsequence)：$x_i(k)=\{x_i(1),x_i(2),\ldots, x_i(m)\}$，k=1，2，…，m；i=1，2，…，n.

(2).Dimensionless processing of data

Due to the different dimensions of the original data, it needs to be processed before analysis to eliminate the differences between different data. Three methods of initialization, averaging and standardized conversion can be used for dimensionless processing. This paper intends to refer to the mean conversion method for data dimensionless processingas,shown in table 3:

$$\xi_i(k)=\frac{\min\limits_i\min\limits_k\left|y(k)-x_i(k)\right|+\rho\max\limits_i\max\limits_k\left|y(k)-x_i(k)\right|}{\left|y(k)-x_i(k)\right|+\rho\max\limits_i\max\limits_k\left|y(k)-x_i(k)\right|}$$

Table 3 Results of dimensionless processing

Particular year	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
2015	0.86	0.76	0.82	0.77	0.77	0.99	0.80	0.93	0.89
2016	0.92	0.83	0.92	0.86	0.84	1.00	0.87	0.96	0.94
2017	0.94	0.95	0.99	0.96	0.96	0.99	0.95	0.97	1.01

2018	0.97	1.08	1.03	1.07	1.07	1.00	1.03	0.98	1.11
2019	1.06	1.16	1.09	1.18	1.16	1.00	1.14	0.99	1.04
2020	1.24	1.22	1.16	1.15	1.20	1.00	1.22	1.16	1.01

(3).Where ρ is the resolution coefficient, and its value range is between [0,1]. The larger the general resolution coefficient, the greater the resolution ; conversely, the smaller the resolution. In this paper, ρ = 0.5.

According to the grey correlation degree formula, the grey correlation degree coefficient is obtained, such as table 4:

Table 4 Grey correlation coefficient of influencing factors of fresh agricultural products in Sichuan

Particular year	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
2015	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2016	0.90	0.82	.0.80	0.86	0.77	0.90	0.84	0.93
2017	0.57	0.64	0.56	0.57	0.73	0.67	0.83	0.81
2018	0.43	0.63	0.44	0.44	0.65	0.55	0.74	0.63
2019	0.42	0.71	0.41	0.43	0.49	0.52	0.56	0.77
2020	0.57	0.89	0.78	0.65	0.33	0.69	0.52	0.41

as per $r_i = \frac{1}{n}\sum_{k=1}^{n}\xi_i(k), = 1,2,\cdots, n$ Calculate the grey correlation degree, as shown in table 5:

Table 5 Grey correlation degree of influencing factors of fresh agricultural products in Sichuan

Index	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
r_i	0.65	0.78	0.66	0.66	0.66	0.72	0.75	0.76

That is, the correlation between each influencing factor and the cold chain logistics of agricultural products is 0.65, 0.78, 0.66, 0.66, 0.66, 0.66, 0.72, 0.75 and 0.76, respectively. Without considering other factors, with the increase of grey correlation coefficient, this influence factor is consistent with the development trend of agricultural products cold chain logistics, and has a greater impact on it.

4.Countermeasure

According to the above analysis, the eight factors listed in this paper have a certain degree of influence on the cold chain logistics of agricultural products in Sichuan, among which the total agricultural production has the greatest influence, indicating that the development of agricultural production directly affects the development of cold chain logistics of agricultural products. The influence of regional GDP on the cold chain logistics of agricultural products is relatively small[8]. Logistics infrastructure and agricultural production are also important factors affecting logistics development. We should lay a solid foundation for infrastructure construction, connect infrastructure, and then penetrate digital technology into all aspects, put talents into the vast world of rural revitalization, and reasonably guide funds to invest in agricultural product processing. Strengthen the basic work of agricultural products preservation, refrigeration, refrigeration and other aspects. Of course, policy orientation, information technology development, professional personnel training, and core competitiveness are important reasons that affect the development of cold chain logistics of agricultural products. Strengthen policy guidance to ensure the healthy and rapid development of cold chain logistics industry ; vigorously develop rural e-commerce, promote the upward movement of agricultural products, and drive logistics with business flow ,so as to ensure the development of cold chain logistics more perfect[9-10].

5.Conclusion

This paper uses the grey correlation analysis method to analyze the correlation degree of each key factor affecting the cold chain logistics, so as to evaluate the current cold chain development status of fresh agricultural products in Sichuan Province, and put forward corresponding countermeasures. In order to improve the development of cold chain logistics of fresh agricultural products, we must start with the degree of correlation between the various indicators that affect the development of fresh agricultural products, promote production and consumption, and also have the support of the government and enterprises.

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