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Comparative study on the comprehensive evaluation of green logistics development level of China and Beijing

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Abstract. This paper makes a comprehensive evaluation of green logistics development level. The evaluation index system includes quantitative indicators of environmental pollution and environmental governance, includes qualitative indicators from government, industry, enterprises, and social masses by questionnaire investigation. Using fuzzy comprehensive evaluation method to the green development level in Beijing compared with the average development level of the country. It puts forward the development mode of green logistics, which provides policy reference for the development of green logistics.

Keywords: Green logistics, Questionnaire survey, Fuzzy synthetic discrimination

Introduction

With the rapid development of the logistics industry, its impact on the ecological environment is more and more obvious. The implementation of green logistics is an important driving force for the sustainable development of economy. Evaluation on the development of green logistics, domestic and foreign scholars study focused on two aspects. One is the research on the construction of green logistics evaluation system; the other is the empirical research on the development of green logistics. Ilsuk Kim（2011） [1] through the establishment of the green logistics performance index (GLPI) and environmental performance system (EPI) to evaluate whether some countries to realize the distribution function at the expense of the environment, in order to prove the importance of green logistics. Yan Jun (2006) [2] analyzes the connotation of green logistics, proposes the significance of green logistics to sustainable development. His paper expounds the significance of sustainable development of green logistics from the green procurement, green transportation, green packaging and green storage of these four aspects, and put forward the green logistics strategy. Cao Cuizhen (2009)[3] combines green logistics and sustainable development, and points out that the green logistics is an important component of sustainable development, pointed out that the green logistics is the symbiotic logistics,, low entropy logistics, circular economy. Green logistics is analyzed and described the specific construction and green logistics.。Liu Donglin (2010)[4] uses system dynamics method to analyze the mutual effects of green logistics system and the relationship between environmental factors, and puts forward government decision on the development of green logistics system and the inspiration of green logistics system of developed countries to china.

This paper constructs the evaluation index system of green logistics in the previous research results [5], used the AHP method and fuzzy comprehensive evaluation method combining scoring investigation and expert questionnaire, and calculated the weight distribution. On this basis, the paper carries out empirical research of the development of green logistics, and compares the development level of Beijing and China.

Construction of evaluation index system set

When using fuzzy comprehensive evaluation method, determine the evaluation index first. Usually the index is divided into the level one and level two index. Assuming a level index is Q_i, and each first level index consists of a plurality of two level index Q_{ij}.

In the evaluation process of qualitative index, because it is difficult to get quantitative data, fuzzy evaluation results so generally need to set up a quantitative to qualitative indexes, established the index weight through questionnaire investigation and expert scoring method. Usually need to set up four kinds of fuzzy evaluation results for each qualitative index. B_1 is better, B_2 is good, B_3 is general, B_4 is poor.

Construction of fuzzy comprehensive evaluation matrix

Through a questionnaire, evaluate each of the two level indicators of Q_{IJ}. According to the evaluation of personnel and distribution of total number of comments, set up two grade fuzzy judgment matrix U_k follows below.

$$U_k = \begin{bmatrix} a_{11} & \cdots & a_{1m} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nm} \end{bmatrix}, \tag{1}$$

Where, $0 \le a_{ij} \le 1$, and $\sum_{j=1}^{m} a_{ij} = 1, i = 1, 2, \ldots, n$.

$$a_{ij} = \frac{\text{The number of select the } j\text{th option people when evaluation of index } S_k}{\text{The total number of participating people}} \tag{2}$$

According to the data of two level fuzzy evaluation matrix U_k, then according to the weight vector X_{ij} of two level indexes calculated by AHP method, by fuzzy transformation formula of $B_i = X_{ij} \bullet U_k$ can calculate all two level indicators of the result vector, each result vector representation as follows.

$$B_i = X_{ij} \bullet U_k = \{b_{i1}, b_{i2}, \ldots, b_{in}\} \tag{3}$$

All two levels of evaluation results matrix vector consist the fuzzy judgment matrix U.

$$U = \begin{bmatrix} b_{11} & \cdots & b_{1m} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nm} \end{bmatrix} \tag{4}$$

Similarly，according to the fuzzy transformation formula of $B = X_i \bullet U$, can get the results of the first level indexes vector ***B***, denoted as $B = \{b_1, b_2, ..., b_p\}$.

The establishment of quantitative evaluation index grade

In order to facilitate the evaluation we select data for 2011 are evaluated, we can come to several

indicators level respectively of Beijing and China, as shown in table 1.

Tab. 1 The quantitative index of the rating of Beijing and China in 2011

Index	Normalized value		Grade	
	Beijing	China	Beijing	China
Q11	1	1	IV	IV
Q12	0.878	0.028	IV	I
Q13	1	1	IV	IV
Q14	1	1	IV	IV
Q15	1	1	IV	IV
Q21	0.57	0.207	III	IV
Q22	0	0.6	IV	III
Q23	1	1	I	I

Questionnaire investigation and qualitative index evaluation

For qualitative index in the evaluation system, which consists of three aspects of survey of Beijing city and the national situation, for the government decision-making and logistics industry, through the expert scoring method, the collection of nearly 100 experts point of view; for the enterprise management, the author visited some companies, conducted a questionnaire survey of nearly 100 employees; social masses, mainly adopts the questionnaire, collected 300 questionnaires, the questionnaire of general conditions summarized in Table 2 and table 3.

Tab. 2 qualitative index questionnaire (Beijing)

Index / Grade	government decision Q3（/100）				logistics industry Q4（/100）					
	Q31	Q32	Q33	Q34	Q41	Q42	Q43	Q44	Q45	Q46
better（I）	4	5	0	0	5	2	0	0	4	5
good（II）	22	9	0	0	27	8	12	10	10	10
general（III）	51	50	72	78	47	65	65	68	66	52
poor（IV）	23	36	28	22	21	25	23	22	20	33
Index / Grade	**enterprise management Q3（/100）**				**social masses Q4（/100）**					
	Q31	Q32	Q33	Q34	Q41	Q42	Q43	Q44	Q45	Q46
better（I）	4	5	0	0	5	2	0	0	4	5
good（II）	22	9	0	0	27	8	12	10	10	10
general（III）	51	50	72	78	47	65	65	68	66	52
poor（IV）	23	36	28	22	21	25	23	22	20	33

Tab. 3 qualitative index questionnaire (China)

Index / Grade	government decision Q3（/100）				logistics industry Q4（/100）					
	Q31	Q32	Q33	Q34	Q41	Q42	Q43	Q44	Q45	Q46
better（I）	0	2	0	2	0	0	0	3	0	0
good（II）	18	9	3	4	16	7	7	10	10	10
general（III）	55	50	65	62	56	68	70	65	70	58
poor（IV）	27	39	32	32	28	25	23	22	20	32
Index / Grade	**enterprise management Q3（/100）**				**social masses Q4（/100）**					
	Q31	Q32	Q33	Q34	Q41	Q42	Q43	Q44	Q45	Q46
better（I）	5	6	7	4	8	5	12	23	85	5

good（II）	15	13	18	13	17	12	58	95	106	15
general（III）	52	58	54	59	58	68	80	107	67	52
poor（IV）	28	23	21	24	17	15	150	75	42	28

Comparison and comprehensive evaluation

It combines qualitative index classification grade and quantitative index questionnaire results, then get the comprehensive evaluation matrix U_i of green logistics development level of each two level indicators of China shown as follows. Where the superscript symbols that *C* denotes China, *B* denotes Beijing.

$$U_1^C=\begin{bmatrix}0&0&0&1\\1&0&0&0\\0&0&0&1\\0&0&0&1\\0&0&0&1\end{bmatrix},\ U_2^C=\begin{bmatrix}0&0&0&1\\0&0&1&0\\1&0&0&0\end{bmatrix},U_3^C=\begin{bmatrix}0&0.18&0.55&0.27\\0.02&0.09&0.5&0.39\\0&0.03&0.65&0.32\\0.02&0.04&0.62&0.32\end{bmatrix},$$

$$U_4^C=\begin{bmatrix}0&0.16&0.56&0.28\\0&0.07&0.68&0.25\\0&0.07&0.7&0.23\\0.03&0.1&0.65&0.22\\0&0.1&0.7&0.2\\0&0.1&0.58&0.32\end{bmatrix},U_5^C=\begin{bmatrix}0.05&0.15&0.52&0.28\\0.06&0.13&0.58&0.23\\0.07&0.18&0.54&0.21\\0.04&0.13&0.59&0.24\\0.08&0.17&0.58&0.17\\0.05&0.12&0.68&0.15\end{bmatrix},$$

$$U_6^C=\begin{bmatrix}0.04&0.19&0.27&0.5\\0.07&0.32&0.36&0.25\\0.28&0.35&0.23&0.14\end{bmatrix}$$

Then, according to the fuzzy comprehensive evaluation method can be used to find all two level indicators result vectors B_i.

$B_1^C = X_1 \bullet U_1^C$ =[0.0890, 0.1629, 0.0552, 0.2614, 0.4315]= [0.1629, 0, 0, 0.8371],

$B_2^C = X_2 \bullet U_2^C$ =[0.1095, 0.5815, 0.3090]=[0.3090,0, 0.5815, 0.1095].

Similarly，

= [0.0046, 0.1047, 0.5837,0.307],

$B_4^C = X_4 \bullet U_4^C$ =[0.0038, 0.1144, 0.6251, 0.2567],

$B_5^C = X_5 \bullet U_5^C$ =[0.0553,0.1461,0.5828,0.2158],

= [0.1259, 0.3162, 0.3152, 0.2426].

Then， integrated vector B_i^C， can get U^C of China as below.

$$U^C = \begin{bmatrix} B_1^C \\ B_2^C \\ B_3^C \\ B_4^C \\ B_5^C \\ B_6^C \end{bmatrix} = \begin{bmatrix} 0.1629 & 0 & 0 & 0.8371 \\ 0.309 & 0 & 0.5815 & 0.1095 \\ 0.0046 & 0.1047 & 0.5837 & 0.307 \\ 0.0038 & 0.1144 & 0.6251 & 0.2567 \\ 0.0553 & 0.1461 & 0.5828 & 0.2158 \\ 0.1259 & 0.3162 & 0.3152 & 0.2426 \end{bmatrix}.$$

First level index vector results of Beijing calculated as below.

$$B^C = X \bullet U^C = [0.4385, 0.2643, 0.0721, 0.0583, 0.1253, 0.041]$$

$$= [0.1656, 0.0452, 0.3179, 0.47].$$

Similarly， we can calculate the data of Beijing.

$$B^B = X \bullet U^B = [0.4385, 0.2643, 0.0721, 0.0583, 0.1253, 0.041]$$

$$= [0.1055, 0.0537, 0.1687, 0.6651].$$

The above data more visually represented as shown in Figure 1.

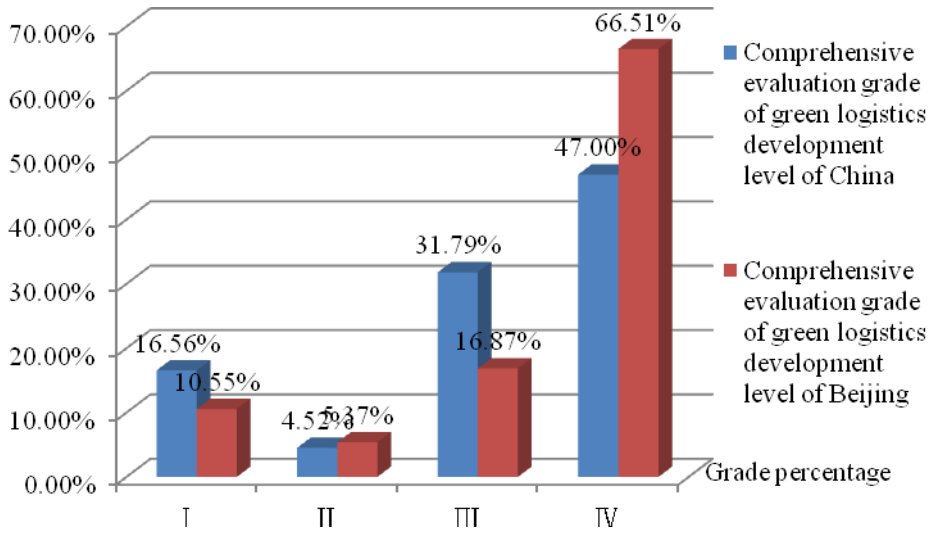

Fig. 1 The green logistics development level comparison of Beijing and China

Through the above figure 1 we can see that 2011 year the development of Beijing green logistics is in worrying situation. The figure shows four development grade proportion, can be seen the grade IV was the highest, which is the worst grade, reaching 66.5%, this shows that Beijing green logistics development level need to make more efforts. Compared with the national average level, level of green logistics development in Beijing city needs to be improved.

Conclusion

In order to realize the green logistics, government, industry, enterprises and society masses must be together.

The government, first, increases the propaganda of green logistics; second, establish the green logistics related laws and regulations; third, require four aspects.

① Pay attention to the relationship between enterprises economic development and environmental protection, to achieve sustainable development

② The requirement of logistics industry norms, to ensure the efficient environmental protection

③ The enterprise must be equipped with sewage, waste gas treatment equipment, sewage treatment and waste gas to the number with a certain proportion of emissions, not less than 85% of the emission.

④ It requires the establishment of supervision system within the industry, green logistics for enterprises conduct regular check, and set up a corresponding system of rewards and penalties

Logistics industry positive response logistics related policies and the implementation of the various enterprises, establish green logistics knowledge training institutions, performance evaluation system.

Enterprise management should establish green logistics supervision team, performance evaluation system, rewards and penalties.

The social masses strengthen the green logistics knowledge learning, then practice of green logistics operations.

In this paper, it takes Beijing as an example, carries on the statistical analysis of the environment development of green logistics, established evaluation index system from environmental pollution aspect in evaluating the development of green logistics. The aim of the study is to make quantitative research on the development of green logistics, points out the insufficiency in the green logistics in our country. There is great significance for the development of green logistics, but also the important impetus to realize sustainable development of economy.

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Reference

[1] Ilsuk Kim, Hokey Min, Measuring supply chain efficiency from a green perspective, Management Research Review. 34(2011)1169-1189.

[2] Yan Jun, Hou Jing, Green logistics——An important part of the realization of sustainable development, The era of economic and trade. 52(2006)81-82.

[3] Cao Cuizhen, Research on building of green logistics systems based on sustainable development, Logistics engineering and management. 31(2009)21-23

[4] Liu Donglin, Study on the system of green logistics, Wuhan: Wuhan University of Technology. 2010.

[5] Li Zhou, Jian Guo, Jie Zhu, Tian Zhiyong.Statistical Analysis and Model of Low Carbon Logistics, Proceedings of Liss 2013,10(2013)1035-1039.