

Review and Comprehensive Bibliometric Analysis of Emergency Logistics Literature Published from 2000 to 2021

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Abstract

The emergency logistics aims to improve the efficiency of post-disaster rescue operations and reduce the property loss of human, as well as maintain the sustainable development of society. Considering the importance of emergency logistics in the aftermath of a natural disaster, this paper presents a review and comprehensive bibliometric analysis of emergency logistics literature that published from 2000 to 2021. The analytical methods including co-occurrence analysis, cluster analysis and citation analysis were used to identify the concepts, methods and relevant theories in this area. Finally, the graphical representation provides the valuable information about the knowledge network among research in emergency logistics, which helped human better respond to natural disasters.

Keywords

Emergency Logistics; Bibliometric Analysis; Optimization; Literature Review.

1. Introduction

In recent years, large-scale natural disasters including tsunamis, earthquakes, hurricanes, and so on have occurred frequently all over the world. Such natural disasters cause a lot of direct property losses and inflict adversity and suffering to the human. In addition, natural disasters may threaten the sustainable development of society. From 2000 to 2020, more than 8000 major natural disasters were recorded, causing direct economic losses about 3.01 trillion dollars, about 1.26 million people confirmed dead, and 4.53 billion people affected. Therefore, it becomes more urgent than before to develop the rapid response plans for relief operations immediately in post-disaster [1,2]. Moreover, compared with the perfect commercial logistics, the knowledge about emergency logistics needs constant exploration.

Reasonable and efficient emergency logistics can promote the performance of relief operations and reduce the negative impact of natural disasters. However, the design of emergency logistics has attracted the attention of researchers, which effectively helps to improve the efficiency of rescue operations. And the existing literature can be divided into two categories, including the emergency logistics problems under ascertain environment and the emergency logistics problems under uncertain environment. The emergency logistics problems under ascertain environment are mainly concentrated in the early stage of this problem. And at this stage, some scholars assumed that there is no information change in post-disaster rescue operations and constructed an single objective optimization model to minimize the total operation cost [3-5], total rescue time [6, 7] or other objectives [8-10]. For the literature under uncertain environment, the scholars considered the travel time of relief vehicle [11], demand in the affected area [12], cost [13] and so on. The addition of uncertain parameters makes the emergency logistics problem realistic but complicated. And the common methods in dealing with these uncertain parameter include robust optimization [14, 15], stochastic programming [16, 17] and fuzzy optimization [18, 19].

At the same time, many scholars constructed multi-objective model under the uncertain environment to find the trade-off between competing objectives [20-23]. Moreover, the disruption risk of emergency facilities and road network is another important potential issues that affecting the efficiency of the relief rescue operations [24]. When planning rescue operations, it is necessary to consider the uncertain environment, as well as the risk of disruption. By determining the location of emergency facilities, evacuation planning, as well as programming the routing of vehicle, distribution planning and so on, the scholars want to help the decision-makers improve the efficiency of rescue operations.

Using mathematical and statistical principles, and basing on the computer, the Bibliometric is an useful method in citation analysis, quantitative analysis and data mining of the literature [25]. To construct the knowledge network among research in emergency logistics, we used the Bibliometric to analyse the 496 literature, which was sourced from the Web of science database. These literature was searched by keywords “relief logistics” and “optimization”. By co-occurrence analysis, cluster analysis, citation analysis and so on, we made the raphical representation to provide the valuable information about the knowledge network among research in emergency logistics.

2. Bibliometric Analysis of Emergency Logistics Literature

In this section, we present and discuss the result of bibliometric analysis on the 496 emergency logistics literature. Figure 1 shows the statistical results of these literature. As we can see, the number of emergency logistics literature is limited between 2001 and 2010, which is the initial stage of emergency logistics research. At this stage, the emergency logistics problem has not yet sufficiently interesting to researchers. Since 2010, there has been a substantial increase in the literature on the emergency logistics problem, which indicting that the scholars has pay more attention on relief rescue operations. And the emergency logistics system has begun to completed.

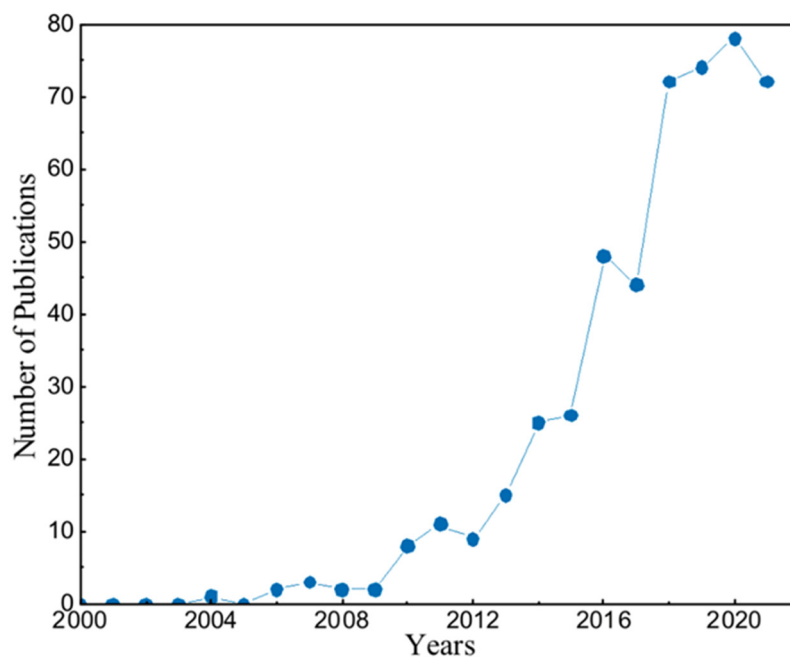


Figure 1. Emergency logistics literature chronology

2.1. Analysis of Co-authorship Authors

Co-authorship authors mapping reveals the distribution of common references. The mapping consists of nodes and lines. Each node represents a scholar who has made contributions to a given field. And the bigger the node, the greater the contribution of scholar [26]. And the line

shows the intensity of Co-authorship authors. Figure 2 shows the analysis result of these literature sourced from the Web of science database. As the figure shown, the node of the scholar who named Bozorgi-Aniri in the emergency logistics field is the biggest. In other words, Bozorgi-Aniri has the greatest influence in the emergency logistics field. Furthermore, Tavakkoli-Moghaddam, Sheu and Jolai have made some contributions to this field, which means they afford the guidance for other scholars in emergency logistics problem.

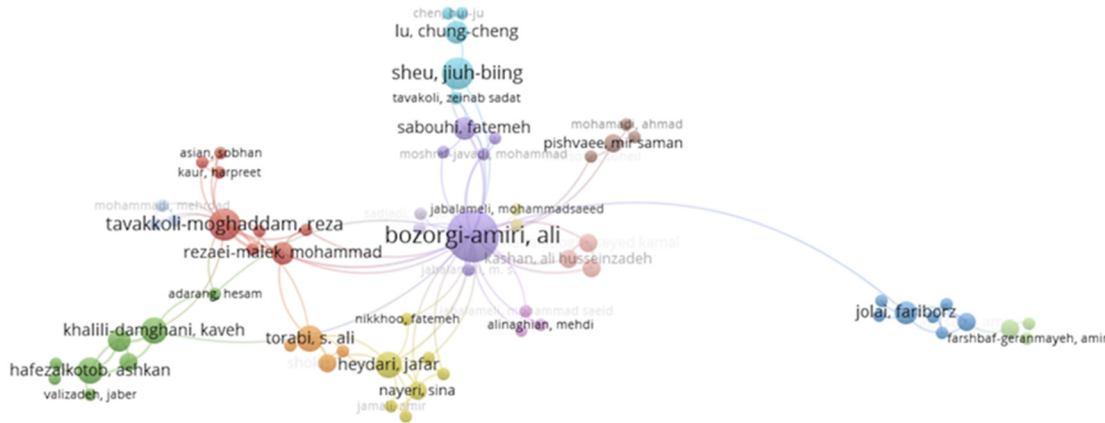


Figure 2. Co-authorship authors mapping

2.2. Analysis of Productive Organizations and Countries

Based on the research collaboration and information sharing, it is possible to produce high-impact research between collaboration organizations [27]. Table 1 shows the 15 most productive organizations in emergency logistics field. As we can see, the university of Tehran with 39 documents, 711 citations and 25 total link strength ranked first, followed by Iran university of science technology, University de toulouse, Delft university of technology and other organizations.

Table 1. The top -15 productive organizations

Rank	Organization	Documents	Citations	Total link strength
1	Univ tehran	39	711	25
2	Iran univ sci & technol	16	408	9
3	Univ toulouse	6	195	9
4	Delft univ technol	4	32	8
5	Hong kong polytech univ	8	176	7
6	Iowa state univ	4	26	6
7	Islamic azad univ	15	165	6
8	Univ agder	3	29	6
9	Wenzhou med univ	4	9	6
10	Natl inst technol agartal	5	39	5
11	Northwest a&f univ	3	77	5
12	Univ sci & technol beijing	3	8	5
13	Univ wisconsin	4	52	5
14	Vellore inst technol	6	40	5
15	Arts & metiers paristech	3	113	4

Figure 3 shows the cooperation network of the productive organizations. The network consists of nodes and lines. Each node represents a organization, and the total link strength of the node is indicated by the size of node. As we can see, the other organizations have more connection and cooperation with the university of Tehran.



Figure 3. Cooperation network of organizations

Figure 4 shows the network of cooperation country. Each node represents a country, and the line indicates the relationship between two countries. The more numerous or thicker the line is, the closer the relationship between two countries. As we can see, China, America and Iran play the key role in the network of cooperation country. As the same time, Turkey, India, England and France have also given a strong boost to the development of emergency logistics problems.

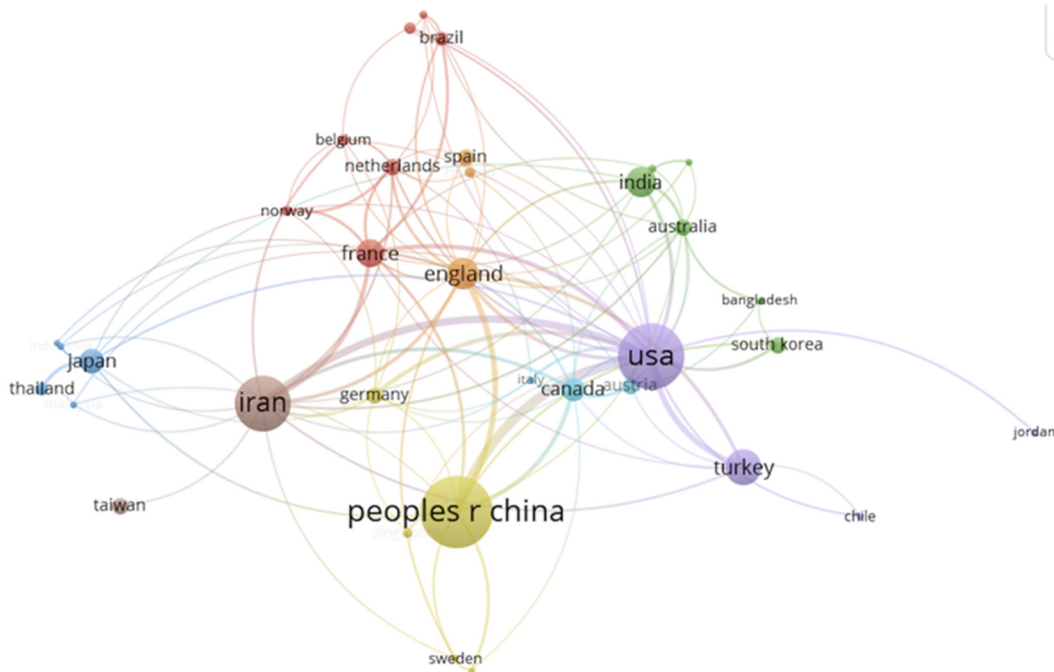


Figure 4. Cooperation country network

2.3. Analysis of Research Hotspots

The co-occurrence of all keywords that related to the problem can be indicated by the research hotspots [28]. In the mapping of keywords, the relevance of items is indicated by the size of the circle, and the most closely related items is presented by the mapping relations. The more frequently the keywords appear, the more popular the topic will be. Figure 5 shows the keyword mapping in field of emergency logistics, and the minimum number of keyword occurrences equals to 3. As the figure shown, the most frequently used keywords including logistics, optimization, management, model, humanitarian logistics and so on. These hotspots

can be divided into three areas. The first one is the types of problem which include routing problem, location-routing problem, evacuation problem and so on. The second one is the theoretical methods which include epsilon constraint method, optimization method and some algorithms. And the last one is the factors that affect the emergency logistics problem which include deprivation cost, vulnerability, uncertainty, redistribution and so on.

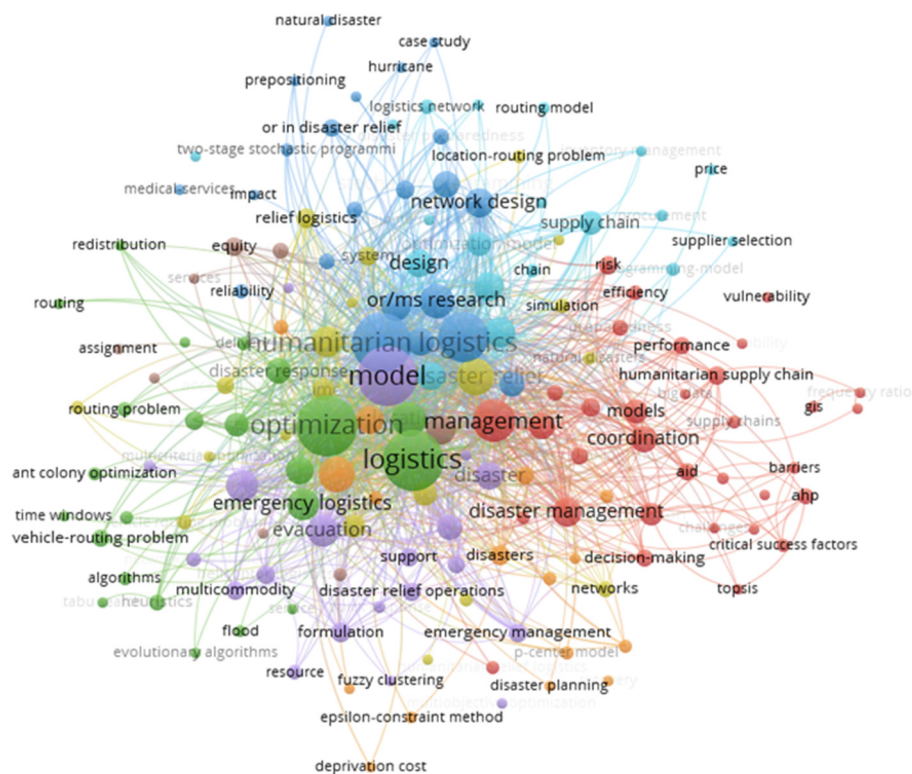


Figure 5. Keywords mapping

3. Conclusion

This paper did a review and comprehensive bibliometric analysis of emergency logistics literature published from 2000 to 2021 and came to several conclusions as follows: since 2010, there has been a substantial increase in the literature on the emergency logistics problem, which indicating that the scholars has pay more attention on relief rescue operations. And now, the research on emergency logistics problem has been relatively completed. Most scholars comprehensively consider the uncertain parameters including demand of relief materials, number of injuries, travel time, cost and risk of emergency facilities or road disruption and construct multi-objective model to determine the location of emergency facilities, routing of vehicle and so on. The addition of these factors makes the research more realistic. Moreover, Bozorgi-Aniri makes the greatest influence to this field. In analysis of productive organizations and countries, we find the other organizations have more connection and cooperation with the university of Tehran. Besides, China, America and Iran play the key role in the network of cooperation country. Finally, we find the optimization, model, management and logistics are the most frequently used keywords in the emergency logistics problems.

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