Scientific Research Publishing

Open Journal of Social Sciences, 2017, 5, 63-73
http://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Forecast and Opportunity Analysis of Cold Chain Logistics Demand of Fresh Agricultural Products under the Integration of Beijing, Tianjin and Hebei

Tongjuan Liu, Songmiao Li, Shaobo Wei

Information Institute, Beijing Wuzi University, Beijing, China
Email: ltj7905@163.com

How to cite this paper: Liu, T.J., Li, S.M. and Wei, S.B. (2017) Forecast and Opportunity Analysis of Cold Chain Logistics Demand of Fresh Agricultural Products under the Integration of Beijing, Tianjin and Hebei. *Open Journal of Social Sciences*, **5**, 63-73.
https://doi.org/10.4236/jss.2017.510006

Received: June 5, 2017
Accepted: October 10, 2017
Published: October 13, 2017

Abstract

This paper is based on the national strategy of Beijing-Tianjin-Hebei integration. At first, we make strategy analysis on the development of cold chain logistics of fresh agricultural products, using the PEST analysis model to analyze the macro environment and SWOT analysis model to distinguish strengths, weaknesses, opportunities and threats it faced now meticulously, then we discuss the development strategy combination under the integration of the Beijing-Tianjin-Hebei region. Secondly, we analyze the cold chain logistics demand of fresh agricultural products in view of the integration of the Beijing-Tianjin-Hebei region under the fresh agricultural products categories. The exponential smoothing is used to forecast first, then the secondary exponential smoothing model is set up to make the fitting figure with the actual and predicted value. In addition, we forecast the output in the next few years and analyze the results. Finally, combining with the development strategy combination and prediction analysis, we put forward the development pattern and give a prospect of fresh agricultural products cold chain logistics.

Keywords

Beijing-Tianjin-Hebei Integration, Strategic Combination, Demand Forecasting, Exponential Smoothing, Circulation System

1. Introduction

The Beijing-Tianjin-Hebei integration not only brings to the three regions economic benefits, but also stimulates the development of the industry capacity, in

which the demand for fresh agricultural products rising, which makes cold chain logistics get a huge opportunity for development. So making an opportunity analysis and demand forecasting for fresh agricultural products cold chain logistics can promote the coordinated development of the Beijing-Tianjin-Hebei in cold chain logistics.

2. Analysis on the Development Strategy of Cold Chain Logistics of Fresh Agricultural Products under the Integration of Beijing-Tianjin-Hebei

2.1. PEST Analysis on the Development of Cold Chain Logistics of Fresh Agricultural Products in the Beijing-Tianjin-Hebei Region

1) Policy analysis

In 2016, the Ministry of Agriculture and other departments jointly issued the "Beijing-Tianjin-Hebei agricultural products circulation system innovation action plan". The 13th five-year plan points out that "we need to vigorously develop cold chain logistics". The strategy of the Beijing-Tianjin-Hebei cooperation, is a long-term plan that needs to be completed in three areas [1].

2) Economic analysis

On the macro level, the economic development level in the Beijing-Tianjin-Hebei region is relatively high, the GDP reached 6935.889 billion yuan in 2015, accounting for 10.16 percent of the country's GDP. The following is a comparison in 2015 (see **Table 1**).

Micro-point of view, the sufficient production of six kinds of fresh agricultural products in the three regions together creates a prerequisite for the development of cold chain logistics (see **Table 2**). To analyze and forecast the cold chain logistics demand of fresh agricultural products can achieve a reasonable allocation of resources [2].

3) Social analysis

With the consumption of fresh agricultural products gradually increase, the relevant storage and end sales of cold chain logistics demand is also increasing as people pay more attention to food quality and safety [3]. The emergence of fresh

Table 1. A comparison of the total economic aggregate of the Beijing-Tianjin-Hebei region in 2015.

Region	GDP	Per capita GDP	The added value of primary industry	The added value of secondary industry	The added value of tertiary industry	The proportion of added value of each industry (%)		
Beijing	23,014.59	106,497.0	140.21	4542.64	18,331.74	0.61	19.74	79.65
Tianjin	16,538.19	107,960.0	208.82	7704.22	8625.15	1.26	46.58	52.15
Hebei	29,806.11	40,255.0	3439.45	14,386.87	11,979.79	11.54	48.27	40.19
total	69,358.89	254,712.0	3788.48	26,633.73	38,936.68	5.46	38.40	56.14

[a]Source: Yearbook 2015, for the Beijing-Tianjin-Hebe Region.

Table 2. The output of major agricultural products in the Beijing-Tianjin-Hebei region in 2016.

Region	Vegetables	Fruit	Meat	Milk	Eggs	Aquatic products
Beijing	183.60	69.61	37.04	45.70	18.30	7.13
Tianjin	453.36	59.20	45.45	68.02	20.63	40.18
Hebei	8193.37	1524.59	457.67	388.54	448.04	132.17
Total	8830.33	1653.40	540.16	502.26	486.97	179.48

e-commerce has also accelerated the demand for cold chain logistics. According to the statistics, China has over 90 billion yuan of fresh e-commerce transactions in 2016.

4) Technical analysis

Statistics show that, there are about 900 professional refrigerated vehicles in Hebei province, about 2800 temperature control processing and sorting facilities. In addition, Tianjin is to speed up the modernization construction of cold storage, more than 40 existing refrigerator.

2.2. SWOT Analysis on the Development of Cold Chain Logistics of Fresh Agricultural Products in the Beijing-Tianjin-Hebei Region

1) Strength analysis

a) Market potential is huge

The consumption of agricultural products is increasing in three areas. As shown in **Figure 1**, the demand for these six types of fresh agricultural products has also increased steadily for nearly six years; we can make a conclusion that this high demand for fresh agricultural products may lead to a high claim for cold chain logistics.

b) Three District traffic integration

The Integration of the Beijing-Tianjin-Hebei region starts with the implementation of the construction of the traffic integration. The three-dimensional convenient transportation system makes the logistics industry more prosperous.

2) Weakness analysis

a) Low degree of informatization

It is found that there is lack of unified cold chain logistics information sharing platform to manage the huge information. The informatization level was 90%, only play a role in controlling the temperature and preservation in the process of cold chain transportation.

b) Cold chain logistics facilities lag behind

At present, China's cold chain logistics transport infrastructure is relatively old, logistic facilities in the coastal cities are more complete than in the inland city. There are only 6970 railway refrigerated trucks accounting for two percent of the total running vehicles.

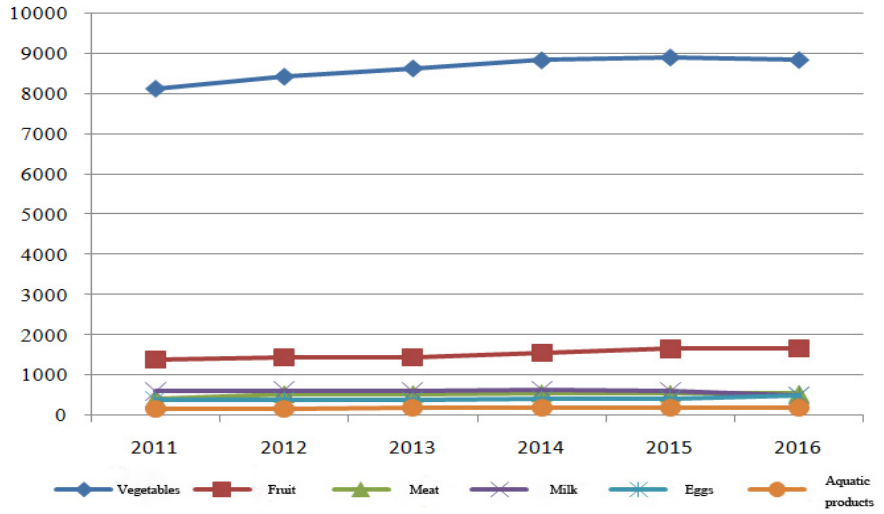

Figure 1. The output of agricultural products in the Beijing-Tianjin-Hebei region in recent six years.

3) Opportunity analysis

a) Government support

The Ministry of Transport said that eight major projects in the Beijing-Tianjin-Hebei region will be promoted in 2016, including promote the construction of highway projects and form the modern port cluster.

b) The demand for cold chain logistics is increasing

According to the data, China has been reaching more than 100 million tons of cold chain demand scale in 2015 and maintaining the growth rate of about 15% of the cold chain logistics market. The total population of the Beijing-Tianjin-Hebei region has exceeded 100 million. It is conceivable that the demand for cold chain logistics will rise.

4) Threat analysis

a) Lack of international competitiveness

In recent years, many international famous logistics enterprises enter the Chinese market. It is a growing threat because China is lack of international competitiveness.

b) Cold chain logistics input cost is high, the risk is big

Cold chain logistics market has a higher threshold and a higher cost of investment compared to other logistics market. In order to keep the freshness of fresh agricultural products, the operation emphasizes that each process is interlocking and the risk is high.

2.3. The Strategic Combination of Cold Chain Logistics Development of Fresh Agricultural Products in the Beijing-Tianjin-Hebei Region

1) Increase the construction of infrastructure

In the face of the competition in the cold chain logistics market, the government should increase investment in cold chain logistics infrastructure equip-

ment, improving or introducing equipment, coupled with reasonable use and management.

2) Establish a perfect cold chain logistics system

The Beijing-Tianjin-Hebei region should strengthen the cold chain logistics information communication and sharing, and jointly establish a perfect cold chain logistics system, which can achieve the entire cold chain logistics monitoring and management.

3) Vigorously develop the third party cold chain logistics

Improving the third party logistics enterprise's development will greatly improve the efficiency of cold chain logistics in our country. At the same time, outsourcing of logistics activities is beneficial to the enterprises to focus on the core business.

3. Analysis on the Demand of Cold Chain Logistics of Fresh Agricultural Products under the Integration of Beijing, Tianjin and Hebei

According to the data, the output of these six kinds of agricultural products in Beijing (see **Table 3**), Tianjin (see **Table 4**), Hebei Province (see **Table 5**) in 2011-2016 are as follows respectively.

Table 3. The output of Agricultural Products in Beijing from 2011 to 2016.

Years	Vegetables	Fruit	Meat	Milk	Eggs	Aquatic products
2011	296.90	87.80	44.40	64.00	15.10	6.10
2012	279.90	84.30	43.20	65.10	15.20	6.40
2013	266.90	79.50	41.80	61.50	17.50	6.40
2014	236.20	74.50	39.30	59.50	19.70	6.80
2015	205.10	71.40	36.40	57.20	19.60	8.20
2016	183.60	69.61	37.04	45.70	18.30	7.13

Table 4. The output of agricultural products in Tianjin from 2011 to 2016.

Years	Vegetables	Fruit	Meat	Milk	Eggs	Aquatic products
2011	444.23	61.58	42.98	69.09	18.65	35.21
2012	445.41	59.91	45.80	67.87	18.66	35.94
2013	455.06	54.17	46.48	68.24	18.89	39.86
2014	460.20	62.70	46.40	68.90	19.80	40.80
2015	441.54	62.69	45.75	68.00	20.20	40.10
2016	453.36	59.20	45.45	68.02	20.63	40.18

Table 5. The output of agricultural products in Hebei from 2011 to 2016.

Years	Vegetables	Fruit	Meat	Milk	Eggs	Aquatic products
2011	7384.30	1238.69	329.50	458.90	339.80	106.71
2012	7695.10	1286.00	442.90	479.00	342.60	116.30
2013	7902.10	1303.10	448.80	465.70	346.10	123.10
2014	8125.70	1420.60	468.10	496.10	362.70	126.40
2015	8243.70	1508.60	462.50	480.90	373.60	129.30
2016	8193.37	1524.59	457.67	388.54	448.04	132.17

3.1. Prediction Method of Cold Chain Logistics Demand for Fresh Agricultural Products [4]

This paper takes the exponential smoothing method proposed by Robert G. Brown, which builds a secondary exponential smoothing model based on an exponential smoothing, making the data more reliable.

The exponential smoothing formula is

$$S_t^{(1)} = \alpha Y_t + (1-\alpha) S_{t-1}^{(1)}$$

Y_t: The actual value of t period

$S_t^{(1)}$: the predicted value of t period

$S_{t-1}^{(1)}$: the predicted value of the t - 1 period

α: the smoothing exponent

The secondary exponential smoothing formula is

$$S_t^{(2)} = \alpha S_t + (1-\alpha) S_{t-1}^{(2)}$$

$S_t^{(2)}$: the second exponential smoothing value of t period

$S_{t-1}^{(2)}$: the second exponential smoothing value of t - 1 period

The quadratic exponential smoothing model is

$$Y_{(t+T)} = A_t + B_t * T$$

$$A_t = 2S_t^{(1)} - S_t^{(2)}$$

$$B_t = \left[\alpha/(1-\alpha)\right] * \left[S_t^{(1)} - S_t^{(2)}\right]$$

3.2. Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Single Smoothing Method

We use the exponential smoothing method to forecast the yield of all kinds of fresh agricultural products in the three places, the most critical step is to determine the value of the smoothing coefficient α, the values of α are 0.1, 0.3, 0.5 and 0.9 respectively, and the predicted values of the demand for the fresh agricultural products with the four smoothing coefficients are calculated. And then compare the error size between predicted value and actual value, and select the smoothing factor in the case of minimum error, and use it for the secondary exponential smoothing.

1) Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Single Exponential Smoothing Method in Beijing.

The following is the cold chain demand based on the data of the poultry egg production during 2011-2010 in Beijing (see **Table 6**).

Similarly, using the method mentioned above ,we can identify that the smoothing coefficients of vegetables, fruits, meat, milk, eggs and aquatic products in Beijing were as follows: Vegetables: $\alpha = 0.9$; Fruit: $\alpha = 0.9$; Meat: $\alpha = 0.9$; milk: $\alpha = 0.5$; eggs: $\alpha = 0.9$; aquatic products: $\alpha = 0.9$.

2) Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Single Smoothing Method in Tianjin and Hebei.

In the same way, using the method mentioned above, we can also get the smoothing coefficients in Tianjin respectively: Vegetables: $\alpha = 0.1$; Fruit: $\alpha = 0.1$; Meat: $\alpha = 0.3$; milk: $\alpha = 0.1$; eggs: $\alpha = 0.9$; aquatic products: $\alpha = 0.9$. What is more, Just like the two regions, the smoothing coefficients in Hebei were as follows: Vegetable: $\alpha = 0.9$; Fruit: $\alpha = 0.9$; Meat: $\alpha = 0.9$: milk: $\alpha = 0.1$; eggs: $\alpha = 0.9$; aquatic products: $\alpha = 0.9$.

3.3. Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Secondary Exponential Smoothing Method

According to the exponential smoothing method, the corresponding smoothing coefficient α of each kind of fresh agricultural products is selected for the second smoothing prediction. Based on the results of the secondary exponential smoothing and the actual value, the fitting situation is observed and the proposed model is used to forecast the sales of various agricultural products from 2017 to 2021.

1) Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Secondary Exponential Smoothing Method in Beijing.

Based on the secondary exponential smoothing method, the forecast sales of poultry eggs and the demand volume of cold chain logistics in Beijing in the past

Table 6. The forecast demand and error of Beijing egg cold chain logistics by the single smoothing method.

Years	Actual output	Predicted value				Absolute error			
		$\alpha = 0.1$	$\alpha = 0.3$	$\alpha = 0.5$	$\alpha = 0.9$	$\alpha = 0.1$	$\alpha = 0.3$	$\alpha = 0.5$	$\alpha = 0.9$
2011	15.10	15.93	15.93	15.93	15.93	0.83	0.83	0.83	0.83
2012	15.20	15.85	15.68	15.52	15.18	0.65	0.48	0.32	0.02
2013	17.50	15.79	15.54	15.36	15.20	1.72	1.96	2.14	2.30
2014	19.70	15.96	16.13	16.43	17.27	3.74	3.57	3.27	2.43
2015	19.60	16.33	17.20	18.06	19.46	3.27	2.40	1.54	0.14
2016	18.30	16.66	17.92	18.83	19.59	1.64	0.38	0.53	1.29
total						11.85	9.63	8.63	7.01
average						1.98	1.61	1.44	1.17

6 years (see **Table 7**). According to the actual value of Beijing egg sales and the forecast value of cold chain logistics demand in the past 6 years, as shown in **Figure 2**.

From **Figure 2**, we can observe that the fitting relationship is very good between the predicted value and the actual value. Therefore, we can use this method to predict the poultry eggs sales and cold chain logistics demand in the next five years in Beijing (see **Table 8**).

Similarly, we can predict the six categories of products' demand in the next five years in Beijing by using the smoothing coefficients they have. As shown in **Table 9** below.

2) Prediction of Cold Chain Logistics Demand for Fresh Agricultural Products under the Secondary Exponential Smoothing Method in Tianjin and Hebei.

Respectively, using the same method, we can get the forecast sales and the demand in the next five years in Tianjin (see **Table 10**) and Hebei (see **Table 11**).

Table 7. Beijing egg sales and cold chain logistics demand in recent six years.

Years	Actual value	Predicted value
2011	15.10	15.93
2012	15.20	15.26
2013	17.50	15.20
2014	19.70	17.06
2015	19.60	19.22
2016	18.30	19.55

Table 8. Forecast of sales and cold chain logistics demand for eggs in Beijing in the next five years.

Years	Predicted value
2017	19.954
2018	20.285
2019	20.616
2020	20.948
2021	21.279

Table 9. Forecast of sales and cold chain logistics demand for six kinds of agricultural products in Beijing in the next five years.

Years	Vegetables $\alpha = 0.9$	Fruit $\alpha = 0.9$	Meat $\alpha = 0.9$	Milk $\alpha = 0.5$	Eggs $\alpha = 0.9$	Aquatic products $\alpha = 0.9$
2017	174.610	64.707	34.758	56.065	19.954	7.458
2018	144.081	59.807	32.482	54.489	20.285	7.788
2019	113.552	54.907	30.205	52.913	20.616	8.119
2020	83.023	50.007	27.928	51.337	20.948	8.450
2021	52.494	45.107	25.651	49.761	21.279	8.780

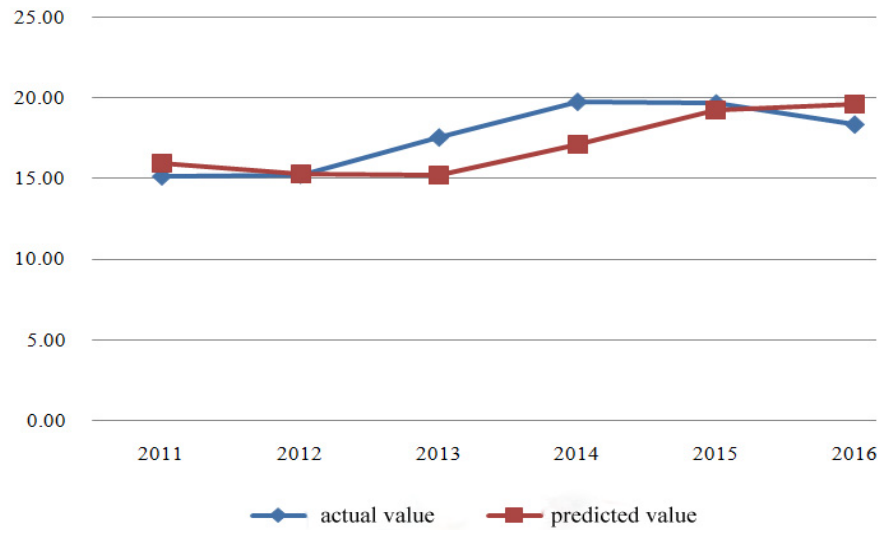

Figure 2. Fitting diagram of sales and predicted value of eggs in secondary exponential smoothing method ($\alpha = 0.9$).

Table 10. Forecast of sales and cold chain logistics demand for six kinds of agricultural products in Tianjin in the next five years.

Years	Vegetables $\alpha = 0.1$	Fruit $\alpha = 0.1$	Meat $\alpha = 0.3$	Milk $\alpha = 0.1$	Eggs $\alpha = 0.9$	Aquatic products $\alpha = 0.9$
2017	449.163	59.233	46.160	68.388	20.681	39.803
2018	449.206	59.263	46.302	68.387	21.158	39.486
2019	449.250	59.293	46.444	68.386	21.635	39.168
2020	449.294	59.323	46.586	68.385	22.112	38.850
2021	449.337	59.353	46.727	68.384	22.589	38.532

Table 11. Forecast of sales and cold chain logistics demand for six kinds of agricultural products in Hebei in the next five years.

Years	Vegetables $\alpha = 0.9$	Fruit $\alpha = 0.9$	Meat $\alpha = 0.9$	Milk $\alpha = 0.1$	Eggs $\alpha = 0.9$	Aquatic products $\alpha = 0.9$
2017	8382.460	1599.569	461.817	475.396	385.241	132.388
2018	8520.189	1690.438	460.887	475.760	396.853	135.464
2019	8657.917	1781.306	459.957	476.124	408.464	138.540
2020	8795.646	1872.175	459.027	476.488	420.075	141.617
2021	8933.374	1963.044	458.097	476.851	431.686	144.693

3.4. Predictive Results Analysis

Summarize the forecast analysis above, the forecast sales of various agricultural products in the Beijing-Tianjin-Hebei region in the period of 2017-2021 areas

shown in **Table 12**. Coupled with the yield of various agricultural products in the Beijing-Tianjin-Hebei region during 2011-2016, this paper analyzes the trend of agricultural products sales in the Beijing-Tianjin-Hebei region in the recent 10 years, as shown in **Figure 3**.

As we can see from the **Figure 3**, the overall demand of fresh agricultural products show a steady upward trend in the Beijing-Tianjin-Hebei region. This requires flexibility and timeliness in cold chain logistics and it is necessary to make the cold chain logistics bigger and stronger during the period of integration.

4. Conclusion

In the 21st century, Beijing, Tianjin and Hebei are actively responding to the ever-changing industry environment and adapting to the environment to make targeted measures to the cold chain logistics system. Through the PEST and SWOT analysis, we put forward the development strategic combination of cold chain logistics. Through fresh agricultural products demand forecasting analysis

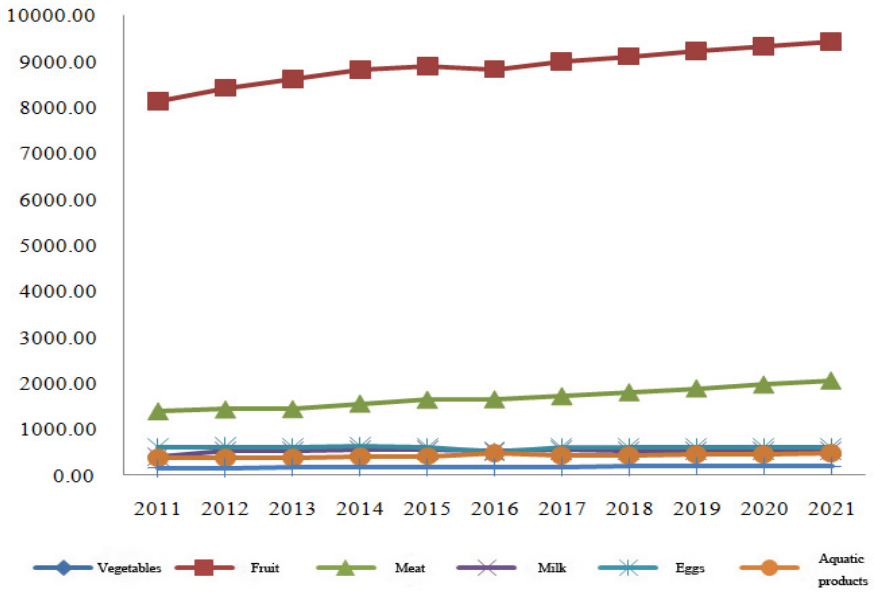

Figure 3. Sales trend of agricultural products in the Beijing-Tianjin-Hebei region.

Table 12. Forecast of sales and cold chain logistics demand of six kinds of agricultural products in the Beijing-Tianjin-Hebei region in the next five years.

Years	Vegetables	Fruit	Meat	Milk	Eggs	Aquatic products
2017	9006.233	1723.509	542.736	599.849	425.876	179.649
2018	9113.476	1809.507	539.671	598.636	438.295	182.738
2019	9220.719	1895.506	536.606	597.423	450.715	185.827
2020	9327.963	1981.505	533.541	596.209	463.134	188.916
2021	9435.206	2067.503	530.475	594.996	475.553	192.006

in the next five years in the Beijing-Tianjin-Hebei region, we know that the sales rose slightly, and we also affirm that the necessity to develop the cold chain logistics under the integration situation.

The economic positioning of the three districts is different and the industrial layout and urban planning in the three regions are inconsistent. This inconsistency can also lead to inconsistencies in the flow and direction of the cold chain logistics. The best solution is to form a circulating system of the Beijing-Tianjin-Hebei region. Moreover, the integration will make good use of the comparative advantages of the regions to form a fixed time fresh agricultural products logistics circle around Beijing, Tianjin and Hebei, so as to construct an efficient food cold chain distribution system, which is beneficial to drive the sale of fresh agricultural products. At the same time, it can provide reference for the government to plan the logistics parks and investors to invest in the cold chain industry of local fresh agricultural products. Therefore, it is promising to develop cold chain logistics of fresh agricultural products under the integration of Beijing, Tianjin and Hebei.

Acknowledgements

This work was supported by funding project for Youth Talent Cultivation Plan of Beijing City University Under the grant number (CIT & TCD201504051), Beijing Key Laboratory (NO:BZ0211) and Beijing Intelligent Logistics System Collaborative Innovation Center.

References

[1] Zhao, Y.J., Wang, S.J., Su, Y.N. and Dai, Y.Y. (2015) SWOT Analysis of "Agricultural Super-Docking" in Hebei Province under the Coordinated Development of Beijing-Tianjin-Hebei. *Logistics Technology*, **4**, 32-33.

[2] Zhao, R. (2016) A SWOT Analysis and Countermeasures for the Coordinated Development of Regional Economic and Regional Logistics in Beijing-Tianjin-Hebei Region. *Logistics Technology*, **35**, 41-43.

[3] Wang, X.H., Zong, Y.S. Wang, G.B. and Ding, L.F. (2013) Agricultural Cold Chain Logistics Demand Impetus and Development Strategies in Shanxi Province. *Journal of Shanxi Agricultural Science*, **9**, 1400-1404.

[4] Jiang, L.L. (2013) Study on Cold Chain Logistics Model of Agricultural Products in Hebei Province Based on Demand Analysis. Thesis, Hebei Normal University, Hebei.