CARBON EMISSION EFFICIENCY EVALUATION OF BEIJING-TIANJIN-HEBEI LOGISTICS INDUSTRY BASED ON SBM MODEL

by

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The establishment of a sound low-carbon logistics system is the basic solution to China's resource, environmental and ecological problems. From the perspective of resources, environment and ecology, building a low-carbon logistics system is the basic solution to the problems of resources, environment and ecology that China is facing. The project takes the logistics industry as the object to establish an evaluation model of logistics industry carbon emission efficiency and obtain the evaluation results of logistics industry carbon emission in 2014-2019. The carbon utilization efficiency of the system is calculated by slacks-based measurement (SBM) method. On this basis, Arc-Map software is used to conduct spatial modelling of empirical analysis is carried out. Through the research on the Beijing-Tianjin-Hebei region, we will further improve the ambitious strategic plan of "carbon reduction, carbon neutrality" and contribute to the country's economic and social development.

Key words*: Beijing-Tianjin-Hebei logistics industry in China, carbon emission efficiency, SBM model*

Introduction

As a major carbon emitter in the world, finding out the current situation of carbon emissions in the contributes to the study of an excellent way to reach the goal of *carbon peak and carbon neutrality*. According to estimates by the carbon neutral working group of the China Energy Conservation Society, China will maintain the highest level of CO_2 emissions in the world until 2021. Logistics industry is a new, extensive development mode of the industry, its carbon after manufacturing [1]. The announcement on accelerating the optimization of the green, low-carbon and circular economic development system is an important policy put forward at the national level. It focuses on building a sound circular system of low-carbon and sustainable development, which is the most fundamental and fundamental way out for China at present. Scientific and accurate measurement of carbon emissions is of great significance to correctly understand the status of carbon emissions in the logistics industry, and it can also put forward meaningful strategic plans for the low-carbon cycle development of the logistics industry.

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The Beijing-Tianjin-Hebei area is one of the most significant areas of Chinese economy. It is also the biggest and most innovative area in north China. Meanwhile, China is also one of the biggest emitting countries of CO_2 in the world, and it has great potential to reduce its emissions [2]. Up to 2016, both Beijing and Tianjin have achieved 20% of CO_2 emissions, and their CO_2 emissions have risen to 5.51%, which is the second-biggest in the entire sector [1]. So, it is necessary to analyse deeply the revenue of Beijing-Tianjin-Hebei. It is not only helpful to construct and perfect China's low-carbon logistics system, to achieve the target of reducing CO_2, but also to other areas in China. Currently, there are few systemic studies about the current Beijing-Tianjin-Hebei logistic industry's developing course. For this reason, we use the SBM model and Arc Graph Space Model to investigate the CO_2 emission rate in Beijing-Tianjin-Hebei city group. In Beijing-Tianjin-Hebei, the target of *Peak Carbon* is being pushed forward, and at the same time, it is also looking for efficient methods of energy-saving and emission reduction.

Review of related research

Domestic scholars have conducted a lot of discussions on this issue, such as using DEA and other methods to evaluate the logistics benefits of a region [3-5]. Zhang *et al*. [3] used the DEA-Malmquist productivity index method to conduct an empirical study on the energy efficiency and technical efficiency of China's logistics industry, and studied the change and gap between the two in energy efficiency and technical efficiency. Ma and Tang [4] used the three-phase data envelopment analysis method to build a mathematical model of the technical efficiency of the logistics industry and evaluate the technical efficiency of the logistics industry in various provinces of China. Li and Sun [5] used the SBM-DEA model to establish a set of comprehensive evaluation index, and evaluated its spatial distribution characteristics and overall level. How to realize the optimal allocation of urban logistics system and how to speed up the construction of nodes in urban logistics system are discussed. However, from the current situation, there is still a lack of relevant literature on the carbon use efficiency evaluation of Chinese industries, especially on the carbon use efficiency evaluation of logistics industry. Moreover, the research level of the two is also very different.

Based on the DEA approach in China, Yao [6] has carried out an overall assessment of Chinese logistic industry, and based on it, he has optimized the operating procedure of Chinese logistic industry, and has improved the efficiency of energy efficiency and emission abatement. Using BCC-DEA and Malmqvist, Lin *et al*. [7] made an evaluation on the efficiency of Chinese logistics. Based on these, we build a dynamic and dynamic assessment indicator for low carbon technological innovation in Chinese logistic sector, which can enhance the level of low carbon technological innovation.

But studies have refined it, treating it as an *unexpected output* to ensure it is evaluated more fully and precisely. They use the super-slacks measurement method (Super-SBM) to analyse the carbon emission efficiency of our country's logistics industry. For example, based on Yao [6] earlier work, Fang [8] will replace the revised super SBM model, which will be used for the carbon efficiency of Chinese major logistics companies, thus improving the accuracy of the prediction. On this basis, according to the problems existing in the development of logistics industry put forward corresponding solutions and suggestions. Based on SBM-undesirable, Gao [9] established a correlation system to estimate the growth efficiency of China's logistics industry and low-carbon economy during the past 10 years, and summarized the previous results, laying a foundation for formulating corresponding low-carbon development strategies in China. Zhang [10] also regarded CO_2 as the *negative output* of the logistics industry, studied the development of China's logistics industry, made use of CCR-DEA and DEA-Malmqust indexes, and proposed corresponding countermeasures. Our logistics industry should give consideration to reducing CO_2 emission and environmental protection while improving energy saving efficiency. Mariano [11] studied CO_2 emissions in China and combined SBM and DEA to compare CO_2 emissions in China with those in other parts of the world, in order to find CO_2 emission countermeasures in line with China's actual situation.

For the inter-provincial level, DEA is used as the main means, SBM and Marquette indicators are used to discuss the carbon emission of logistics industry from static and dynamic perspectives. Li and Li [12] used BC2-DEA and Malmquist indicators to conduct static and dynamic research on logistics industry in nine provinces of *Silk Road Economic Belt*, and proposed corresponding energy-saving countermeasures for logistics industry. Based on SBM and LMDI, Zhu *et al*. [13] investigated the influence of logistic building on China's logistics sector during 2014-2018. Xu [14] used DEA, Super-PEBM and Malquist Index to compare them. Based on the previous analysis, the author makes a comparative study on both the static and the dynamic in order to get a more specific and explicit conclusion.

Compared with the survey results at the national and provincial levels, the survey objectives at the city level are more complex and it is more difficult to obtain survey data, so the relevant literature is relatively rare. Yang *et al*. [15] used DEA model and Marqvist index to conduct static and dynamic comparative analysis on 16 cities in Yunnan Province, and discussed the paths and methods to reduce carbon emissions. On this basis, Yan [16] introduced the *unexpected* factor into the *Belt and Road* region, established the SBM-DEA model, conducted an empirical study on the logistics efficiency of the *Belt and Road* region, and conducted an empirical test on it. At the same time, there are also some scholars on the Bohai Sea [17], Yangtze River Delta [18] logistics industry carbon utilization efficiency has done related analysis.

Therefore, our country has carried on the low carbon performance appraisal to logistics industry systematically, and has put forward the corresponding countermeasure suggestions. On the provincial scale, the emission pathways and emission control strategies are emphasized. The survey at the city level is mainly for important areas, such as economic development. However, there are still many problems to be solved in the theories and methods of carbon source utilization efficiency in Beijing-Tianjin-Hebei logistics industry. On this basis, the introduction of unexpected output, the use of SBM method, the Beijing-Tianjin-Hebei logistics industry as the research objects, to study its application in the logistics industry. Finally, the paper discusses the spatial pattern and spatial pattern of the development of manufacturing cluster in our country from three perspectives of industrial chain structure, enterprise cooperation and regional development.

Evaluation model and index system of logistics carbon emission efficiency

Evaluation model

Desired Output SBM model Desired output SBM model is a DEA derived model proposed by Tone [19, 20]. The relaxation factor introduced by Tone [19, 20] can effectively avoid the shortcomings of the classical data envelopment analysis method, and continuously optimize the unexpected results in practice to build the SBM method containing unexpected results. The undesired output SBM model can be expressed as follows: suppose W decision units (DMU_l = 1,2,3, ... ,V), each DMU has X input n species, expected output T^a (M1) species, and unexpected output T^b (M2) species. Vector expression: x Î R^V, t^a Î R^{M_1}, t^b Î R^{M_2}. The input-output matrix is shown:

$$\begin{aligned} X &= \left[x_1, x_2, \ ... \ , x_N\right] \in R^{V\times n}, \quad x_i > 0 \\ T^a &= \left[t_1^a, t_2^a, \ ... \ , t_N^a\right] \in R^{V\times M_1}, \quad t_i^a > 0 \\ T^b &= \left[t_1^b, t_2^b, \ ... \ , t_N^b\right] \in R^{V\times M_2}, \quad t_i^b > 0 \end{aligned} \tag{1}$$

The linear programming expression for an undesirable SBM output model based on the return of a scale variable:

$$Min\delta = \frac{1-\dfrac{1}{n}\displaystyle\sum_{i=1}^{n}\frac{Z_i^-}{x_{i_0}}}{1+\dfrac{1}{m_1+m_2}\left(\displaystyle\sum_{r=1}^{m_1}\frac{Z_r^a}{T_{r_0}^a}\right)+\left(\displaystyle\sum_{r=1}^{m_2}\frac{Z_r^b}{t_{r_0}^b}\right)} \tag{2}$$

Its constraints:

$$\begin{aligned} x_{i_0} &= X\lambda + Z_i^- \\ t_{r_0}^a &= T^a\lambda - Z_r^a \\ t_{r_0}^b &= T^b\lambda - Z_r^b \\ Z_i^- \geq 0,\ Z_r^a &\geq 0,\ Z_r^b \geq 0,\ \lambda \geq 0 \end{aligned} \tag{3}$$

where Z_i^- denotes the relaxation variable of the expected output, Z^a represents expected output relaxation variable, Z^b represents the non-expected output relaxation variable, *l* represents the weight vector. When r = 1, Z_i^- = 0, Z^a = 0, Z^b = 0, compared with the DMU, the overall technology efficiency, the technology efficiency and the scale efficiency are higher.

When 0 £ r < 1, it indicates that the decision-making unit is relatively inefficient. The role of SBM model can not only make a good decision on the efficiency value of each decision unit, but also provide a method to improve the efficiency of low efficiency decision units.

Index system

In the process of SBM modelling, the correct selection of input and output has a great influence on the modelling result. Therefore, in order to make the selected input-output indicators more realistic and representative, this study sorted out and summarized the indicators selected from the relevant literature on the assessment of carbon emission efficiency of the logistics industry in the past five years, as shown in tab. 1.

In view of the representativeness of the indicators recommended by scholars in tab. 1 and the availability of data between cities, on this basis, two indicators of *expectation* and *accident* are selected to construct the *carbon emission right* evaluation index of the logistics industry in the Beijing-Tianjin-Hebei region, as shown in tab. 2.

Currently, there is not a precise measurement method for China's logistic industry's carbon use efficiency. Currently, the cost of transportation, storage, mail and telecom is estimated to replace the logistic. Thus, we will make scientific measurement and calculation on Beijing-Tianjin-Hebei Logistic Industry's CO_2 emission reduction efficiency in order to offer some new thinking for promoting low carbon economy in our country. This program will be helpful to implement the *Carbon Peak Neutral* policy in China.

Table 1. Evaluation index of carbon emission efficiency of logistics industry

Author	Input indicators	Output indicators
Yao [6]	Number of employees, capital stock and energy input in logistics industry	Output value, the system-wide turnover of the logistics industry and the carbon emissions of the industry
Xu [14]	Number of people who work in the logistics industry, investment in fixed assets of logistics industry	Main GDP of logistics industry, carbon dioxide emissions associated with various energy sources in the logistics industry
Li and Li [12]	The fixed asset investment of logistics industry, the number of employees at the end of logistics industry and the terminal energy consumption are uniformly converted into the total of standard coal	Transportation, warehousing and postal industry GDP, Gross turnover, carbon emissions
Shang [21]	Number of employees in logistics field, the measurable fixed asset investment in the logistics field, energy consumption	GDP of logistics industry, carbon emissions of logistics industry
Wu [22]	Number of staff in the logistics industry, the investment in fixed assets related to the logistics industry, the energy consumption related to the logistics industry	Final value added of the logistics industry, carbon emissions from fossil energy consumption added value of logistics industry, carbon emissions from fossil energy consumption
Jiang, *et al*. [23]	Logistics employment, capital stock, energy consumption and infrastructure	Production value, carbon emissions

Table 2 Carbon emission efficiency measurement index system of logistics industry

Types of indicators	Level 1 Indicators	Secondary indicators
Input variables	Energy consumption	Liquefied petroleum gas energy consumption (tons)
	Labor input	Employment in transportation, warehousing and postal services (10,000)
Measure of Output 1	Expected output: The value of output	Total output value of transportation, warehousing and postal services (RMB 100 million)
Output Index 2	Undesirable output: carbon emissions	Carbon emissions per unit GDP of transportation, warehousing and postal services (10,000 tons)

The logistics related carbon emissions in this study were calculated using Governmental Panel on Climate Change Guidance on Forestry Land Use, Land Use Change and Proper Practices and Relevant 2006 Intergovernmental Panel on Climate Change Guidance d for National greenhouse gas Inventories as:

$$\begin{aligned}&\text{Industrycarbonemissions} = \text{energyconsumptionperunitGDP [tons of standard coal per Yuan]}\times\\&\times\text{carbon emission coeficient (tons of CO}_2\text{ per ton of standard coal)}\times\\&\times\text{output value of logistics industry (millionYuan)}\end{aligned} \tag{4}$$

Evaluation of carbon emission efficiency of logistics in the Beijing-Tianjin-Hebei region

Data collection

In the existing literature [24-27], we believe that quantification is needed to measure the carbon emissions of the logistics industry. Therefore, this project takes the Beijing-Tianjin-Hebei region as an example, National Bureau of Statistics, prospective database and 12 cities as examples (Langfang is not considered due to limited samples). A total of 12 cities were collected from 2014 to 2019 liquid petroleum gas energy consumption, transportation, storage and postal employment, transportation, storage, total output value of the postal industry (100 million Yuan), transportation, storage, postal industry per unit GDP carbon emissions, etc. These data are completely credible.

Evaluation

Based on the input-output data of logistics industry in 12 major cities of Beijing-Tianjin-Hebei from 2014 to 2019, the super SBM (SBM) method was used to obtain the carbon source utilization efficiency (SBM) of logistics industry in each city.

As can be seen from tab. 3, the carbon source utilization efficiency of the logistics industry in Beijing-Tianjin-Hebei during 2014-2019 has been maintained at a relatively low level. However, there are great differences in efficiency values between regions. The overall benefit of economic development in the Beijing-Tianjin-Hebei region increased from 0.6617 to 0.7570, with the maximum benefit reaching 0.7806. The overall benefit is low and needs to be further improved. At the same time, the effectiveness of the two is very different. For example, the per capita emission reduction efficiency of Handan reached 1.4132, while the annual emission reduction efficiency of Cangzhou and Beijing from 2014 to 2016 both exceeded 1, achieving a high emission reduction efficiency. However, the maximum carbon source utilization rate in Chengde City was only 0.3206, and the six-month average level was only 0.243. From 2014 to 2019, Handan City has the largest variation range of carbon use efficiency, with a coefficient of variation exceeding 0.2. Handan City in 2015 from *weak efficient* to *efficient efficient*, generally showing an *improved* situation. It was followed by Qinhuangdao, Tangshan and Tianjin, and the coefficient of variation was 0.1. During the 2014-2018 period, Tianjin maintained an *effective* carbon emission, which was significantly reduced to an *ineffective* carbon emission in 2019. The efficiency of Hengshui City and Xingtai City was basically flat compared with the previous years, and there was a significant improvement in 2019 and 2017. After a period of slight improvement in 2017, the carbon utilization efficiency of Xingtai City has dropped to the average level of about 0.5 in 2017-2018.

Table 3. Carbon emission efficiency of logistics industry in Beijing-Tianjin-Hebei region of China, 2014-2019

Region	2014	2015	2016	2017	2018	2019	Mean	Variance
Beijing	1.1939	1.1847	1.2431	1.2306	1.2751	1.3932	1.2534	0.0058
Tianjin	1.1209	1.1160	1.1435	1.1312	1.1000	0.3357	0.9912	0.1033
Cangzhou	1.1807	1.1771	1.1553	1.1800	1.3696	1.3946	1.2429	0.0118
Shijiazhuang	0.2672	0.3058	0.3906	0.3384	0.3901	0.5088	0.3668	0.0071
Chengde	0.2800	0.2796	0.3206	0.2818	0.1600	0.1360	0.2430	0.0057
Handan	0.5004	1.4904	1.6782	1.3804	1.6792	1.7505	1.4132	0.2190
Baoding	1.0085	1.0484	0.6794	0.9128	0.8788	1.0554	0.9306	0.0203
Hengshui	0.1143	0.1445	0.2006	0.1887	0.2648	0.5922	0.2508	0.0306
Tangshan	1.1224	0.6211	1.0514	0.6353	0.3142	0.2924	0.6728	0.1246
Qinhuangdao	0.4301	0.2445	0.6429	1.0317	1.0117	1.0523	0.7355	0.1215
Zhangjiakou	0.4395	0.3231	0.3778	0.2791	0.1767	0.1364	0.2888	0.0135
Xingtai	0.2824	0.2967	0.3700	0.7769	0.5601	0.4360	0.4537	0.0354
Population	0.6617	0.6860	0.7711	0.7806	0.7650	0.7570	0.7369	0.0582

Results and Discussion

Time variation analysis of carbon emission efficiency in Beijing-Tianjin-Hebei region

As you can see from fig. 1, the efficiency of the overall CO_2 emissions varies over time, between 0.1360 and 1.7505. From the point of view of the carbon source use efficiency in the Beijing-Tianjin-Hebei region, the carbon source use efficiency in most areas has decreased and increased obviously, while the carbon source use efficiency in some remote areas has decreased to a certain extent. In the Beijing-Tianjin-Hebei region, for example, carbon efficiency in most areas is *first down and then up*, while in some remote areas it is *slow down*, which reflects the reasonable use of energy resources, the environment and the low level of ecological governance in some areas. In view of the differences of carbon emission efficiency among different regions in China, it reflects the distribution differences of green environmental industries in different regions, as well as the differences of energy saving and emission reduction efficiency in different regions, leading to the differences between different regions.

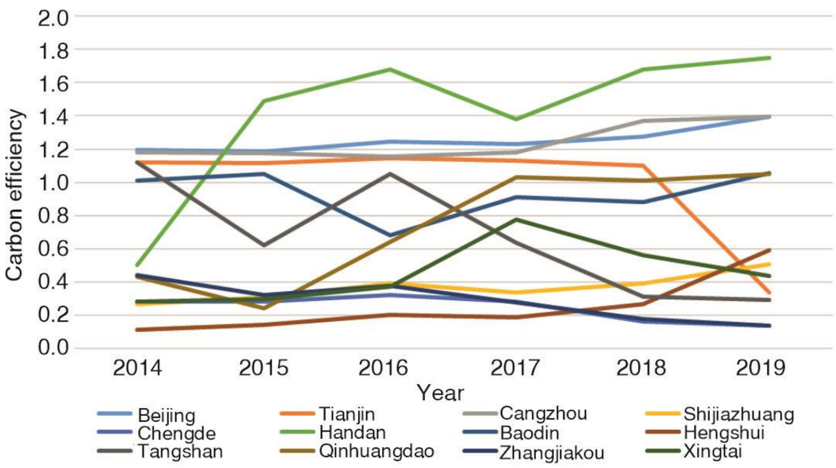

Figure 1. Trend of carbon emission efficiency over time in the Beijing-Tianjin-Hebei region (*for color image see journal web site*)

First, the carbon source utilization efficiency of logistics industries in Shijiazhuang, Handan, Hengshui and Qinhuangdao is constantly improving, especially in Handan and Qinhuangdao. According to the data of Hebei Provincial Bureau of Statistics, the LPG energy consumption of Handan City in 2018-2019 has been significantly reduced. This is because the Handan government has greatly reduced the emission of GHG through a series of treatment and the transformation of abandoned industrial land into a cultural park. Take Shijiazhuang City as an example, since 2012, to improve the level of public transport, improve the level of public transport, improve the level of public transport service, improve the level of public transport service. During 2014-2019, Shijiazhuang City's carbon source utilization efficiency has been significantly improved due to the improvement of its transportation system and transportation system, as well as the obvious enhancement of the supply capacity of infrastructure. In addition, due to the low energy consumption per unit GDP of Qinhuangdao city and the gradual decline of energy consumption dominated by coal-fired power generation, the carbon emission reduction efficiency of the logistics industry in Qinhuangdao City increased from a relatively low level in 2014 to a relatively high level in 2019.

Second, the carbon use efficiency of Tangshan city has changed a lot and decreased significantly. The overall development level and urbanization level of Tangshan City group have obvious influence on the efficiency of carbon emission reduction. Zhang [28] points out in his paper *The Impact of the change of residents' consumption structure on Energy consumption* that the direct energy consumption of Chinese urban residents is 3.4 times that of farmers. However, the per capita energy consumption level and the continuous improvement of the per capita energy consumption level will play a great role in promoting the Chinese energy consumption level. Tangshan is the birthplace of modern industry and a high carbon steel based industrial system. Large-scale industrial production and energy consumption bring rapid economic development, but also inevitably bring inefficient carbon emission reduction.

Finally, Cangzhou and Beijing all maintain high carbon use efficiency, while Hengshui and Zhangjiakou all maintain very low carbon use efficiency. Low-carbon cities such as Cangzhou and Beijing are vigorously promoting the popularity of new energy vehicles. Qin and Liao [29] proposed a new energy trajectory: new energy opens a new way to reduce emissions. Through the use of new, environmentally friendly and clean new energy, the existing logistics network can be transformed, making the construction of the whole logistics network healthier and more reasonable. It is important to increase new energy, and choose the right method in the direction, transform the traditional logistics technology to the direction of energy saving and green, to achieve the energy saving and reduction. However, in Hengshui and Zhangjiakou, the carbon emission reduction is low, mainly because of the imbalance between the regions in terms of capital and technology.

Spatial variation analysis of carbon emission efficiency in Beijing-Tianjin-Hebei region

In fig. 2 told us that the Beijing-Tianjin-Hebei region presents a spatial layout of *low efficiency values are concentrated and contiguous, and high efficiency values are scattered*. With Beijing, Cangzhou and Handan as the center, the carbon efficiency of the surrounding cities shows on step-down table. Average carbon efficiency in Beijing, Cangzhou and Handan was at a relatively high level in 17-19, Baoding and Tianjin basically met the requirements, while the carbon emission efficiency of other regions in Hebei was still at a relatively low level.

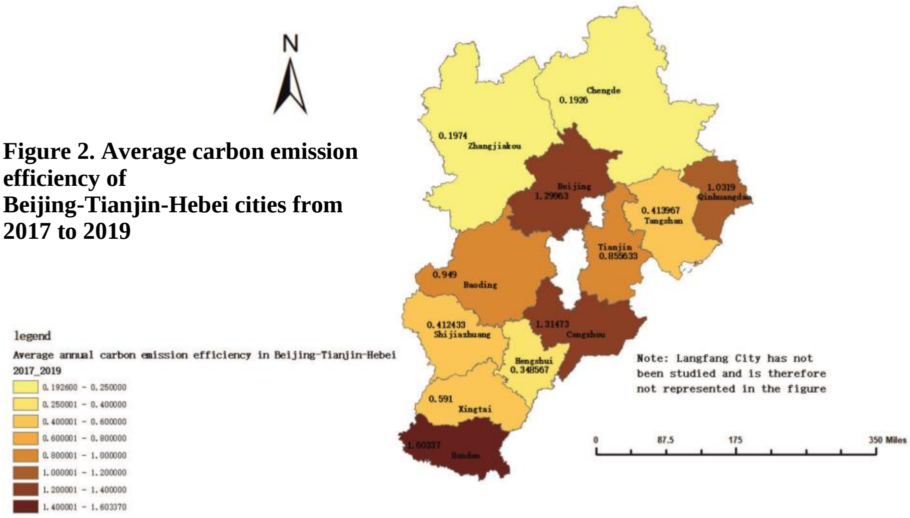

Figure 2. Average carbon emission efficiency of Beijing-Tianjin-Hebei cities from 2017 to 2019

Conclusions

In order to actively respond to the international community's request to the environment and co-operate with the national emission reduction policy, we need to discuss deeply how to promote our carbon emission efficiency. On this basis, aiming at different regions in China, Bottom-Model is adopted to systematically sort out the carbon sink effects of different regions in China (Beijing-Tianjin-Hebei), find out the obvious differences, and construct the spatial model of Beijing-Tianjin-Hebei region (different regions) suitable for different regions in China (Beijing-Tianjin). Arc Map technology is used to quantify the carbon sink effect of different regions (Beijing), so as to clarify the contribution degree of each region to the carbon sink effect according to the actual situation of different regions (region, region, region), and provide a basis for regional economic development. On this basis, targeted emission reduction countermeasures can be found through research to provide decision-making basis for local governments to accurately and effectively improve their carbon sink efficiency.

- Speed up the transformation of industrial chain structure.

First, Hebei should get more focus on the low-carbon cycle of first and secondary industries, and build a set of primary and tertiary green cycle technologies based on green prevention and control technology, livestock and poultry manure pollution control technology and straw high value recycling technology. In this context, the Beijing-Tianjin-Hebei region should focus on the adjustment in Hebei and other regions, promote the development of industrial chain within these regions, and further deepen the innovation of institutional mechanisms within the region. At the same time, all parts of southern Hebei should grasp the opportunity of this *platform*, strengthen cooperation, improve management level, highlight actual results, avoid large-scale industrial migration, avoid *going through the motions* type of reform.

- Strengthen enterprise cooperation.

Local industrial base is very different, therefore, all regions should use their own advantages, use their own advantages, coordinated development, to achieve a win-win goal. North Xinjiang of Hebei Province is located in the less developed region of Beijing and Tianjin, and its economic development level is quite different from that of the regional economy, so the level of this region is relatively low. Therefore, all localities should show their advantages, avoid their disadvantages, strengthen their soft power, and further enhance their soft power on this basis. On this basis, it is proposed that in Beijing, Tianjin and Hebei, we should use the development potential of *talent sharing*, grasp the opportunity of *cross-regional* talent cooperation, optimize the use structure of human capital, and get higher level of technological innovation in the region.

- Pay attention to coordinated development.

Wu *et al*. [30] discussed the idea of building a new industrial chain with emphasis on development after deep industrial chain cooperation in the three regions of Beijing, Tianjin and Hebei. By sorting out the major industries in the city, they systematically planned the major industrial chains and industries in the three regions of Beijing and Tianjin, and established a rapid response innovation platform based on the industrial chain alliance. Therefore, Beijing and Tianjin should focus on the new generation of high-tech, high-tech manufacturing, high-tech services. At the same time, all parts of Hebei Province should also implement hierarchical management of industrial products and industrial products, so as to promote the industrial chain agglomeration of industrial products. In view of the current situation of large differences in carbon emission levels in Hebei Province, it is proposed to carry out collaborative development among different regions to find the advantages and weaknesses of each region, so as to further shorten the carbon source utilization level between regions, promote technical cooperation between regions, and solve the technical and financial deficiencies in Zhangjiakou, Shijiazhuang and other regions.

- Strengthen environmental regulation

Liu *et al*. [31] research shows that both government policy making and government policy making will have an obvious impact on the economics of our country. Promote low carbon in the Beijing-Tianjin-Hebei region, all regions need to promote collaborative low-carbon with the goal of saving energy and reducing consumption, so as to achieve low carbon. Hebei's environmental protection efforts are the least. Environmental management should be strengthened, such as increasing the emission tax, strengthening the management of environmental management, but also increase the resource investment in environmental protection, so as to improve the use efficiency of human capital.

- Increase low-carbon innovation investment

Increasing investment in research and development of technologies can improve the efficiency of development of cities. First, the production process, equipment, technology and other reasonable adjustment, in order to promote its technical progress in the production process. Logistics industry should follow the *green orientation*, through the construction of its own innovation network, achieve the logistics industry, *energy saving* and co-ordination, so as to promote the logistics industry *energy saving* and *energy saving*. On this basis, according to their own resources, economic and environmental conditions, cities should provide more low-carbon innovation impetus for companies, increase more guiding and targeted low-carbon innovation investment, and promote the development of low pollution, low emission with low energy consumption.

At present, due to the limitation of empirical research means, we only select SBM as the quantitative research object, and do not use other models for more data test and deeper research. Therefore, the next research should be based on this article, select more sequential methods to get more of the depth and breadth, and strive to provide more accurate and direct basis for the green logistics industry.

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