

# ***Knowledge Mapping Analysis of Rural Logistics Based on WOS and Citespace***

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**Abstract.** Rural logistics serves as a critical conduit for the transportation of agricultural products and consumer goods between rural and urban areas. This plays a vital role in elevating the standard of living for rural inhabitants and driving rural revitalization initiatives. Utilizing the WOS, this study meticulously examines 321 scholarly articles on rural logistics spanning from 2004 to 2023. By leveraging the advanced analytical capabilities of Citespace software, we conduct an in-depth exploration of research collaboration networks, authorship patterns, and keyword co-occurrence trends within this domain. Our findings reveal a remarkable surge in scholarly interest, with a period of exponential growth observed between 2018 and 2023. The results reveal that the related researches experienced an explosive growth from 2018 to 2023, indicating a surge of interest in this field during this period. Among all the countries, China stands out as having the greatest impact in rural logistics research. It was found that the research focus has shifted, now concentrating on the construction of low - carbon sustainable and high - quality rural logistics.

**Keywords:** rural logistics; logistic delivery; low-carbon rural logistics; rural evaluation indicators

## **1. Introduction**

Agriculture plays a crucial role in production, but there are issues such as agricultural product backlog due to insufficient rural logistics construction. The inconvenience of rural logistics has greatly affected economic development, which not only causes damage to the interests of farmers but also brings problems such as waste of agricultural resources[1]. Rural logistics refers to the provision of transportation, handling, loading and unloading, packaging, processing, storage, as well as all related activities for rural residents' production and other economic activities[2]. Over the past few years, the development of e-commerce has spurred fast growth of rural logistics. Especially, since the outbreak of COVID-19, the physical retail industry has been severely impacted, while online shopping has developed rapidly. In 2022, online retail sales in rural China reached 2.17 trillion yuan, with an increase of 3.6% compared to the previous year[3]. The growth of rural e-commerce cannot be achieved without the backing of rural logistics, so it also drives the development of rural logistics. Rural logistics not only helps to improve the lives of farmers,

increase the economic income of farmers, promote the sales of agricultural products in poverty-stricken areas, and prevent a large-scale return to poverty, but also accelerates agricultural production and development. Thus, the study of rural logistics can grasp the development status of rural logistics, assist regions in selecting suitable models, and promote rural economic development. In this context, the study of rural logistics is constantly favored by researchers. Based on WOS (Web of Science), this paper adopts Citespace to analyze the study of rural logistics from 2004 to 2023. The data objectively reflect the current research status of rural logistics and its development trend in recent years.

## 2. Literature review

### 2.1. Rural last-mile delivery

The high delivery cost is one of the main obstacles hindering the development of rural logistics. It has proven that path optimization can enhance logistics delivery efficiency and reduce logistics costs. Especially, the optimization of the last-mile delivery route, as a typical vehicle routing problem, has attracted much research attention[4]. In the path research of rural logistics, some studies propose a capable vehicle path model and approximation algorithm based on a rural road network - a tree topology model[5]. It has been suggested that the truck and trailer routing problem may be more practical in rural areas[6]. Unmanned aerial vehicles (UAVs), or aerial drones, are also considered a good approach to delivering packages to remote rural areas[7] and, as a result, the UAV routing problem[8] has become a research hotspot. The above research aims to reduce the delivery cost and improve delivery efficiency through path optimization based on the existing delivery model. Also, some studies use different delivery modes to enhance delivery efficiency, thereby reducing the delivery cost of the last mile of rural logistics. The current research mainly focuses on two delivery modes: crowdsourcing mode [9] and multimodal transportation mode[10].

### 2.2. Rural logistics construction

The construction of rural logistics involves planning and designing the location and layout of rural logistics and establishing an evaluation system for rural logistics indicators. Specifically, planning and designing the location and layout of rural logistics can improve the delivery efficiency of rural logistics, while establishing an evaluation system for rural logistics indicators can enhance the satisfaction of rural logistics delivery and assist in the sustainable development of rural logistics. Li Z C, Bing X, and Fu X. W. investigated the integrated design problem of urban and rural logistics networks under uncertain demand conditions, and they proposed a model based on a demand scenario algorithm to solve this problem. The algorithm and model can greatly improve the efficiency of urban and rural logistics systems[11]. Considering the characteristics of relatively dispersed logistics needs in urban and rural areas, Dai PQ and Xu J constructed a planning model for urban and rural logistics networks and designed a planning plan to meet the dispersed logistics needs[12].

Some researchers focus on the establishment of an evaluation index system for rural logistics. For example, Jiang H and Yang J employed the rough set theory to analyze the evaluation index system of modern rural logistics, and they constructed a modern rural logistics system specifically from seven aspects[13]. Luo Y and Bai Y utilized the analytic hierarchy process and fuzzy evaluation comprehensive to construct a rural e-commerce logistics service quality evaluation system and

model.[14]. Juan X, et al. developed a dynamic evaluation model for rural logistics development based on the perspective of urban agglomeration[15].

### 2.3. Low Carbon Rural Logistics Study

As people pay attention to the low-carbon economy, research on the low-carbon development of rural logistics is gradually increasing. The main viewpoint is that rural logistics should avoid traditional development models. The earlier rural logistics adapt to a low-carbon development environment, where enterprises face less pressure on rural logistics. Thus, there's an urgent need to implement low-carbon policies, apply appropriate strategies in a timely manner, and transition rural logistics firms to low-carbon models[16, 17].

The existing research work on rural low-carbon logistics mainly focuses on two aspects. One is analyzing factors impacting rural low-carbon logistics development. For instance, Li Lixiao studied China's rural logistics from 2002 to 2012, exploring the influence of economic, infrastructure, and market factors, and offered suggestions based on foreign experience[18]. Zhang DM et al. established an evolutionary framework for low-carbon rural logistics systems, showing that low-carbon capabilities are key for sustainable development[19]. The other aspect is studying the operation mode of rural low-carbon logistics. Huang Fuhua et al., via literature and field research, proposed a low-carbon co-development model linking rural e-commerce and logistics[20]. Bian X and Xu J suggested the government adopt green image policies initially and carbon tax rebate policies later to boost rural logistics' low-carbon transformation[21].

## 3. Data sources and research tools

The WOS core collection database contains more than 10,000 excellent academic journals in various disciplines over the world, so this study chooses the WOS core database as the source of research data. The selected period is 2004 to 2023, and because fewer journals are searched with precisely merged keywords, the theme of this paper is set as "rational logistics", while "rural e-commerce", "agricultural product logistics", "rural supply chain", "last mile", "rural revitalization", and "agricultural product business" were searched in the database. The types of literature searched were essays and reports, while conference papers, patents, etc., were excluded. Finally, 321 valid documents were obtained, and the filtered results were exported in the plain text format of "Full Record with Cited References" as the research samples for analysis.

This study mainly uses CiteSpace as the search tool to analyze the number and growth trend of annual publications through software, investigate the cooperation network between authors/institutions/countries, identify commonly cited references, and capture strong cited keywords that change over time to reveal the research frontiers and emerging trends of rural logistics.

## 4. Current status of rural logistics research

### 4.1. Analysis of the annual volume of publications

As shown in Figure 1, the research on rural logistics in the twenty-first century first appeared in 2004, and during the period from 2004 to 2017, the number of publications was relatively small, all in single digits. With the proposal of China's rural revitalization strategy and the development of rural e-commerce in October 2017, there is an explosive growth of articles about rural logistics in

the WOS core database. Trend analysis shows that the number of publications in this field will continue to grow and maintain a high level.

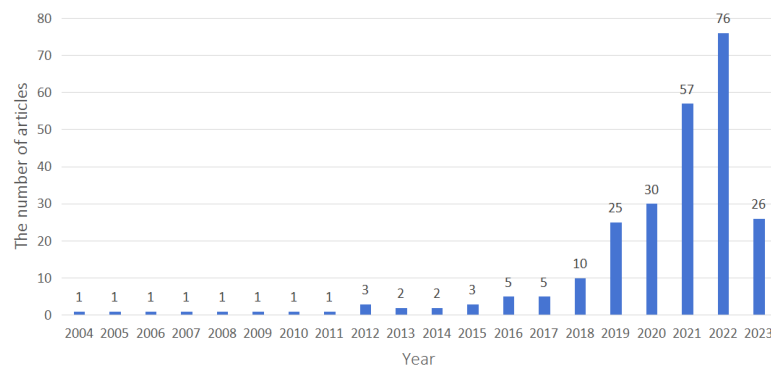


Figure 1: The annual number of publications

## 4.2. Author Collaboration Network



Figure 2: Author of the text

It can be seen from Figure 2 that KANGKANGYU has the largest number of articles (i.e., five), followed by THOMASGRIFFITHS, MARKJSIEDNER, KHAERABULA and other eight authors, and each of them has three articles, and ZIXINGWANG, ZHIQIANGLIU, YANQIZHANG, and other forty-nine authors have two articles, while other authors have one article. Also, it can be seen from Figure 2 that the collaboration network of authors involved in rural logistics research from 2004 to 2023 consists of 276 authors and 404 connecting lines, and the connecting lines between nodes indicate that there are collaborative publications between different authors. Besides, Figure 2 demonstrates that although the per capita number of articles is small, the authors cooperate a lot and have formed a collaboration group. In the future, different groups can collaborate to advance rural logistics by integrating diverse perspectives. Meanwhile, KANGKANGYU has fewer exchanges with other authors, and the group formed includes only four authors, without forming a mature core field; in the future, the author can strengthen communication and cooperation with others in the field to promote the development of the field.

### 4.3. National (regional) collaboration networks

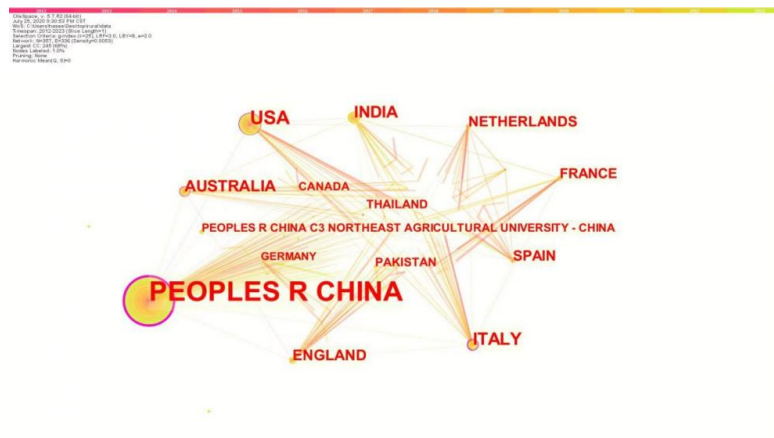


Figure 3: Mapping of collaboration networks in the issuing countries (regions)

Table 1: Top 10 countries (regions) in terms of intermediary centrality

| States        | Number of communications | intermediary centrality | States         | Number of communications | intermediary centrality |
|---------------|--------------------------|-------------------------|----------------|--------------------------|-------------------------|
| China         | 94                       | 0.56                    | Italy          | 7                        | 0.05                    |
| America       | 27                       | 0.2                     | Australia      | 3                        | 0.05                    |
| Britain       | 10                       | 0.17                    | Banglades<br>h | 2                        | 0.05                    |
| Nigeria       | 8                        | 0.1                     | Iran           | 3                        | 0.03                    |
| Brazilia<br>n | 12                       | 0.08                    | Cameroon       | 2                        | 0.03                    |

In CiteSpace, nodes with mediated centrality over 0.1 are referred to as key nodes with high academic influence. From Table 1, it can be seen that the mediated centrality of China, America, Britain, and Nigeria are 0.56, 0.2, 0.17, and 0.1, respectively, so these countries exhibit high mediated centrality and play a crucial role in connecting with other countries (regions). In the collaboration network of countries (regions), China's number of articles and intermediary centrality are much larger than those of other countries, indicating that China has a high voice and academic influence in the research field of rural logistics. It is worthwhile to pay attention to two points. First, many developing countries are actively studying rural logistics, and the positive links between rural logistics and economy have been confirmed[22]; second, among the top ten countries ranked by the centrality of intermediaries, five countries (regions) have signed the cooperation documents of the "Belt and Road" with China (Nigeria, Italy, Bangladesh, Iran, and Cameroon). Some studies in China have investigated the relationship between the logistics industry and economic growth under the "Belt and Road" initiative, and some studies have shown that since the "Belt and Road" initiative was put forward, green logistics has increased the exports of the countries along the route and promoted the sustainable development of the economy[23]. The trade cooperation between China and the countries along the route has promoted the logistics and economic development of the countries along the routes, and this could be the reason why they are paying more attention to logistics.

## 5. Hot Trends in Rural Logistics Research

### 5.1. Keyword co-occurrence analysis

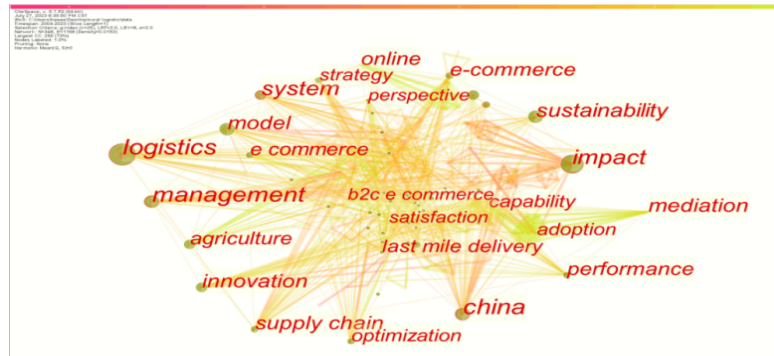


Figure 4: Keyword contribution mapping

In the keyword map illustrated in Figure 4, the size of the node represents the number of keyword appearances; the larger the node, the higher the frequency of keyword appearances, and the thicker the connecting line, the higher the frequency of co-occurrence. As illustrated in Figure 4, there are 348 keywords and 1168 connecting lines in the keyword co-occurrence mapping, and the grid density is 0.0193. The connecting lines represent that the keywords appear in the same paper, and the larger the font size, the larger the centrality of the nodes where the keywords are located. In this figure, China, management, and logistics are the main keywords, followed by e-commerce, model, and impact. Moreover, Figure 4 shows that the research hotspots in this field are concentrated and clear, with strong articulation between different keywords and high keyword hotness. Combined with the figure, it is concluded that much literature uses models to study the impact factors of e-commerce and rural logistics in China and puts forward the corresponding management recommendations for better constructing rural logistics.

### 5.2. Keyword Cluster Analysis

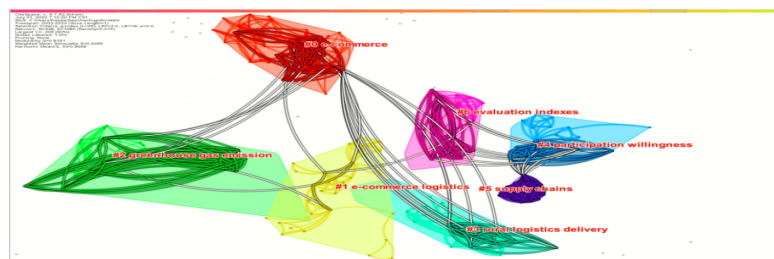


Figure 5: Keyword clustering map

The clustering analysis results of keywords based on keyword co-occurrence mapping are shown in Figure 5. In the network structure of the knowledge graph and clustering map, there are the clustering module value (i.e., Q value) and the clustering average module value (i.e., S value). When the Q value is more than 0.3, it indicates that the structure of the clustering is obvious, and when the S value is more than 0.7, it indicates that this clustering has a high degree of credibility. As shown in Figure 5, the clustering module value of the clustering map is  $0.8151 > 0.3$ , which is much larger than the standard value of 0.3, indicating that the clustering structure is obvious; the average module

value of the clustering is  $0.9255 > 0.7$ , which indicates that this clustering has a high degree of credibility. Combined with the literature review, clusters #0, #1 "e-commerce" and "evaluation" are to study the development of rural logistics in the context of rural e-commerce, cluster #2 focuses on greenhouse gas emissions, i.e., the development of rural low-carbon logistics, cluster #3 "rural logistic delivery" focuses on the last-mile delivery of rural logistics, cluster #4 "participation willingness" focuses on the crowdsourcing and multimodal transportation of multimodal logistics, cluster #5 "supply chain" focuses on agricultural supply chain logistics, and cluster #6 "evaluation index" focuses on the establishment of evaluation indexes for rural logistics. These clusters represent hot research directions of rural logistics, and future research will be on these hot spots.

### 5.3. Keyword emergence analysis

CiteSpace provides the Burstdetection function to detect a large change in the citation volume in a certain period. In this study, it is used to detect the decline or rise of a certain topic or keyword.

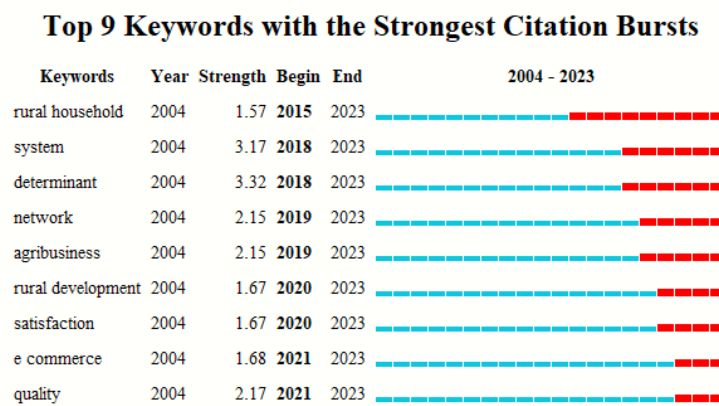


Figure 6: Keyword emergence mapping

In this paper, the number of keyword occurrences in the literature on rural logistics from 2012 to 2022 is calculated by "mutation detection", and nine hot words with a strong mutation are obtained. The hot words in the chart are sorted according to the time, and the part of the bold horizontal line in the chart represents a surge in the amount of related literature on the hot words in the corresponding years. It can be seen from Figure 6 that the first emergent word is "rural household", which represents the initial focus of researchers on rural households, and the subsequent emergent words are "system", "determinants", "network", and "agribusiness", which suggests that in the earlier period after 2017, researchers focused on the rural logistics system/network, including the main body (agribusiness) involved in rural logistics and the determinant of rural logistics, and from 2020 onwards, researchers pay attention to investigating the impact of rural logistics on rural development, the evaluation system of rural logistics, how to improve the satisfaction of rural logistics, the development of rural logistics driven by rural e-commerce, and how to develop high-quality rural logistics.

## 6. Conclusion and outlook

### 6.1. Conclusion

By analyzing the literature in the field of rural logistics research based on Citespace, the following conclusions are drawn.

1.The number of annual publications demonstrates that there was less literature on rural logistics before 2017, and after the rural revitalization strategy was proposed in 2017, the literature related to rural logistics increased exponentially. According to the keyword clustering analysis, that rural logistics research mainly concentrates on four aspects: the development of rural logistics driven by rural e-commerce, the evaluation indexes of rural logistics, the distribution of rural logistics, and the low-carbon construction.

2.China ranks first in terms of the number and impact of articles published on rural logistics, and in terms of the impact of articles published, six of the top ten countries are developing countries, which are actively researching rural logistics to promote the development of local rural economies. Also, five out of the top ten countries have signed the "Belt and Road" cooperation agreement with China, and China's emphasis and research on rural logistics has been radiated to the partner countries along the "Belt and Road" through trade, which has driven the development of local logistics and rural logistics, leading to the development of local logistics and research on rural logistics.

3.There are no influential representatives among the authors who have studied rural logistics, and there is much cooperation among authors; however, different cooperation groups are dispersed, and there is a lack of cooperation among these groups. In the future, these groups from different countries can communicate more and use foreign trade as an intermediary to jointly promote the development of rural logistics.

4.The emergence of keywords in rural logistics research indicates that the research direction of rural logistics is more focused on three aspects: (1) the construction and development of low-carbon rural logistics; (2) the construction of a rural logistics evaluation system to improve the satisfaction of rural logistics; (3) the construction and development of rural logistics under the impetus of rural e-commerce.

### 6.2. Research Outlook

1.Further promote the research on low-carbon rural logistics. While the influence of low-carbon policies on this field has been studied, some policies haven't been adopted by the logistics sector. Future research could explore better ways to apply these policies to rural logistics. Some studies indicate that without policy intervention, rural logistics may not adopt low - carbon behaviors on their own[24]. In the future, research will focus on the factors that can improve the low-carbon autonomy of rural logistics and the green awareness of rural logistics enterprises and related personnel; in the study of low-carbon logistics, some variable parameter indicators, such as the carbon tax rate and the public's green awareness, can be incorporated as an influencing factor in the study of low-carbon rural logistics development. Moreover, it may be an interesting research direction to focus on the "catfish effects" and investigate whether the competition of multiple logistics enterprises can be utilized to promote the development of low-carbon rural logistics.

2.Promote the construction of high-quality rural logistics. The effectiveness of some site selection models in increasing the efficiency of rural logistics and distribution is only verified theoretically, and in the future, the results of the model can be used in the actual logistics construction to verify its

effectiveness; meanwhile, the model can be continuously improved through the tracking and measurement of the model and apply it to the actual situation again; many scholars have conducted much research on the quality of logistics services and have achieved many outstanding results, and in the future, the model can be more comprehensive by considering other quality indicators of logistics services. In the study of rural logistics, many models are developed only for a certain region and are not representative, and in the future, they can be applied to other regions to find out the common points of the development of rural logistics in different regions, broaden the application scope of the model, and compare the differences between different regions, so that the model can be improved in a targeted approach to help the development of local rural logistics.

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