

The Analysis on the Research Status and Development Process of Green Logistics in China Based on Knowledge Map

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ABSTRACT: Logistics industry is an important part of social and economic development. In order to understand the current situation of China's green logistics development, this paper draws the knowledge map of green logistics by using data mining method. Base on knowledge map, this paper obtains four themes of China's green logistics research through keyword cluster analysis. Those four themes are the research on the essential attributes of green logistics, the research on the problems and countermeasures of green logistics, the research on sustainable development of green logistics and green logistics system. Then it puts forward three key paths of the development of green logistics, which are the application of systematic thinking, the upgrading of transportation equipment and the construction of evaluation system.

Keywords: green Logistics, knowledge map, status, development history

1. INTRODUCTION

Logistics industry is an important part of social and economic development. Green logistics helps to achieve carbon peak and carbon neutralization. The research on green logistics in China has been more than 20 years. With the implementation of green and low-carbon economic development model in China, there are many research branches of green logistics. In order to further understand the research status of green logistics, this paper uses software CiteSpace to extract high-frequency keywords and draw keyword clustering knowledge map based on CNKI. This paper analyzes the theme and development trend of green logistics research in China from the perspective of data visualization.

2. DATA SOURCE

In the database of CNKI, the article searches all periodical documents with "Ti = green logistics" as the search condition. A total of 1979 effective documents have been searched by

2022. The annual distribution of documents is shown in Figure 1. It can be seen that since 2003, China's research on green logistics has developed rapidly, peaked in 2007, and then showed a downward trend as a whole. The number of documents issued in 2021 is 92, which is obviously small.

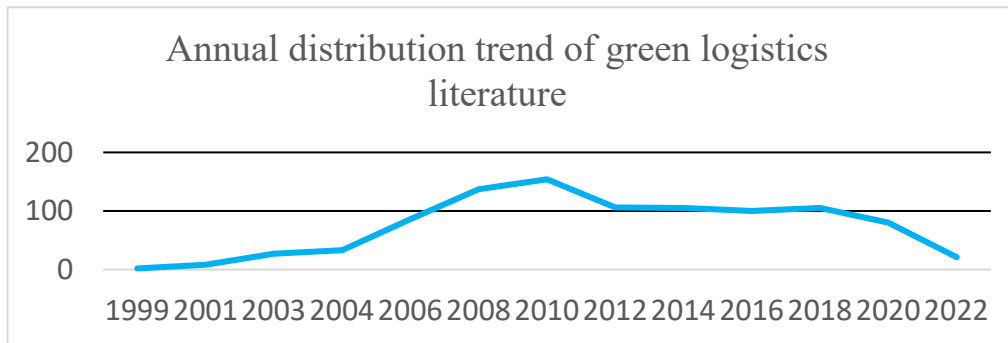


Figure 1 Annual distribution trend of green logistics literature

3. QUANTITATIVE ANALYSIS OF GREEN LOGISTICS LITERATURE

3.1 Distribution of research disciplines

The research disciplines involved in the literature are relatively concentrated. They mainly belong to macroeconomic management and sustainable development (1783). The second is environmental science and resource utilization and agricultural economy.

3.2 Cooperative distribution of literature authors

Through the visual analysis of the author cooperation network, it is concluded that the number of articles issued by Li Chunxiang, Xu Honglian and Liu Na ranks among the top three. An author clustering is formed, which is composed of Peng Tingting, song Zipeng, Chen Ping and Cao Xueqi, as shown in Figure 2. It is basically predicted that the three authors form a research group to research green logistics.

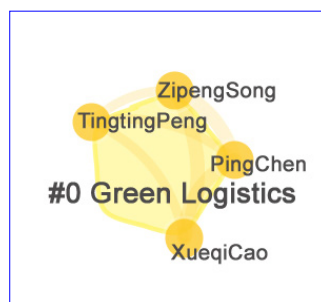


Figure 2 Cooperative distribution of literature authors



Figure 3 Cooperation distribution of research institutions

3.3 Cooperation distribution of research institutions

As shown in Figure 3, through the visual analysis of the cooperation network of research institutions, it is found that there are 13 institutions with more than 10 articles, such as Beijing Jiaotong University. Research institutions have formed two cooperative clusters. The first cooperative cluster is composed of the School of Management of China University of Mining and Technology and the School of Economics of Shenyang University of Technology. This cluster focuses on the development strategy of green logistics. The second institutional cooperation cluster is composed of Nanjing University and Ningbo Institute of Engineering, which focuses on the objective optimization model of green logistics.

3.4 Distribution of documents and periodicals

The top five journals published literature are logistics engineering and management, mall modernization, logistics technology, logistics technology and Chinese market. They are all professional journals of logistics management, accounting for 24% of the total literature.

4. KEYWORDS ANALYSIS OF GREEN LOGISTICS RESEARCH

High frequency keywords analysis can reflect the research topics in the research field. This paper uses CiteSpace software to extract keywords from 1979 documents. After merging and classifying, 14 keywords with a frequency of more than 40 times are classified as high-frequency keywords, as shown in Table 1.

Table 1 High frequency keywords with word frequency threshold of 40

No	keywords	frequency	No	keywords	frequency
1	Green logistics	1968	8	Environmental protection	62
2	Current situation and Countermeasures	396	9	Green packaging	61

3	Circular economy	101	10	Environmental logistics	61
4	Sustainable development	83	11	Low-carbon economy	54
5	Logistics management	77	12	Green transportation	47
6	Logistics activities	73	13	Logistics enterprise	45
7	Agriculture products	69	14	Reverse logistics	41

High frequency keywords can basically reflect the current research status of green logistics. Therefore, it can be preliminarily concluded that the current research on green logistics is mainly reflected in green development (represented by keywords such as green logistics, green packaging and green transportation), analysis of the research status of green logistics (represented by keywords such as status quo, problems and Countermeasures), sustainable development of green logistics (represented by keywords such as circular economy, sustainable development, environmental protection, low-carbon economy and carbon emission) and other research on logistics management (represented by keywords such as logistics management, logistics activities, agricultural products, environmental logistics, logistics enterprises and reverse logistics).

5. KEYWORDS CLUSTERING VISUAL ANALYSIS

Using CiteSpace software to draw keywords knowledge map can further classify the current research topics of green logistics. In CiteSpace, set time slicing as "from 1999 to 2021", year per slice as 2, select "keyword" in node types function, select "top 10% per slice, up to 100" for node threshold setting, and other settings as default. After data calculation, automatic cluster analysis and visual presentation, The keywords clustering map shown in Figure 4 is obtained.

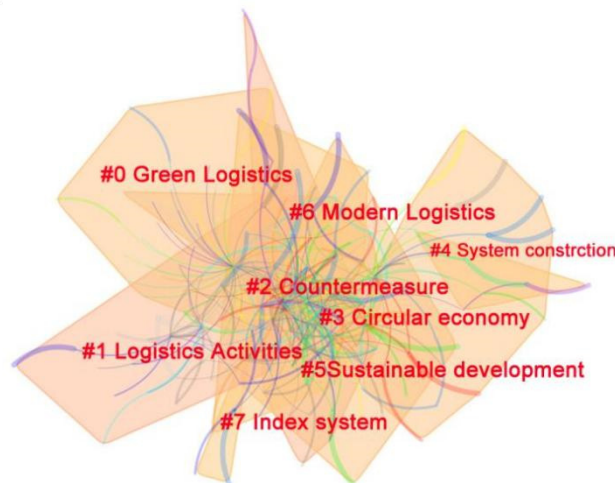


Figure 4 clustering map of green logistics keywords

A total of 9 clusters are formed in the keywords co-occurrence map shown in Figure 4. Through the secondary classification of the 9 sub clusters and the citation analysis of highly cited literature, we get four research topics in the field of green logistics research.

5.1 Research on the essential attribute of green logistics

The research on the essential attributes of green logistics is mainly carried out from the aspects of the development and origin of green logistics, the concept and connotation of green logistics, the theoretical basis of green logistics, the characteristics of green logistics and so on. For example, Zhang Nian [1] analyzed the three theoretical bases of green logistics, and put forward various measures to implement green logistics management from the perspective of government and enterprises. Wang Changqiong [2] analyzed the connotation of green logistics from four aspects: the goal, behavior subject, activity scope and theoretical basis of green logistics, and analyzed the interdisciplinary, multi-objective, multi-level, time domain and regional characteristics of green logistics from a systematic point of view. Wang Ling [3] discussed the concept, development and theoretical connotation of green logistics, and discussed the development path of green logistics. Huang Zhouxuan [4] studied the basic concept, definition, characteristics, main content and significance of green logistics. Xue Hongsong [5] discussed the concept of green logistics, analyzed the five theoretical bases of green logistics theory (sustainable development theory, circular economy theory, ecological economics theory, ecological ethics theory and logistics management theory), and expounded the necessity of studying green logistics theory. Xia Fu [6] focused on the theoretical basis of green logistics on the basis of studying the development trend of logistics management.

5.2 Research on problems and countermeasures of green logistics

The research on the problems and countermeasures of green logistics mainly studies the current situation and existing problems of the development of green logistics in China, and puts forward the corresponding strategies for the problems. For example, Fu Lei [7] and others put forward countermeasures to solve the rapid development of green logistics in China from the perspectives of government, enterprises and consumers through the analysis of non green factors in the whole process of logistics. Lin Jingsong [8] analyzed the existing problems of green logistics under the circular economy and put forward the Countermeasures for the development of green logistics: establish a green logistics system with coordinated economy and ecology, improve the management ability of green logistics, establish waste recycling logistics, actively play the leading role of the government, actively advocate green marketing, green demand and green consumption, and promote the operation of green logistics. Dai Chengxia [9] analyzed the main problems in the development of green logistics in China and put forward the ways to develop green logistics in China, such as improving green logistics laws and regulations, green management of logistics enterprises, green packaging, financial support for small and medium-sized logistics enterprises, etc.. Jiang Xiaoru [10] put forward the countermeasures to improve the development of green logistics in China from the aspects of legal construction, technology development, healthy operation and innovative talents.

5.3 Research on sustainable development of green logistics

This research theme mainly includes analyzing and solving problems from the perspective of sustainable development. For example, Wang Changqiong [11] analyzed the background of

green logistics from the perspective of sustainable development, and discussed the basic connotation and strategic value of green logistics. Zhang Yi [12] systematically analyzed the relationship between green logistics and sustainable development, and put forward the way to realize the interaction between green logistics and sustainable development. Liu Hongxia [13] proposed that green logistics is a complex system project from the perspective of sustainable development, which needs to be completed by the government, logistics industry and logistics enterprises. Rong Changling [14] analyzed the impact of traditional logistics activities such as transportation, packaging, storage, handling, circulation processing and information processing on the environment, and studied the significance of green logistics to environmental sustainable development. Chen Wanting [15] put forward countermeasures and suggestions for the sustainable development of green logistics in China based on the circular economy model. Liu Ziqi [16] proposed the implementation strategy of green logistics management under the background of sustainable development. Lou Leyi [17] put forward the strategy of port green logistics development from the perspective of sustainable development.

5.4 Research on green logistics system

This research topic mainly combines the research status and existing problems of green logistics, puts forward the strategy of building a green logistics system, or establishes a green logistics evaluation index system. For example, Xie Wuzhou [18] put forward the countermeasures of building China's green logistics system in combination with the prominent problems in the development of China's green logistics. Che Huichun [19] and others studied the significance of green logistics to urban development and put forward some policies and measures on how to build Beijing's green logistics system on the premise of sustainable development. Yang Huihui [20] proposed the construction of China's green logistics system based on the analysis of the development status and existing problems of China's green logistics. Mao Shuonan [21] studied the construction and development of green logistics system at home and abroad, and put forward the technical direction of building a green logistics standard system suitable for China's logistics enterprises. Jin Hao [22] analyzed the feasibility of developing green logistics in China and put forward the development idea of establishing green logistics system.

6. EXTRACTION AND ANALYSIS OF BURSTS IN GREEN LOGISTICS

The research direction of a field can often be reflected by the burst words in the field, and the burst words can be one or more high-frequency keywords. Therefore, extracting burst words can predict the research direction of green logistics. Based on the green logistics keyword knowledge map, it is extracted by centrality (the position of keywords in the keyword map network) and burst comparison extraction. Based on CiteSpace software data mining, the highlighted words as shown in the Table 2 are extracted. It can be seen that the top five keywords with high prominence value include logistics activities (the value is 11.83), management strategy (the value is 7.72), environmental logistics (the value is 7.37), agricultural products (the value is 7), environment (the value is 6.84), etc., which are new directions in the field of green logistics research. In addition, the low-carbon economy proposed in 2016 and the research topics such as express packaging and management

strategies proposed in 2017 have strong vitality.

Table 2 Top 19 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	1999 - 2021
Logistics activities	1999	11.83	1999	2007	
Logistics activities	1999	11.83	1999	2007	
Management strategy	1999	7.72	2017	2021	
Environmental logistics	1999	7.37	2007	2008	
Agriculture products	1999	7	2014	2019	
Environment	1999	6.84	2003	2008	
Green transportation	1999	6.71	2004	2008	
Logistics	1999	5.24	2003	2008	
Low-carbon economy	1999	4.86	2016	2021	
Green consumption	1999	4.82	2007	2010	
Green packaging	1999	4.67	2004	2006	
Reverse logistics	1999	4.52	2003	2010	
Administration	1999	4.52	2016	2021	
Express packaging	1999	4.33	2017	2021	
Green marketing	1999	4.02	2007	2009	
Problem	1999	3.95	2014	2016	
Joint	1999	3.81	2000	2000	

distribution	99		3	06	
Greening	1999	3.27	2002	2003	
Constraints	1999	3.2	2013	2018	

7. ANALYSIS ON HISTORICAL TRACK OF GREEN LOGISTICS RESEARCH

The Timeline view of the green logistics knowledge map generated by CiteSpace software can present the development process of each cluster, as shown in Figure 5. It can be seen that the clustering "#0 green logistics" and "#2 countermeasures" run through the starting and ending time of literature retrieval (from 1999 to 2021), indicating that the development momentum of these two research clusters is strong and will even continue to develop, becoming the main research topic in the field of green logistics. Clustering "#3 circular economy" and "#5 sustainable development" began in 2004. Some clusters such as "#8 index system" have a relatively short life cycle, lasting only about 3 years.

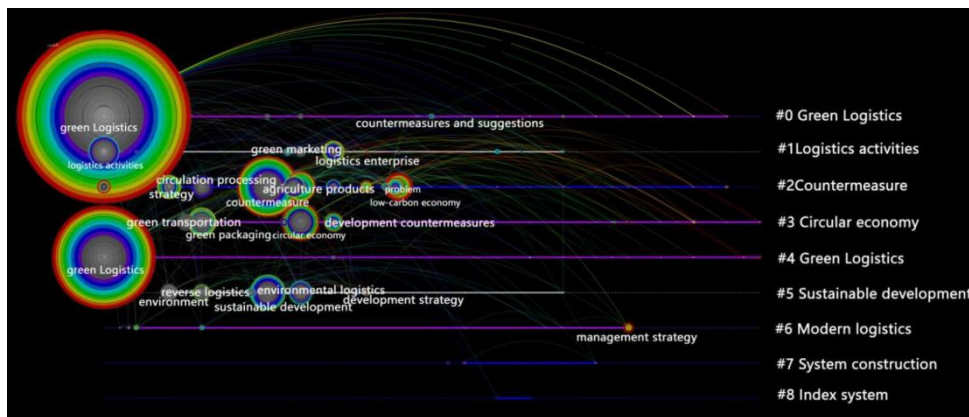


Figure 5 Timeline view of green logistics knowledge map

In the whole process of green logistics research, new high-frequency keywords continue to appear, and the emergence of these high-frequency keywords also constitutes the track of green logistics research in China. For example, the main research contents in 1999 and before were green logistics, logistics activities and real-time distribution. The keywords such as logistics cost, green consumption, joint distribution, green manufacturing, reverse logistics and environment appeared in 2003. In 2004, there were green transportation, green packaging, circulation and processing appeared. In 2006, there were logistics enterprises, system marketing, agricultural products and development strategies appeared. Based on the timeline view of knowledge map of green logistics, we designed the fishbone diagram of the development track of green logistics as shown in Figure 6, so as to master the research process of green logistics as a whole.

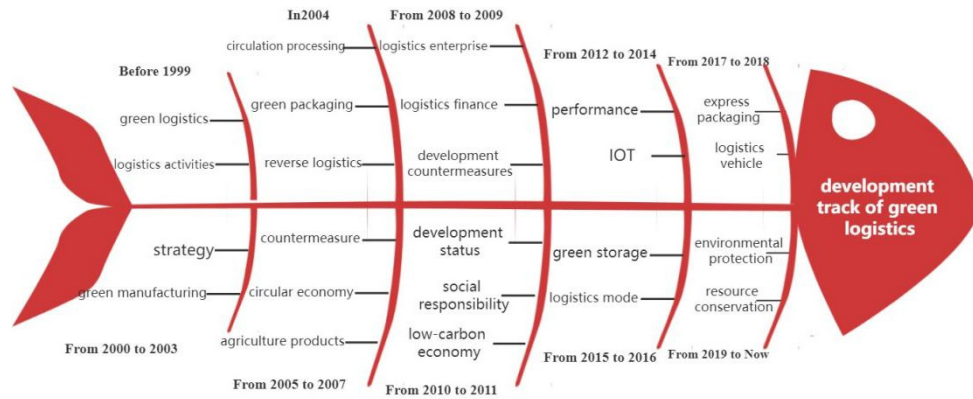


Figure 6 The fishbone diagram of the development track of green logistics since 1999

8. RESEARCH SUMMARY AND PROSPECT

Based on the above research, this paper systematically and intuitively analyzes the research status of green logistics in China: forming a cooperative research team and two cooperative research institutions, and forming a stable research theme and research direction. The research on green logistics mainly focuses on circular economy, sustainable development, green packaging and consumption. Combined with the above knowledge map and related research analysis, this paper believes that green logistics should also carry out in-depth research in the following three aspects.

8.1 Using systematic thinking to carry out research on green logistics

The development of green logistics should aim at long-term interests. It is a long-term complex system engineering. It needs to use system thinking to analyze and solve problems, study the characteristics of this complex system and its relationship with the environment. Using the method of combining reductionism and holism, we can effectively deal with the relationship between the whole and part.

8.2 Promote the upgrading of logistics and transportation equipment

First, we need to promote the application of new energy and clean energy logistics and transportation equipment. Secondly, we should speed up the renewal of old logistics and transportation equipment with high energy consumption and high emission. Thirdly, with the application of modern information technologies such as IOT, cloud computing and big data, intelligence is becoming the biggest boost to the development of green logistics, so that intelligence can contribute to the construction of green logistics infrastructure.

8.3 Constructing green logistics evaluation index system

Without an evaluation index system, it is difficult to evaluate the degree of green logistics development of cities or enterprises. We use analytic hierarchy process to establish and

improve the evaluation index system of green logistics to evaluate the development degree of green logistics. After evaluation, we can find the bottleneck of green logistics development and find solutions to the problems.

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