Scientific Research Publishing

Open Journal of Social Sciences, 2023, 11, 244-261
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Knowledge Structure of Emergency Logistics Research in China: An Analysis Based on Bibliometrics

Tianming Ning[1], Yongjian Huang[1], Jinzhao Yang[1], Yaoyao Wei[1,2*], Tian Xie[1], Yang Gao[1]

[1]School of Economics, Management and Law, University of South China, Hengyang, China
[2]School of Education at Central China Normal University, Wuhan, China
Email: 1425136752@qq.com, *24359048@qq.com

How to cite this paper: Ning, T. M., Huang, Y. J., Yang, J. Z., Wei, Y. Y., Xie, T., & Gao, Y. (2023). Knowledge Structure of Emergency Logistics Research in China: An Analysis Based on Bibliometrics. *Open Journal of Social Sciences, 11,* 244-261.
https://doi.org/10.4236/jss.2023.112016

Received: January 12, 2023
Accepted: February 17, 2023
Published: February 20, 2023

Abstract

Based on Bibliometrics and CiteSpace visualization software, relevant research literatures from 2002 to 2022 are retrieved with the topic of emergency logistics, and the scientific knowledge graphs are drawn. Comprehensive analysis and discussion are carried out from multiple dimensions including research time, research subject, research hotspot and research frontier by integrating the graph and data results. The research shows a certain number of active research teams in this field, but the cooperation between them is insufficient. The research institutions in this field are mainly universities and research platforms, but there is also a lack of cross-regional cooperation between them. The emergency logistics network and information construction, the emergency logistics model and system, the emergency management system construction and improvement, the emergency logistics site-path model and the emergency supplies support capability constitute five major research hotspots in this field. It is speculated that the research on pandemic response and improving the intelligent logistics system will become a future research hotspot of this field, providing ideas and references for the follow-up researches.

Keywords

Emergency Logistics, CiteSpace, Visual Analysis, Knowledge Graph

1. Introduction

With the development of China's economy and society, the frequency and level of emergencies have been increasing. The improvement of the emergency logis-

tics system directly determines the emergency supplies support capability, and then affects the overall development of emergency work. Therefore, emergency logistics often plays a decisive role in the face of various emergencies, and has become one of the focuses of research in recent years. As of April 11, 2022, domestic and foreign scholars have conducted a lot of analysis and review of the literature in emergency logistics (Li, 2013; Chen, 2014; Wang, 2014; Wang et al., 2015b; Wang et al., 2021; Liu et al., 2020b; Zhao, 2020; Gao et al., 2009; Li & Lu, 2017; De Brier et al., 2020).

However, most of the researches are still based on qualitative analysis, and only a few are carried out by quantitative methods such as bibliometrics. Different authors usually choose different time slicing, research topics and data sources when using bibliometric methods for research, among which the research topics differ the most. In terms of research topics, there are two literatures in **Table 1**

Table 1. Literature statistics of emergency logistics research review field (12 articles).

The author	Time Slicing	Article	Data sources
Hui Yin, Jin Chen	2006-2010	Visualizing Study of China Logistics Research Issues Based on Co-word Analysis	https://www.cnki.net/ (CSSCI/EI)
Cheng LYU	2012-2016	Current Situation, Hot Spots and Future Trends of Logistics Research: Bibliometrics and Theoretical Review	WOS (SCI/SSCI)
Haoqing Li	2010-2014	Visualization Analysis of Emergency Management in China Based on Knowledge Mapping (2010-2014)	https://www.cnki.net/
Qiong Li, Jie Yang	2003-2020	Research on Emergency Management in China (2003-2020): History, Hot Spots and Prospects—Visual Analysis Based on CNKI Literature	https://www.cnki.net/ (CSSCI)
Junling Wang, Lingyu Sheng	2002-2017	Backtracking and prospect on emergency management research of coal mine enterprises in China—Bibliometric analysis based on CiteSpace knowledge graph	https://www.cnki.net/
Jia Liu, Yanan Li	2017	Visualization Analysis of Hot Spot and Trend of Emergency Logistics Research Field	https://www.cnki.net/ WOS
Ying Zhou	1990-2019	A review of domestic emergency logistics research in the past 30 years based on the analysis of literature measurement	https://www.cnki.net/
Hengsheng Zhou, Yuanyuan Zhang	2000-2020	Knowledge Graph Analysis of Emergency Logistics Research Based on CiteSpace	https://www.cnki.net/ WOS
Feng Pei, Bukuo Zhang, Maochun Wang	2000-2021	Overview of Domestic Research on Emergency Logistics and Its Frontier Evolution: A Visual Analysis Based on CiteSpace	https://www.cnki.net/
Jian Li	2000-2021	Visual Analysis of Research Literature on Emergency Logistics Based on CiteSpace	https://www.cnki.net/
Aakil M. Caunhye, Xiaofeng Nie, Shaligram Pokharel	1976-2010	Optimization models in emergency logistics: A literature review	WOS
Yiping Jiang, Yufei Yuan	1996-2018	Emergency Logistics in a Large-Scale Disaster Context: Achievements and Challenges	WOS

that focus on domestic or foreign logistics partly involving emergency logistics (Yin & Chen, 2011; Lyu, 2017). The three literatures mainly focus on emergency management, so they are related to emergency logistics relatively limited (Li, 2016; Li & Yang, 2020; Wang & Sheng, 2018). The other five literatures focus on domestic or foreign emergency logistic: In the study of Liu & Li (2018), there is no cluster analysis of keywords, and the research time line is short. Research on Zhou (2020) lacks the control of future research frontiers and trends. The clustering view analysis of Zhou & Zhang (2022) is relatively macro, which cannot realize specific analysis of different knowledge groups. Pei et al. (2022) do not carry out correlation analysis on research institutions. Li (2021) does not show a graph for visual analysis. Two foreign literature reviews the model optimization and large-scale disasters in emergency logistics (Caunhye et al., 2012; Jiang & Yuan, 2019).

Therefore, this research uses CiteSpace 5.8.R3 visualization software to comprehensively analyze the research literature on emergency logistics from 2002 to 2022, and explores the development trend and hot frontiers of China's emergency logistics research from multiple dimensions such as research time, research subject, research hotspot and research frontier. It provides some ideas and references for the follow-up researches.

2. Data Sources and Research Methods

2.1. Data Sources

The data in this study are from the CNKI. In order to comprehensively retrieve the published literature related to emergency logistics, reduce the influence of other disciplines on the analysis, so as to make the research data have a higher generality, the main topic is emergency logistics. A total of 2702 results were retrieved from January 1, 2002 to April 11, 2022, and were downloaded and saved as plain text. After format conversion on CiteSpace 5.8.R3, 2694 results were obtained in record-conversion, which is the final data of this study.

2.2. Research Methods

In this study, CiteSpace 5.8.R3 visualization software is used to set its parameters as follows: time slicing—January 2002 to April 2022—years per slice—one year—pruning consists of three ways: pathfinder, pruning sliced networks, pruning the merged networks. Visualization selects cluster view-static and shows merged network. Other settings remain unchanged. Node types are selected as author, institution and keyword in order to draw and analyze the visual knowledge graph.

3. Research Results and Analysis

3.1. Analysis of Annual Print Volume of Emergency Logistics

The change of the number of publications in a discipline field over time reveals the academic status and research activity in a certain period to some extent. In this study, Origin was used to make a dot plot for the annual number of posts

and the cumulative number of posts, and the variation trend of them over time is shown in Figure 1.

From the perspective of time distribution, the annual number of posts and the cumulative number of posts can reflect the research heat of emergency logistics from 2002 to 2022 to a certain extent. The number of articles published in the direction of emergency logistics in China fluctuates little and tends to be stable on the whole. The number of articles published in 2008 and later years is larger than the previous years. The cumulative amount of articles published each year presents an upward trend, and the increase has increased significantly since 2008. The Wenchuan earthquake in 2008 reflected the situation of emergency logistics in China, which greatly exposed many problems in emergency management. It can be seen that 2008 is an important node for the development of China's emergency logistics, and the research in this field has attracted more and more attention from scholars. The outbreak of the COVID-19 at the end of 2019 puts forward new requirements for the development of emergency logistics in China. Given that there are still many problems to be solved in this field, the research of emergency logistics still needs further attention from domestic scholars. This study predicts that the number of articles published in this field will show an upward trend, and the cumulative number of articles will increase again.

3.2. Subject Analysis of Emergency Logistics Research

3.2.1. Co-Occurrence Analysis of Core Authors

Visualization software CiteSpace 5.8.R3 is used to set Node Types as Author, and other settings remain unchanged. The knowledge graphs are shown in Figure 2 and Figure 3, and the top 10 prolific authors are listed in Table 2.

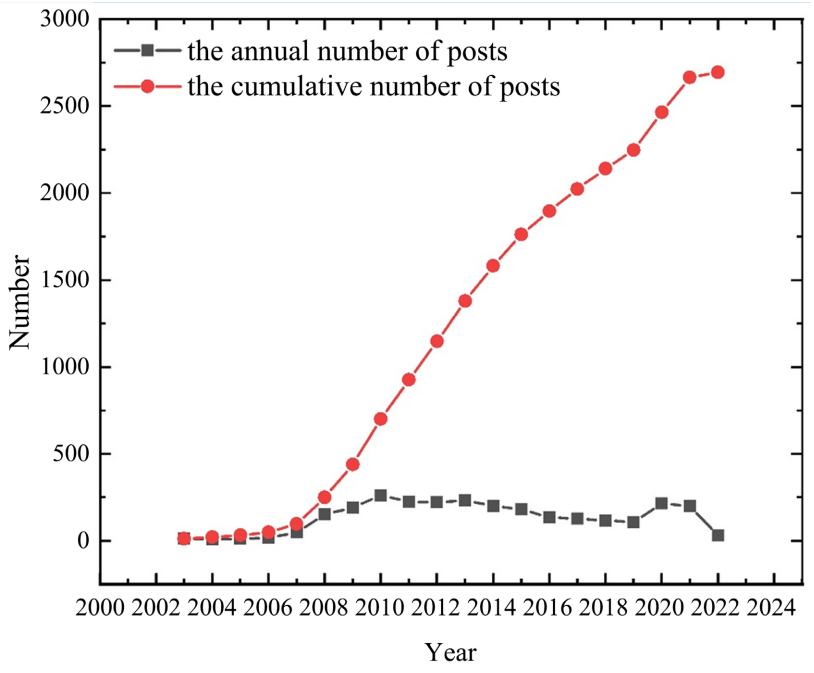

Figure 1. Trend chart of annual and cumulative number of emergency logistics posts.

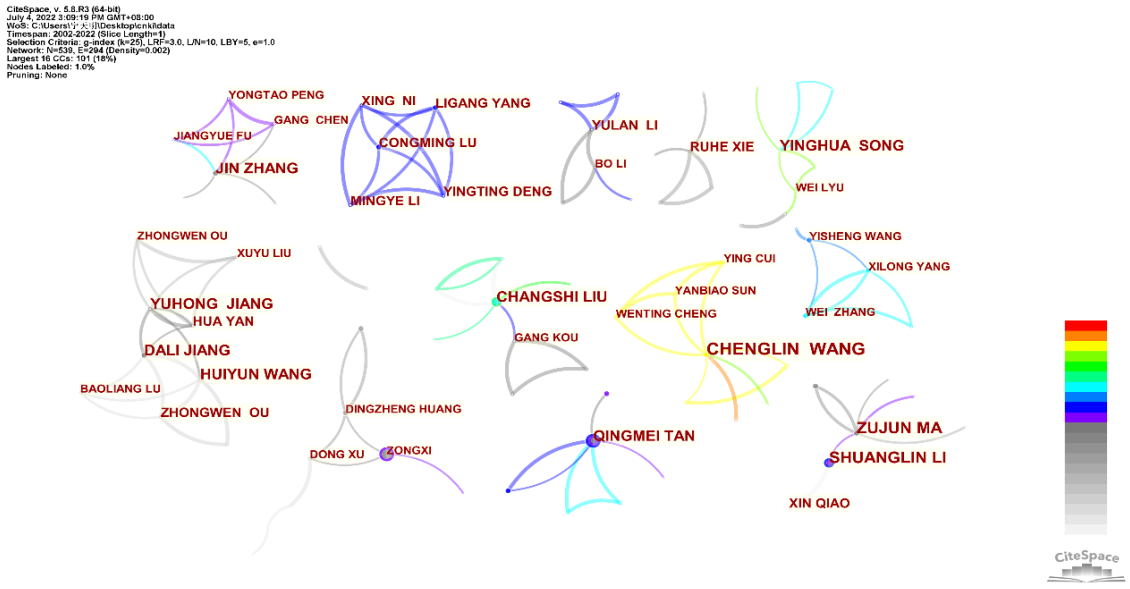

Figure 2. Translated co-occurrence knowledge graph of core authors.

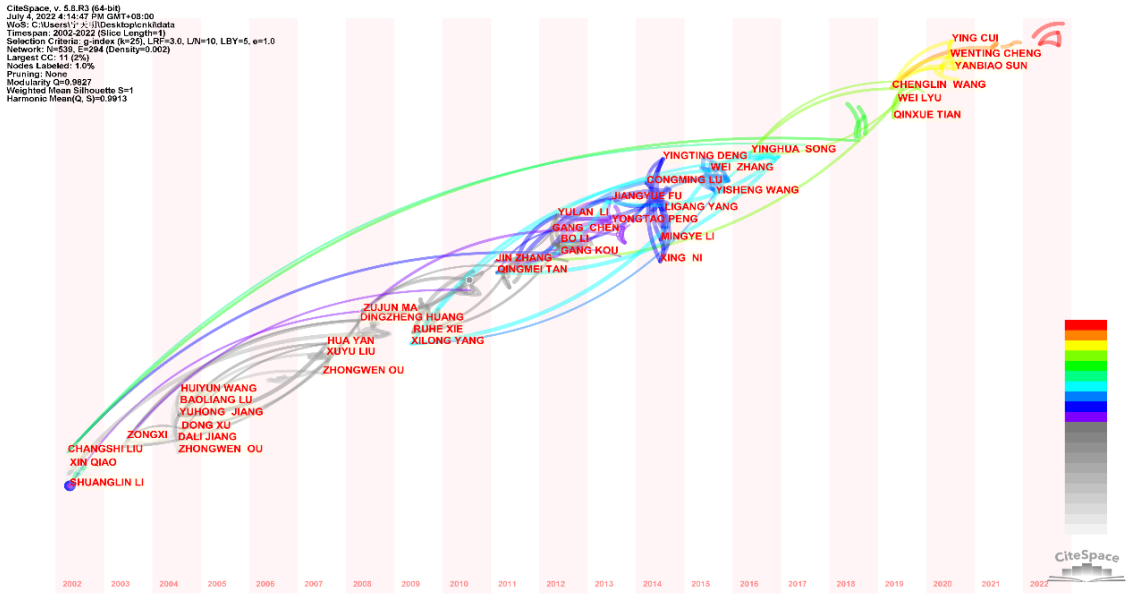

Figure 3. Translated time-zone view of core author co-occurrence knowledge graph.

The top 3 authors are Jigang Wei, Changshi Liu and Zi Yan respectively. Among them, Jigang Wei published 90 articles, far ahead of other scholars, and the other scholars published more than 10 articles. The academic research group represented by them promotes the development of China's emergency logistics. From the perspective of the cooperation among authors and the distribution of research teams, the cooperative relationship between authors in this field is relatively harmonious, with a certain number of research teams. However, the cooperation between authors is limited within the team and lacks of communication between teams. This will directly affect the quality and process of further development of this field, and there is still a large space for development in the future.

Table 2. Core authors of emergency logistics research (TOP 10).

Ranking	The author	Number of post
1	Jigang Wei	90
2	Changshi Liu	24
3	Zi Yan	19
4	Jing Ni	15
5	Xin Qiao	15
6	Qingmei Tan	14
7	Jin Zhang	14
8	Qiang Fu	14
9	Huiyuan Ren	14
10	Dingzheng Huang	13

Through the time-zone view of the co-occurrence knowledge graph of the core authors, Figure 3 is obtained. We can clearly obtain the founders of the research of emergency logistics in China, such as Changshi Liu, etc., which lays a solid foundation for the development. At the same time, we can find that some up-and-comers in the current research, such as Yanbiao Sun, will be the backbone of the rapid development in the future. In addition, we can easily conclude the active period of emergency logistics research in China, such as the period from 2013 to 2015. However, in recent years, the research activity has slowed down, and it needs to be paid more attention by domestic scholars.

3.2.2. Co-Occurrence Analysis of Core Research Organization

Visualization software Citespace 5.8.R3 is used to set node types as institution, and other settings remain unchanged. The knowledge graph is shown in Figure 4, and the top 10 research institutions in the number of publications are listed in Table 3.

The top 3 research institutions in terms of publication volume are Industrial Economic Research Department of the Development Research Center of The State Council, School of Business Administration of Chongqing Technology and Business University, and School of Management Science and Engineering of Chongqing Technology and Business University, with publication volume of more than 40. Universities and research institutions, as the two major groups of research institutions, are the main body and important position of scientific research innovation, which helps to promote interdisciplinary integration and construction. From the perspective of cooperation between research institutions, most exchanges and cooperation only exist between different universities in the same province or city, or between different colleges in the same university, but there is still a lack of cross-regional cooperation between universities in different provinces and cities. This will make it difficult to form a regional academic community of emergency logistics, and thus restrict the development of this field.

Figure 4. Translated co-occurrence knowledge graph of core institutions.

Table 3. Core Institutions in the field of emergency logistics research (TOP 10).

Ranking	Research institutions	Number of post
1	Industrial Economic Research Department of the Development Research Center of The State Council	46
2	School of Business Administration of Chongqing Technology and Business University	42
3	School of Management Science and Engineering of Chongqing Technology and Business University	42
4	School of Transportation and Logistics of Southwest Jiaotong University	26
5	School of Traffic & Transportation Engineering of Central South University	25
6	University of Shanghai for Science and Technology	22
7	China logistics and Supply chain think tank	21
8	School of Logistics and Transportation of Central South University of Forestry and Technology	21
9	School of Management and Economics of Beijing Institute of Technology	20
10	School of Transportation of Lanzhou Jiaotong University	18

3.3. Analysis of Hot Spots of Emergency Logistics Research

3.3.1. Co-Occurrence Analysis of Key Words in Emergency Logistics Research

Visualization software CiteSpace 5.8.R3 is used to set node types as keyword, and other settings remain unchanged. The knowledge graph is shown in **Figure 5**. The data are further processed by Excel, and keywords with the same meaning

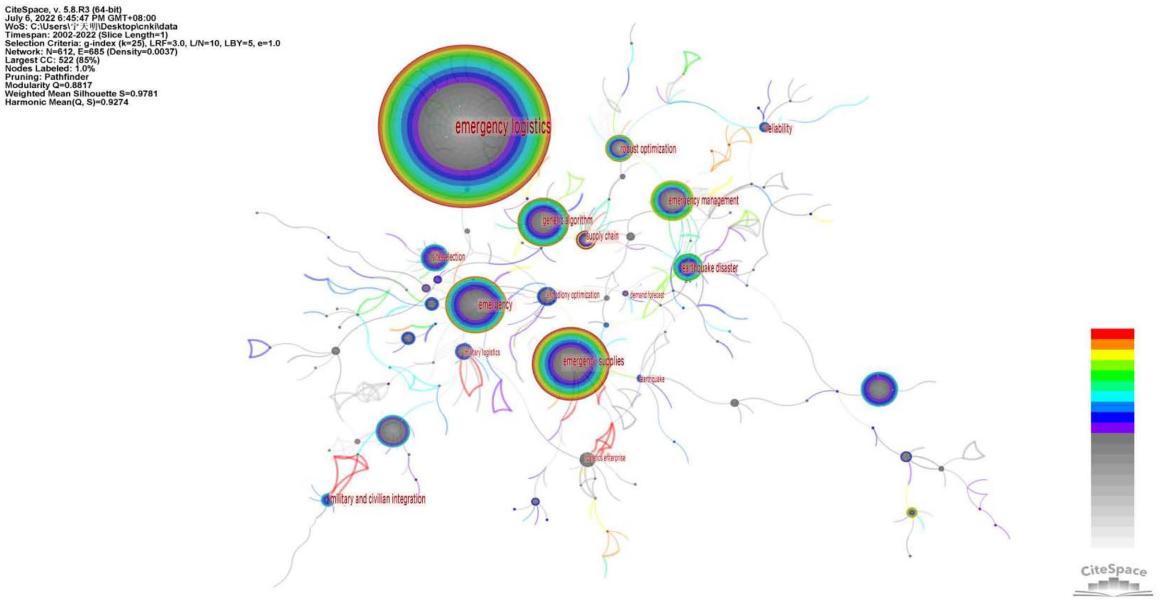

Figure 5. Translated co-occurrence knowledge graph of keyword.

are merged, such as "site selection" and "site selection model" are merged into "site selection", etc. The top 20 keywords in frequency and centrality are obtained, as shown in **Table 4** and **Table 5**.

It can be seen that the keywords with the highest frequency in **Table 4** is emergency logistics, followed by emergency supplies, natural disasters, site selection model and emergency, etc. The research mainly focuses on such keywords. Keywords such as demand forecast, two-level planning, emergency distribution and COVID-19 are the research hotspots in recent years. High centrality keywords in **Table 5** include emergency, emergency logistics and military logistics, etc. The highest centrality keywords are emergency, which is the source of research in the field of emergency logistics, mainly including emergency logistics, military logistics and emergency management three main subjects. In terms of research methods, it focuses on the use of models and methods such as robust optimization, ant colony algorithm, genetic algorithm and AHP. In terms of research direction, it mainly focuses on emergency supplies, demand forecast, management system, operation mode, evaluation model and supply chain, which reflects the significance of emergency logistics.

3.3.2. Cluster Analysis of Key Words in Emergency Logistics Research

On the basis of keyword co-occurrence, this study clustering keywords through LLR algorithm recommended by professor Chaomei Chen, a total of 92 clusters are obtained, in which Q (modularity) = 0.8817, S (silhouette) = 0.9781. The data show that the clustering structure of keywords is significant ($Q > 0.3$), and the clustering effect is convincing ($S > 0.7$). In this study, the first 5 large and representative clusters were selected to draw the knowledge graph, as shown in **Figure 6**. After reading the core literature, the 5 clusters were summarized into 5 research topics, and their expansion was analyzed in detail.

Table 4. High-frequency keywords of emergency logistics (TOP 20).

Ranking	Keywords	Frequency	Ranking	Keywords	Frequency
1	emergency logistics	1121	11	security mechanism	40
2	emergency supplies	213	12	ant colony algorithm	39
3	natural disasters	173	13	path optimization	37
4	site selection	145	14	supply chain	33
5	emergency	133	15	military logistics	32
6	genetic algorithm	89	16	military and civilian integration	28
7	emergency management	87	17	human resources	22
8	robust optimization	62	18	countermeasures	21
9	logistics activity	62	19	emergency rescue	21
10	system building	50	20	aggravated	21

Table 5. High centrality keywords of emergency logistics (TOP 20).

Ranking	Keywords	Centrality	Ranking	Keywords	Centrality
1	emergency	0.70	11	logistics activity	0.16
2	emergency logistics	0.59	12	across the region	0.16
3	military logistics	0.35	13	management system	0.15
4	emergency management	0.32	14	evaluation model	0.15
5	robust optimization	0.32	15	genetic algorithm	0.14
6	earthquake disaster	0.30	16	mode of operation	0.14
7	ant colony algorithm	0.30	17	supply chain	0.13
8	emergency supplies	0.26	18	ahp	0.13
9	indicator system	0.17	19	logistics management	0.11
10	demand forecast	0.16	20	transportation	0.11

1) Emergency logistics network and information construction

Primary construction stage: Emergency logistics has a low level of informatization and systematicness in China, and lacks a good information platform. Therefore, the construction of information system centered on logistics network collaboration system is one of the keys in the construction of emergency logistics (Wei, 2010). In the study of urban emergency logistics network, Zhao (2007) focused on the interaction structure of urban emergency management and logistics network, so as to realize the sharing of information resources and emergency supplies. From the perspective of national security strategy, strengthening the informationization construction of emergency logistics is also the top priority to accelerate its construction (Wang, 2009).

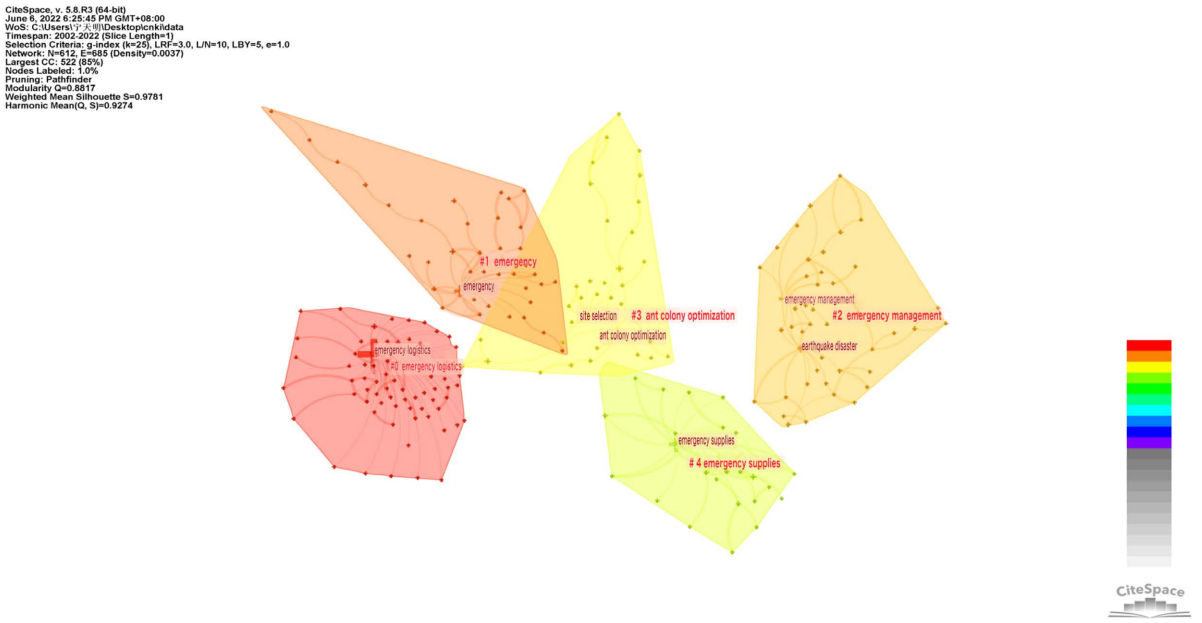

Figure 6. Translated cluster knowledge graph of keyword.

Adjustment and optimization stage: The frequent occurrence of emergencies makes the evaluation of emergency logistics capability gradually put on the agenda (Deng et al., 2010). Xu et al. (2015) constructed an evaluation index system for the reliability of emergency supply chain from the aspects of information system and network structure. In view of the evaluation of dynamic network topology structure under emergencies, Zhu et al. (2018) proposed an evaluation method for cascade failure resistance of emergency logistics network based on CI-TOPSIS fuzzy multi-criteria group strategy. In addition, taking the May 12 Wenchuan earthquake as the background, Zhou et al. (2020) optimized the design of the traditional initial post-earthquake rescue emergency logistics network in consideration of the facility interruption scenario. However, the outbreak has typical unstructured characteristics, such as fuzzy diffusion boundary and dynamic time-varying situation. Based on this, Liu et al. (2020a) constructed a kind of innovative decision-making framework model for dynamic adjustment and optimization of emergency logistics network, so as to make continuous adjustments according to the actual situation.

2) Emergency logistics model and system

Emergent or abnormal nature is a significant mark that distinguishes emergency logistics from general logistics, which requires that the emergency logistics supply chain must have reliability (Wang et al., 2005; Zheng, 2009). In view of this, Ji & Zhu (2007) established an optimization model of emergency logistics resource distribution to respond to the requirements of rapid distribution in emergencies and solve the problem of shortage of anti-disaster materials. A scientific, reasonable and fully functional emergency logistics system is the basic guarantee for responding to emergencies, and also an important work for the Chinese government to comprehensively improve the ability and efficiency of

emergency logistics management (Li et al., 2012). In the rescue of emergency supplies in major emergencies, Zhizhu Lai et al. (2020) established a multi-objective finalization model and a robust optimization model for the location of emergency logistics center, and studied the site selection of emergency logistics center and the transportation of emergency supplies. In addition, emergency logistics is an important support to deal with public health emergencies. Based on blockchain application, Li et al. (2020b) explored and improved emergency logistics under emergencies. Combined with the COVID-19 epidemic, Jiang et al. (2020b) analyzed the problems in China's emergency supplies support and established a GOVERNMENT-led BCM emergency supply chain system.

3) Emergency management system construction and improvement

Wenchuan earthquake emergency response reflected some deficiencies in China's emergency response system, such as the lack of emergency logistics coordination management system (Jing & Song, 2009). It shows that a scientific management system is the basis for the effective organization of emergency logistics. Cheng (2010) pointed out the defects and problems existing in the operation of the current natural disaster emergency logistics management system, and proposed key tasks and measures to improve its operational effectiveness. At the same time, to comprehensively improve the ability to prevent and respond to emergencies, the construction of emergency management system should rely on the support of the emergency industry, and accelerate the formation of a scientific and technological support system for national public safety and emergency management (Liu & Li, 2012). In the era of extensive application of modern information technology and the Internet, the outbreak of COVID-19 has brought challenges and opportunities to international emergency procurement management, and also provided good experience and practical cases for comprehensive summary of national emergency procurement plans in the future (Meng, 2020). Through information update from the perspective of grid management, Qu et al. (2022) established a multi-stage time-constrained response-timeliness location model for emergency supplies distribution, which is conducive to the development of actual rescue.

4) Emergency logistics site-path model

After studying the core literature, it is found that the researches of domestic scholars on this topic mostly focus on the construction of site-path model. Huang & Xie (2009) combined ant colony algorithm and radial basis neural network to establish a location decision model of food emergency distribution center. To solve the location-path problem of disaster reduction system, Zeng et al. (2010) established a LRP model aiming at minimizing the total cost. Li et al. (2013) established an optimization model of multi-objective site selection and multimodal transport for post-earthquake emergency supplies distribution, so as to minimize the total time of emergency supplies distribution and the total loss of unmet emergency supplies at the disaster-hit points. In view of the uncertainty of emergency supplies demand and time of transportation vehicles between demand points, Wang et al. (2015a) set up a minimum time and cost minimiza-

tion of dual stochastic programming model under the certain emergency restrictions, and establishes Sun et al. (2019) establish an emergency facility site-path robust optimization model with the goal of minimizing the sum of the rescue time of material delivery to demand points. From the perspective of COVID-19 prevention and control, Li et al. (2020a) established an emergency response decision-making model including multi-level collaborative storage location and logistics distribution, in order to cope with the uncertainty and dynamic change of demand for emergency supplies in public health emergencies.

5) Emergency supplies support capability

In the early practice of dealing with all kinds of major unexpected public events, China has had certain ability to support emergency supplies, but it still reflects the status quo of the relatively backward construction of emergency logistics system (Wei & Zhang, 2009). In this regard, Wang & Wang (2012) proposed a coordinated optimization scheduling scheme for multi-period emergency supplies in multi-epidemic areas, and constructed a multi-objective stochastic programming model for a class of emergency logistics network optimization. Wang et al. (2013) constructed a multi-objective emergency supplies point selection model under transport capacity constraints, aiming at the shortest supply time and minimum supply cost. Efficient delivery of relief materials is a key link in emergency rescue of major public emergencies (Ma et al., 2013; Huang et al., 2021). In view of the robust uncertainty of disaster relief information in the process of emergency supplies distribution, Zhu et al. (2016) constructed a multi-stage and multi-objective robust optimization model for emergency supplies distribution, and proposed a robust control strategy on this basis. Liu et al. (2016) constructed a multi-objective fuzzy LRP optimization model based on opportunity constrained programming, so as to effectively solve the fuzzy location-path problem of post-earthquake emergency supplies distribution. In addition, Zhang & Ni (2020) constructed a dual-objective optimization model of efficiency and equity to achieve a fair and reasonable distribution of relief supplies on the basis of considering that relief supplies can be delivered separately (**Table 6**).

3.4. Frontier Analysis of Emergency Logistics Research

On the basis of keyword co-occurrence, the first 24 burst words are counted in this study, as shown in **Table 7**.

It can be concluded that the intensity and span of burst keywords are different. The keywords with the greatest intensity were robust optimization, and the keywords with the longest time span were robust optimization and logistics activity.

1) In 2002, emergency logistics was still in its infancy in China, and the research in this field was in the basic stage (Sheu, 2007). The sudden outbreak of SARS in 2003 has gradually transformed China's emergency logistics management system from single disaster response to comprehensive and coordinated emergency management. The keywords that burst around 2002 disappeared before 2010.

Table 6. Main clusters of emergency logistics research.

Cluster ID	Cluster labels	The main keywords contained
#0	emergency logistics	emergency logistics, dynamic network, rescue efficiency, information sharing, management system, system architecture, Armed Police Forces, green channel, public crisis, demand for grading, supply network, utility function, safeguard measures, comprehensive evaluation, cloud model, collaborative operation, military and local government work together, geological disaster, personnel security, cloud service, operation procedure, storage model, optimal management, traffic engineering, ogsa, reasonable compensation, block chain, Beidou communication, information network, practice patterns
#1	emergency	emergency, information system, logistics activity, logistics system, emergency safeguard, blowout needs, distribution model, synergy mechanism, medical logistics, simulation model, security goal
#2	emergency management	emergency management, earthquake disaster, system building, ahp, simulation, indicator system, performance evaluation, fuzzy clustering, emergency response plan, key factors, risk control, collaborative decision making, major outbreaks, operation mechanism, optimal path, public safety, allocation optimization, dynamic demand
#3	ant colony algorithm	site selection, ant colony algorithm, path optimization, data mining, emergency scheduling, military and civilian integration, logistics network, cloud computing, queuing theory, operations research, classification of regression, perishable items, water supply system, priority
#4	emergency supplies	emergency supplies, human resources, COVID-19, two-level planning, material logistics, disaster waste, digital technology, COVID-19 vaccine, cooperative game, logistics efficiency, information resource, mechanism research, objective function, highway freight

Table 7. Burst keywords in emergency logistics (TOP 24).

Keywords	Year	Strength	Begin	End	2002-2022
empirical analysis	2002	3.78	**2002**	2008	
multistage location	2002	3.37	**2002**	2007	
disaster waste	2002	3.12	**2002**	2006	
digital technology	2002	3.12	**2002**	2006	
rescue efficiency	2002	3.12	**2002**	2006	
collaborative site	2002	3.11	**2002**	2007	
collaborative layout	2002	3.11	**2002**	2007	
security mechanism	2002	3.52	**2003**	2009	
logistics activity	2002	3.14	**2003**	2009	
logistics	2002	5.16	**2004**	2008	
logistics enterprise	2002	4.55	**2008**	2011	
logistics industry	2002	3.49	**2009**	2010	
path selection	2002	3.38	**2009**	2012	
construction	2002	3.23	**2009**	2011	
logistics center	2002	3.22	**2010**	2011	
natural disaster	2002	4.64	**2012**	2014	
Internet of things	2002	4.07	**2012**	2014	
demand forecast	2002	3.28	**2012**	2016	
military and civilian integration	2002	3.47	**2014**	2016	

Continued

robust optimization	2002	9.41	**2016**	2022	
emergency rescue	2002	4.17	**2018**	2020	
COVID-19	2002	3.52	**2020**	2022	
COVID-19 vaccine	2002	3.12	**2020**	2022	
intelligent logistics	2002	3.23	**2020**	2022	

2) Since 2008, major emergencies such as the Wenchuan earthquake have highlighted the important role of emergency logistics. With the explosive development of the logistics industry, emergency logistics has begun to "turn defense into attack" and gradually move towards comprehensive emergency logistics management (Liu et al., 2020b). In this stage, the keywords of the logistics industry, path selection, construction, natural disaster and so on suddenly burst and become new research hotspots (Yong et al., 2017).

3) At the end of 2019, COVID-19 swept across the country, bringing great challenges to China's emergency logistics, and exposing many problems, such as incomplete management system, insufficient information synchronization, etc., which led to sudden burst in keywords such as COVID-19, COVID-19 vaccine and intelligent logistics (Jiang et al., 2020a; Hou & Jiang, 2021).

At present, China is in a period of high incidence of emergencies and the coexisting situation of COVID-19 still exists for a long time. The research on pandemic response and improving intelligent logistics system will become the research frontier and development trend in the field of emergency logistics, which has a promising future.

4. Conclusion and Future Work

This research reveals the current research hotspots and future trends of China's emergency logistics based on bibliometrics, and the main contributions are in the following aspects: 1) The active researchers, leaders and research institutions in this field are presented, and provide references for future scientific research cooperation. 2) Five major research hotspots in this field are summarized: the emergency logistics network and information construction, the emergency logistics model and system, the emergency management system construction and improvement, the emergency logistics site-path model, the emergency supplies support capability. 3) The prediction of future research trends of this field is provided: pandemic response and improving the intelligent logistics system. All these have great reference significance for finding the research trendency and pointing the research directions for scholars who are or will be engaged in emergency logistics research.

However, due to technical limitations, CiteSpace tool cannot process the literature data from the CNKI and WOS databases simultaneously. Therefore, we only analyzed the literature data of China's emergency logistics research from the CNKI, and our future work will be focused on the above aspects.

Acknowledgements

This paper is supported by the Special Funds for Student Innovation and Entrepreneurship Training Program (http://gjcxcy.bjtu.edu.cn/, 202110555088), Philosophy and Social Science Foundation Youth Project of Hunan Province of China (19YBQ093), Scientific research project of Education Department (http://www.cutech.edu.cn/, No.20C1625), Natural Science Foundation of Hunan Province of China (http://kjt.hunan.gov.cn/zxgz/zkjj/, No.2018JJ2336), Philosophy and Social Science Foundation of Hunan Province of China (18YBQ105), Youth talents support program of Hunan Province of China (http://www.hunan.gov.cn/, 2018HXQ03), Key scientific research project of Education Department (http://www.cutech.edu.cn/, No.20A443), Social Science Key Breeding Project of USC (https://jgxy.usc.edu.cn/, 2018XZX16), Doctoral scientific research foundation of USC (https://www.usc.edu.cn/, No.2013XQD27).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Caunhye, A. M., Nie, X., & Pokharel, S. (2012). Optimization Models in Emergency Logistics: A Literature Review. *Socio Economic Planning Sciences, 46,* 4-13. https://doi.org/10.1016/j.seps.2011.04.004

Chen, H. (2014). Research on the Optimization of Emergency Logistics System in China. *China Business and Market, No. 8,* 20-24.

Cheng, Q. (2010). On the Operation of Natural Disaster Emergency Logistics Management System. *Theory Monthly, No. 4,* 87-89.

De Brier, N., Stroobants, S., Vandekerckhove, P., & Buck, E. D. (2020). Factors Affecting Mental Health of Health Care Workers during Coronavirus Disease Outbreaks (Sars, Mers & Covid-19): A Rapid Systematic Review. *PLOS ONE, 15,* e0244052. https://doi.org/10.1371/journal.pone.0244052

Deng, A. M., Zhang, F., Xiong, J., & Wu, P. F. (2010). Emergency Logistics Capability Evaluation Based on Fuzzy Grey Comprehensive Evaluation Method. *Statistics & Decision, No. 6,* 174-176.

Gao, W. J., Chen, J. H., & Fei-Hu, H. U. (2009). The Retrospect and Prospect of Chinese Emergency Logistics Study. *Logistics Sci-Tech, No. 8,* 6-10.

Hou, C. X., & Jiang, H. Y. (2021). Methodology of Emergency Medical Logistics for Multiple Epidemic Areas in Public Health Emergency. *PLOS ONE, 16,* e0253978. https://doi.org/10.1371/journal.pone.0253978

Huang, H., Liang, X., Li, M. X., & Zhang, J. (2021). Research on Decision-Making for Joint Distribution of Emergency Materials. *Operations Research and Management Science, No. 6,* 48-54.

Huang, X. R., & Xie, R. H. (2009). Emergency Distribution Decision Based on Ant Colony Algorithm and RBF Neural Network Model. *Statistics & Decision, No. 15,* 56-58.

Ji, G. J., & Zhu, C. H. (2007). Study on the Distribution Optimal Problem in Emergency Logistics for Emergency Ecent. *China Business and Market, No. 3,* 18-21.

Jiang, P., Wang, Y., Liu, C., Hu, Y. C., & Xie, J. (2020a). Evaluating Critical Factors Influencing the Reliability of Emergency Logistics Systems Using Multiple-Attribute Decision Making. *Symmetry, 12,* 1115. https://doi.org/10.3390/sym12071115

Jiang, X., Guo, Q. C., Jiang, X. Y., & Zhuo, Y. (2020b). Research on Government-Led' BCM Emergency Supply Chain System—Take China's Emergency Supply Chain as an Example under COVID-19. *China Soft Science, No. 11,* 1-12.

Jiang, Y. P., & Yuan, Y. F. (2019). Emergency Logistics in a Large-Scale Disaster Context: Achievements and Challenges. *International Journal of Environmental Research & Public Health, 16,* 779. https://doi.org/10.3390/ijerph16050779

Jing, K. P., & Song, Z. J. (2009). Construction of Disaster Emergency Logistics System in China—Reflection on Wenchuan Earthquake. *Science and Technology Management Research, No. 8,* 59-62.

Lai, Z. Z., Wang, Z., Ye, D. M., & Chen, Y. L. (2020). A Multi-Objective Robust Optimization Model for Emergency Logistics Center Location. *Operations Research and Management Science, No. 5,* 74-83.

Li, C. (2013). Review on Domestic and Foreign Research on Emergency Logistics. *East China Economic Management, No. 6,* 160-165.

Li, H. Q. (2016). Visualization Analysis of Emergency Management in China Based on Knowledge Mapping (2010-2014). *Journal of Modern Information, No. 1,* 160-166.

Li, J. (2021). Visual Analysis of Research Literature on Emergency Logistics Based on CiteSpace. *Journal of Yancheng Teachers University (Humanities & Social Sciences Edition), No. 5*, 90-99.

Li, C. L., & Lu, L. (2017). Research on Emergency Logistics Distribution in Complex Environment Based on GERT. In *2017 International Conference on Machine Learning and Cybernetics (ICMLC)* (pp. 1-7). IEEE. https://doi.org/10.1109/ICMLC.2017.8107734

Li, Q., & Yang, J. (2020). Research on Emergency Management in China (2003-2020): History, Hot Spots and Prospects—Visual Analysis Based on CNKI Literature. *Journal of Risk, Disaster & Crisis Research, No. 1,* 79-106.

Li, C. D., Liu, Y., & Liao, C. (2012). Research on Emergency Logistics Management System and Information System Construction. *Commercial Research, No. 1,* 197-201.

Li, S. L., Ma, Z. J., Zheng, B., & Dai, Y. (2013). Fuzzy Multi-Objective Location-Multimodal Transportation Problem for Relief Delivery during the Initial Post-Earthquake Period. *Chinese Journal of Management Science, No. 2,* 144-151.

Li, C. B., Li, X. Q., Cao, S., & Yang, X. W. (2020a). Research on Collaborative Site Selection and Logistics Distribution of Multilevel Storage Warehouses from the Perspective of Epidemic Prevention and Control. *Operations Research and Management Science,* 1-10.

Li, X. D., Wang, Y. Q., & Wang, F. (2020b). Research on Improvement of Emergency Logistics Based on Application of Blockchain during Public Health Emergencies. *Contemporary Economic Management, No. 4,* 57-63.

Liu, C. S., Peng, Y., & Kou, G. (2016). Research on Fuzzy Location-Routing Problem in Post-Earthquake Delivery of Relief Materials. *Chinese Journal of Management Science, No. 5,* 111-118.

Liu, Y., & Li, C. D. (2012). Establishment and Perfection of Emergency Industry Management System: International Experience and Inspiration. *Reform, No. 6,* 32-36.

Liu, J., & Li, Y. N. (2018). Visualization Analysis of Hot Spot and Trend of Emergency Logistics Research Field. *Journal of Wuhan University of Technology (IAME), No. 1,*

5-11.

Liu, M., Cao, J., & Zhang, D. (2020a). Dynamic Adjustment Method for Optimizing Epidemic-Logistics Network Based on Data-Driven. *Systems Engineering—Theory & Practice, No. 2,* 437-448.

Liu, Y. W., Li, L., Tu, Y., & Mei, Y. L. (2020b). Fuzzy TOPSIS-EW Method with Multi-Granularity Linguistic Assessment Information for Emergency Logistics Performance Evaluation. *Symmetry, 12,* 1331. https://doi.org/10.3390/sym12081331

Lyu, C. (2017). Current Situation, Hot Spots and Future Trends of Logistics Research: Bibliometrics and Theoretical Review. *China Business and Market, No. 12,* 33-40.

Ma, Z. J., Zheng, B., & Li, S. L. (2013). Joint Location-Transportation Problem with Transfer Facilities in Relief Distribution. *Management Review, No. 10,* 166-176.

Meng, X. M. (2020). Practice and Thinking of International Emergency Procurement Management under Epidemic Situation. *Journal of International Economic Cooperation, No. 2,* 51-58.

Pei, F., Zhang, B. K., & Wang, M. C. (2022). Overview of Domestic Research on Emergency Logistics and Its Frontier Evolution: A Visual Analysis Based on CiteSpace. *Logistics Technology, No. 2,* 8-11+37.

Qu, C. C., Wang, J., & Yu, J. H. (2022). Emergency Distribution Center Location Model and Application Based on the Grid Management Perspective. *Operations Research and Management Science, No. 1,* 75-79+98.

Sheu, J.-B. (2007). Challenges of Emergency Logistics Management. *Transportation Research Part E Logistics & Transportation Review, 43,* 655-659. https://doi.org/10.1016/j.tre.2007.01.001

Sun, H. L., Xiang, M. K., & Xue, Y. F. (2019). Robust Optimization for Emergency Location-Routing Problem with Uncertainty. *Journal of Systems & Management, No. 6,* 1126-1133.

Wang, H. C., Ma, X. Y., & Smith Neale, R. (2021). Research on Multiobjective Location of Urban Emergency Logistics under Major Emergencies. *Mathematical Problems in Engineering, 2021,* Article ID: 5577797. https://doi.org/10.1155/2021/5577797

Wang, H. J., Du, L. J., Hu, D., & Wang, J. (2015a). Location-Routing Problem for Relief Distribution in Emergency Logistics under Uncertainties. *Journal of Systems & Management, No. 6,* 828-834.

Wang, L. F., Song, J., & Shi, L. Y. (2015b). Dynamic Emergency Logistics Planning: Models and Heuristic Algorithm. *Optimization Letters, No. 9,* 1533-1552. https://doi.org/10.1007/s11590-015-0853-z

Wang, H. J., Wang, J., Zheng, D., & Ma, S. H. (2013). Depot Selection Problems for Multiple Emergency Materials with Transportation Capacity Constraint. *Journal of Industrial Engineering and Engineering Management, No. 4,* 156-160. https://doi.org/10.1155/2013/768031

Wang, J. L., & Sheng, L. Y. (2018). Backtracking and Prospect on Emergency Management Research of Coal Mine Enterprises in China—Bibliometric Analysis Based on CiteSpace Knowledge Graph. *Journal of Safety Science and Technology, No. 9,* 175-179.

Wang, S. F. (2014). The Application of "The Fifth Party Logistics Theory" in the Field of Emergency Logistics. *China Business and Market, No. 2,* 41-45.

Wang, X. P., & Wang, H. Y. (2012). Optimal Mufti-Period Collaborative Scheduling of Emergency Materials for Multiple Epidemic Areas. *Systems Engineering—Theory & Practice, No. 2,* 283-291.

Wang, X. P., Fu, K. J., & Hu, X. P. (2005). Research on Emergency Logistics System and

Its Emergent Response Mechanism. *China Soft Science, No. 6,* 127-131.

Wang, Z. X. (2009). Some Problems on the Construction of Emergency Logistics. *China Business and Market, No. 3,* 20-22.

Wei, J. G., & Zhang, Y. (2009). Accelerate the Construction of Emergency Logistics System and Improve the Guarantee of Emergency Material. *China Business and Market, No. 5,* 15-17.

Wei, Q. (2010). Construction of Emergency Logistics Information System for Natural Disaster. *Journal of Zhongnan University of Economics and Law, No. 4,* 60-64.

Xu, Z. Y., Ren, S. K., Guo, X. S., & Yuan, Z. P. (2015). Evaluation of Emergency Supply Chain Reliability under Uncertain Information. *Operations Research and Management Science, No. 3,* 35-44.

Yin, H., & Chen, J. (2011). Visualizing Study of China Logistics Research Issues Based on Coword Analysis. *Library and Information Service, No. 20,* 129-133.

Yong, Y., Pan, L., Fang, J., & Pan, B. (2017). A Two-Stage Scheduling Method for Global Humanitarian Logistics in Large-Scale Disaster Response. *International Journal of Shipping & Transport Logistics, 9,* 54. https://doi.org/10.1504/IJSTL.2017.080572

Zeng, M. G., Cui, Z. S., & Yu, G. H. (2010). Research on Location-Routing Problem of Relief System Based on Emergency Logistics. *Chinese Journal of Management Science, No. 2,* 75-80.

Zhang, Q. W., & Ni, J. (2020). Distribution Model and Algorithm of Emergency Supplies under Equity Constraint. *Statistics & Decision, No. 7,* 179-182.

Zhao, L. D. (2007). A Research on Emergency Logistics Network of Urban Major Hazards. *Journal of Southeast University (Philosophy and Social Science), No. 1,* 27-29+123.

Zhao, Q. H. (2020). Construction of Fractal Emergency Logistics Management System for Major Emergencies and Its Guarantee Mechanism. *Jianghuai Tribune, No. 4,* 13-20+27.

Zheng, Z. W. (2009). Building the Emergency Logistics Supply Chain Based on the Reliable Technology. *China Business and Market, No. 10,* 54-56.

Zhou, H. S., & Zhang, Y. Y. (2022). Knowledge Graph Analysis of Emergency Logistics Research Based on CiteSpace. *Logistics Sci-Tech, No. 2,* 53-56.

Zhou, Y. (2020). A Review of Domestic Emergency Logistics Research in the Past 30 Years Based on the Analysis of Literature Measurement. *China Logistics & Purchasing, No. 22,* 60-62.

Zhou, Y. F., Chen, N., Li, Z., & Gong, Y. (2020). Optimization Design of Emergency Logistics Network Considering Facility Disruption Scenarios during the Early Stage of Post-Earthquake Relief. *Operations Research and Management Science, No. 6,* 107-112.

Zhu, J. X., Cai, J. F., Jiang, T. T., & Lin, X. X. (2018). Study on the Evaluation of Emergency Logistics Network Cascading Failure Invulnerability Based on CI-TOPSIS Fuzzy Multi Criteria Group Decision Making Tactics. *Management Review, No. 9,* 229-238.

Zhu, J. X., Tan, Q. M., Cai, J. F., & Deng, S. F. (2016). Emergency Supplies Distribution Strategy Based on Robust Uncertainty. *Journal of Beijing Jiaotong University (Social Sciences Edition), No. 1,* 106-116.