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Literature Research on Port Logistics and Regional Coordinated Development

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Abstract

With the rapid development of the economy and society, trade exchanges are becoming more and more frequent, and logistics has become the third source of profit in economic and social production and development activities. In the context of deepening economic globalization and regional integration, port logistics, as an important hub of trade, occupies a considerable proportion in the entire logistics industry, and its coordinated development with the region has attracted attention. Exploring the interaction between port logistics and regional coordinated development has important theoretical and practical value in optimizing regional resource allocation, enhancing regional economic competitiveness, and achieving regional healthy and sustainable development. This paper reviews and analyzes the research results of port logistics, and reviews the research results of port logistics and regional economic development, green coordinated development and linkage development level evaluation, so as to have a more comprehensive understanding of the research on port logistics and regional coordinated development in recent years, and provide reference for future research on port logistics.

Keywords

Port Logistics; Regional Economy; Green Development; Evaluation System; Review.

1. Introduction

As the core link of the global supply chain, port logistics plays an irreplaceable role in regional development and global economic process. It is not only a key area for governments and international organizations to formulate policies and plan development strategies, but also the first choice for cross-border trade when choosing logistics methods, in which 90% of goods are transported through seaports. With the accelerated development of economic globalization and the increasingly frequent flow of production factors, the efficiency and innovation ability of port logistics have become the key factors affecting the competitiveness of a country or region. At present, the academic research on port logistics is gradually deepening, and is committed to exploring how to improve the quality of port services and reduce logistics costs, so as to better adapt to the trend of regional coordinated development. Policymakers are also actively exploring ways to strengthen port infrastructure construction and improve the efficiency of port customs clearance through policy innovation to support regional economic development. At the same time, the implementation of the "dual carbon" strategy and the improvement of public awareness of environmental protection have prompted port logistics and regional development to pay more attention to green, coordinated and sustainable development. The concept of a green port was born with the goal of achieving environmentally friendly port operations and efficient use of energy. Research in the field of port logistics is of far-reaching significance for guiding practice, promoting global trade and regional development.

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2. Data Sources and Research Methods

2.1. Data Source

The literature data in this paper are extracted from the relevant literature of the China National Knowledge Infrastructure (CNKI) paper database in the past ten years. In order to better grasp the research topics and research hotspots and ensure the quality of data, the literature category is academic journals and master's and doctoral dissertations, the screening topic is port logistics, and the journal literature sources are set up to be core journals such as Peking University Core, CSSCI, EI and CSCD. The obtained literature excluded articles that were not closely related to the theme, such as conferences, newspapers and standards, and finally obtained 598 valid literature. Among them, there are 500 journal papers and 98 master's and doctoral dissertations.

2.2. Research Methods

In this paper, the bibliometric method is adopted, and the knowledge graph visual analysis is carried out with the help of VOS viewer bibliometric tool. Using the visual analysis technology of VOS viewer, the obtained effective subject literature was analyzed by keyword co-occurrence network analysis and keyword co-occurrence time zone distribution map analysis, and the development path, hotspots and trends in this field were studied.

3. Research Status

Port logistics refers to the city located in the port, using its own port advantages, relying on the advanced software and hardware environment, strengthening its radiation capacity for logistics activities around the port, with the support of information technology, with the goal of optimizing the integration of port resources, and developing a comprehensive port service system covering all links of the logistics industry chain [1]. Port logistics takes transportation and transit as the main function, and realizes the functions of transportation, warehousing, processing, packaging, distribution and information exchange of goods. The rise of port logistics is closely related to economic and social progress, which mainly depends on the economic conditions, foreign trade and economic technology of the port hinterland. Before the 80s of the 20th century, China's logistics was characterized by multiple batches, small batches, and low specialization, and the demand for port logistics services was small [2]. After the reform and opening up, especially since the beginning of the 21st century, China's port logistics industry has developed rapidly, gradually transforming from traditional to modern port logistics system.

Through the analysis of the keyword co-occurrence network in Figure 1, it is found that the research on port logistics focuses on its relationship with regional development, mainly including the coordinated development of port logistics and regional economy, the coordinated development of port logistics and regional green, the comprehensive evaluation of port logistics development level, port logistics and regional industrial structure, and port logistics and supply chain. It shows that these are hot issues in the study of port logistics. According to the time zone distribution of keyword contributions in Figure 2, with the development of time, the research hotspots of port logistics in recent years have focused more on port logistics and regional economic development, port logistics efficiency evaluation, port logistics and supply chain and sustainable development of port logistics. It can be seen that these aspects are the main trends of future research.

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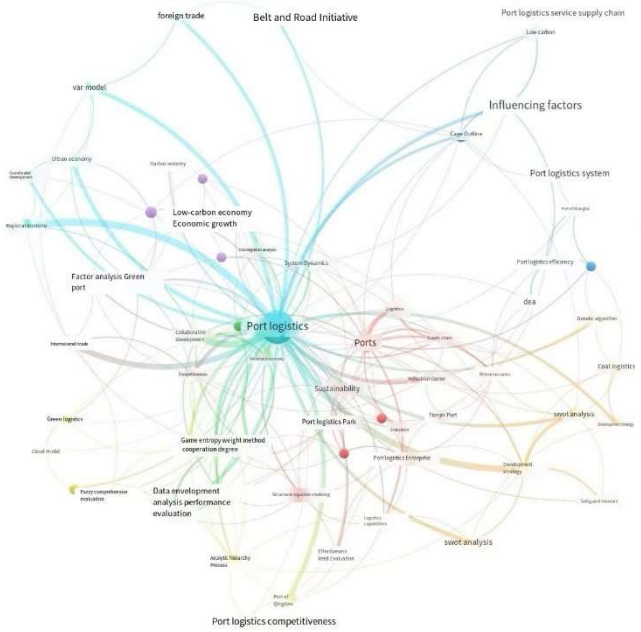

Fig. 1 Keyword co-occurrence network

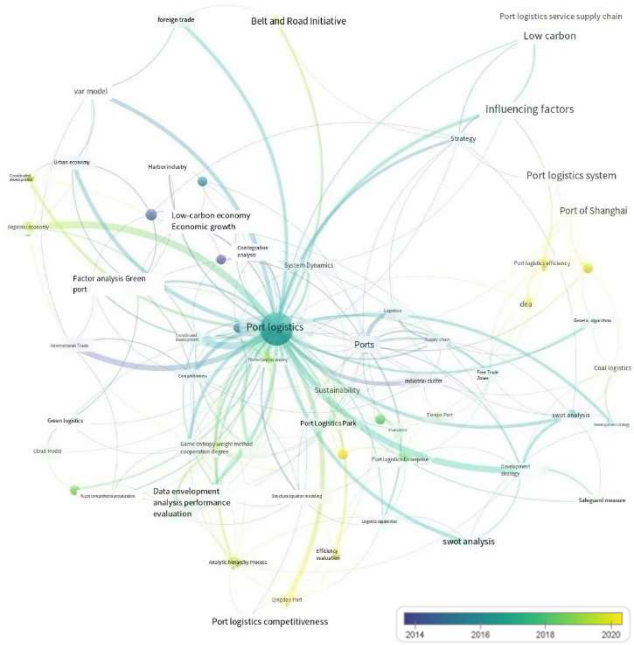

Fig. 2 Keyword time zone distribution

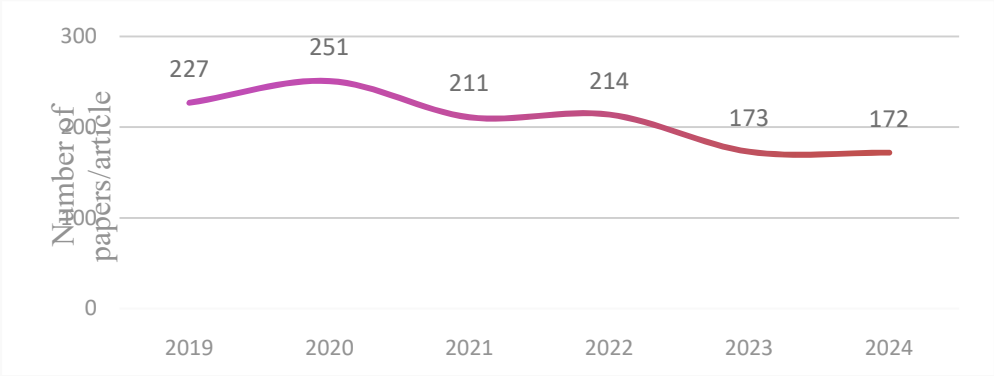

Fig.3 The number of documents issued by port logistics in the past five years

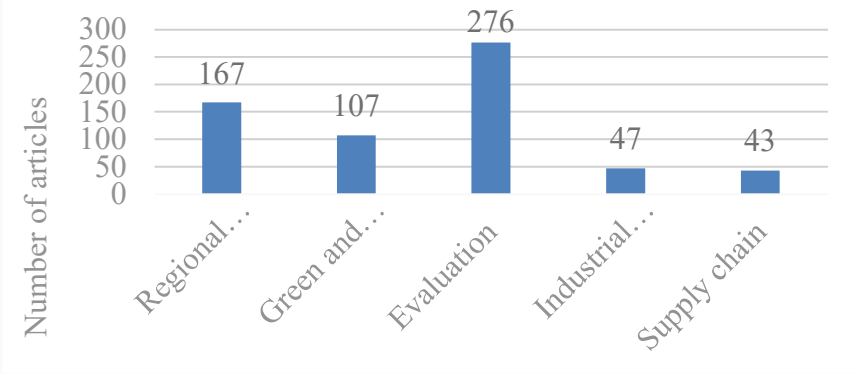

Fig.4 The distribution of major topics related to port logistics in the past five years

Using the same method as above, the relevant topics were searched in the core database of CNKI, and the number of publications on port logistics and the main related topic literature in the last five years were collected. As shown in Figure 3, the number of publications related to port logistics in the past five years has remained at a relatively stable level, and the exploration of related fields is still ongoing, and the research in this field can continue to be deepened. As shown in Figure 4, the research on port logistics shows a trend of diversification, and scholars

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not only conduct research in the fields of port logistics evaluation, regional economic impact and green coordinated development, but also explore related port logistics and industrial structure and supply chain management.

In addition, in the process of searching the literature, there is also a research on the theory of port logistics policy, which is of great significance for guiding and promoting the development of port logistics. Lin Yang [3] believes that the public policy of port logistics refers to the various opinions and measures implemented by local governments to favor port logistics according to the development trend of the port logistics industry in the region and in order to achieve the goal of accelerating the development of port logistics and the evolution to a higher level in a certain period of time. Xing Husong [4] elaborated on the connotation and manifestation of port logistics policy, China's port logistics policy is mostly in the form of "planning", "opinions", "notices" and "demonstration projects" issued by government departments, which is authoritative and practical, and needs to have stronger coercive policies. In terms of port logistics and industrial structure, supply chain management. Lü Zan et al. [5,6] used the deviation-share analysis method and the grey correlation analysis method to explore the relationship between the regional industrial structure and the development of port logistics, and discussed the port logistics operation mode based on supply chain management. Yuan Peng [7] studied the informatization construction of the port logistics trade supply chain and analyzed the factors affecting the informatization construction of the port logistics trade supply chain.

In summary, based on the keyword co-occurrence cluster analysis and the distribution of related topics, combined with the analysis of the number of publications, research hotspots and trends in recent years, this paper will summarize the relationship between port logistics and regional economic development, the coordinated development of port logistics and regional green, and the evaluation of the level of linkage development between port logistics and region.

4. Research on Port Logistics

China's port logistics has developed rapidly in recent years and has made remarkable achievements, largely thanks to the continuous and in-depth research of relevant scholars in this field. This paper will comprehensively analyze the main views and achievements of the current academic research on port logistics and regional development from the following perspectives of port logistics, in order to provide reference and enlightenment for future development.

4.1. Research on Port Logistics and Regional Economic Development

When discussing port logistics and regional development, we cannot ignore the key role of port logistics in promoting regional economic development, which not only greatly improves the economic vitality of the region, but also accelerates the process of regional integration. In recent years, Xu Rui [8] has focused on the interaction between port logistics and urban economic development, the influencing mechanism and the optimization path. Cao Bingru et al. [9,10] calculated the gravitational value between port logistics and hinterland economy by constructing a synergy model and a gravitational model, and further analyzed the synergistic relationship between the two. It is found that there is an obvious synergistic relationship between port logistics and hinterland economy, and the gravitational value is closely related to the degree of synergy. Zhai Wandong [11] also explored the relationship between trunk port logistics and regional economy through the gravitational model, which significantly increased the import and export trade volume and played an important role in regional development, but the impact on human capital was not significant. Regression analysis is also a common method to study port logistics and regional economic development, and the specific literature and perspectives are shown in Table 1.

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Table 1. Major literature using regression analysis

Theme	Model/methodology	Research conclusions	literature sources
The impact of coastal port logistics on the city's economy	VAR model	The cargo throughput of the port has significantly promoted the economic growth of the city and the optimization of the industrial structure	Li Zhimin[12]
The interaction between port logistics, industrial structure upgrading and urban economic growth	PVAR model	Inland port logistics has a significant impact on regional economic growth and deeply affects regional industrial upgrading	Meng Kui et al.[13]
The relationship between port logistics and urban economic development	Regression analysis	In order to maximize the economic driving effect of port logistics, it is necessary to optimize the industrial structure	Chen Yi et al.[14]

On the basis of the use of regression analysis, the grey correlation analysis method is further combined. Liu et al. [15,16] used grey correlation and VAR models to analyze the correlation and coordinated development of cargo throughput and regional economic indicators in port clusters. Strengthening the mutual penetration of port logistics and regional economy, and rational planning and layout, will promote the sustainable and healthy development of the regional economy. Xu Xinyi [17] pointed out that China's port logistics has the characteristics of large scale and high degree of intensification, and has entered the stage of green development. However, at the same time, there are problems such as insufficient informatization construction, and it is necessary to continue to improve infrastructure and promote intelligent development. Zhu Lanlan [18] discussed the internal driving forces of port logistics agglomeration in China from the perspective of the dynamic mechanism of port logistics agglomeration, and analyzed the impact of these dynamics on the regional economy. The Lorentz curve is used to quantify the degree of agglomeration of port logistics, and the five factors of technology, location, market, economy and policy drive the agglomeration of port logistics are examined in detail. Using the logistic function model, the spatial distribution of port logistics agglomeration power and the effect of regional economic development are accurately analyzed.

Exploring port logistics and regional economic development has become a hot issue of concern. In the current study, scholars have used a variety of methods and models to explore the interaction mechanism between the two and their influencing effects. Commonly used methods and models include the gravitational model, which draws on the concept of gravity in physics to calculate the "economic gravity" between port logistics to evaluate the economic impact of ports; The synergy model analyzes the degree of synergistic development between the port and the hinterland economy, and examines the interaction and synergy between the two, so as to reveal the internal mechanism of port logistics on the regional economy. The regression model establishes the relationship between variables and analyzes the main impact of port logistics on urban economic growth and industrial structure optimization; The VAR model and PVAR model are used to study the dynamic relationship between inland port logistics, industrial structure upgrading and urban economic growth by combining panel data and vector autoregressive analysis methods. Grey correlation analysis, an analysis method based on grey system theory, is used to study the degree of correlation between different variables; The

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Lorentz curve is often used to analyze the degree of port logistics agglomeration, while the Logistic function model is used to predict and simulate the change trend of the impact of port logistics agglomeration on the regional economy. These methods and models have their own emphasis, and the synergy model mainly focuses on the synergistic relationship and influence scope between ports and hinterland economy, but fails to deeply explore the interaction between port logistics and specific aspects such as industrial structure upgrading and urban economic growth. Although the PVAR model can analyze the interaction between the three, its dynamics are relatively weak, and it is difficult to capture the long-term impact effect between the three. Gravitational models assume that the connection between ports and hinterland economies is linear, which may not be the case. Therefore, future research needs to select the appropriate model according to the research question and consider the limitations of the model. In addition, most of the data in the study are mainly derived from official statistics, and in the process of collecting data, attention should be paid to the source and reliability of the data to improve the objectivity and accuracy of the research.

4.2. Research on the Coordinated Development of Port Logistics and Regional Green.

Against the backdrop of increasingly serious global environmental degradation, green and low-carbon development has become imperative. As an important part of logistics, the green innovation of port logistics business is of great significance to promote regional and even global sustainable development. This paper explores how to balance the development of port logistics with regional environmental protection and the strategies and practices of promoting green growth, so as to provide theoretical reference for policy formulation and academic research in related fields.

Research on the application of technological innovation and intelligence in green port logistics. Liang et al. [19,20,21] focused on how to use advanced technologies to achieve energy saving, emission reduction, and efficiency improvement in port logistics. For example, ports widely adopt shore power technology, high-efficiency LED lighting and clean energy; Robotic loading and unloading systems and automated guided vehicles (AGVs), predictive maintenance systems, intelligent inventory siting, and vehicle route optimization systems, among others. Yin Xuecheng [22] elaborated on the strategy of Lianyungang Port to build a green and low-carbon port, including building a guarantee system, researching and promoting green technologies, and using information tools. For example, building green shipping routes and promoting the development of low-carbon industries to support the green transformation of ports.

Research on the application of multimodal transport in green port logistics. Cui Can et al. [23,24] analyzed some problems existing in the port logistics system and proposed strategies to innovate and optimize the multimodal transport organization model. It gives full play to the comparative advantages and combined efficiency of various modes of transportation, improves the network effect and scale efficiency of logistics, and promotes the specialization and standardization of multimodal transportation equipment. Zou et al. [25] pointed out that innovative technologies should be used to promote the intelligent and green transformation of the collection and distribution system, and at the same time, attention should be paid to the coordination with other transportation modes to form an efficient, environmentally friendly and safe transportation network. It can be seen that multimodal transport is an important measure to promote the coordinated development of port logistics and regional green, and other major literature is shown in Table 2.

In terms of theoretical, policy, and cultural studies. Zhu Li et al. [30] discussed the green ecological mechanism of the port area, and pointed out that the motivation of port logistics enterprises in reducing emissions and environmental protection is insufficient, and it is necessary to strengthen government guidance and combine it with ecological and cultural

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construction, and adopt mandatory and incentive strategies. Zhou Ning [31] Considering the high energy consumption and high pollution characteristics of the port logistics industry, and the lag of green port construction in China, theoretical research and practical exploration are in the initial stage. It is necessary to change the concept and cultivate a green port culture, improve environmental protection facilities, evaluation systems and legal norms, and promote the port to move towards scale, intensification and modernization. Zhu Jingjing [32] introduced the theoretical research status of port cluster logistics network optimization, low-carbon transportation and hub-and-spoke network, and explored the application of the theory of radial transportation network based on carbon emissions in the optimization of port cluster transportation.

Table 2. Main literature on multimodal transport

Theme	Model/methodology	Research conclusions	literature sources
Economical and green multimodal transport	Entropy weight method, sensitivity analysis method, fuzzy evaluation	Sea-rail intermodal transport to increase the proportion of railway transport and sea transshipment	Jin Linet al.[26,27]
The issue of coordinated development of different modes of transport	Synergy evaluation model and evolution equation	The level of low-carbon coordinated development is low	Cui Qiang et al.[28]
Calculation of carbon reduction effect of multimodal transport	Grey predictive model	Verify the effectiveness of multimodal transport	Liu Haoxue et al.[29]

Zhou Xiaoyang et al. [33] studied the port logistics system under uncertain conditions, adopted a decentralized two-tier planning method, and considered environmental factors, to construct a two-layer multi-objective port logistics green collaborative model. The uncertainty is dealt with by chance constraints, and the interactive algorithm is used to simplify the two-level programming into a single-layer problem, so that the model can be solved. The model takes into account the port's competitiveness, environmental impact, economic benefits and costs, as well as the optimal allocation of transportation resources. Gan et al. [34] integrated these two methods through the SWOT-PEST model, analyzed the advantages, disadvantages, opportunities and threats of the development of low-carbon logistics ports from political, economic, social and technological factors, and proposed an implementation plan that was dynamically adjusted in combination with policy planning. Hu et al. [35] also used SWOT analysis to analyze the advantages and disadvantages of port logistics, as well as the opportunities and challenges faced by the outside world in a low-carbon economy.

From multiple perspectives, including technology application, strategic transformation, standardized management, policies and regulations, cultural cultivation and method models, the researchers discussed the green innovation of port logistics and the green and coordinated development of the region. The application of emerging technologies is key to achieving energy saving, emission reduction and efficiency improvement, while strategic transformation measures can help to promote the development of a more environmentally friendly and efficient port logistics industry. Standardization measures, information tools and the use of multimodal transport can improve port layout and production management, and improve overall operational efficiency. Mandatory and incentive strategies under the guidance of the government are of great significance to promote the development of green ports. At the same time, building an intelligent and green collection and distribution system has also become a key

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strategy for the future of port logistics. These studies provide ideas and solutions for the green transformation of the port logistics industry, but the current research as a whole mainly focuses on technological innovation, and relatively few studies on policy guidance, regulation formulation and social participation. In the future, the research should pay more attention to empirical research and data analysis, strengthen policy research and social participation, and provide more specific and practical suggestions for the coordinated development of port logistics and regional green, so as to promote the sustainable development of the port logistics industry.

4.3. Research on the Evaluation of Port Logistics and Regional Linkage

In the context of economic globalization and regional integration, the interaction between port logistics and regional development is becoming increasingly significant. Sorting out the existing research literature on the linkage evaluation of port logistics and region, and identifying the main evaluation indicators and methods, is helpful to understand the development level of port logistics and the promotion mechanism of regional development, and also provides theoretical support and practical guidance for optimizing the port logistics system and improving the level of regional coordinated development.

In terms of the selection of evaluation indicators. Jiang Dongwei [36] analyzed the current development of the port logistics industry in different coastal regions of China. The first-level indicators including port logistics infrastructure, port logistics scale, and port logistics collection and distribution level were selected and subdivided into 14 second-level indicators, which reflected the development level and trend of China's port logistics. Zhu Fangyang et al. [37] evaluated the logistics competitiveness of different ports in the region, and the main indicators selected were composed of five aspects: port logistics scale capacity, port logistics infrastructure, port hinterland economic level, port logistics service level and port logistics sustainable development ability. After analyzing the evolution, characteristics, and future trends of port logistics, Xu Yufeng [38] examined three core dimensions that affect the development of port logistics: infrastructure status, logistics capacity, and economic level. Through correlation analysis and principal component analysis, a quantitative evaluation system of port logistics was constructed. Liu Yungang [39] took the Beibu Gulf Port as the research object to conduct an empirical study on the relationship between port logistics and import and export trade in the Beibu Gulf region. The main indicators such as cargo throughput, container throughput and total import and export trade were selected to establish a vector autoregressive model with three variables. There is a certain similarity in the selection of indicators, which are also commonly used in the evaluation process.

In terms of evaluation methodology. Different scholars have also adopted a variety of methods, and through the understanding of these evaluation methods, they can provide reference for future research. The common methods of his research are shown in Table 3.

Huang Meiying et al. [46] focused on the impact of port logistics on the development of foreign trade in the region, and selected data such as total import and export volume and port cargo throughput. The econometric model was constructed, and the cointegration test was carried out by eviews software to draw conclusions. Wei Jiajia et al. [47] used the port logistics service level index as the standard to measure the port performance, and used the fuzzy comprehensive evaluation method and information entropy technology to verify the effectiveness of the evaluation model of port logistics service level by taking Qinzhou Port as a case.

In the research on the evaluation of the development level of port logistics and regional linkage, it covers many aspects such as port logistics infrastructure, scale, collection and distribution level, greening degree and service level. Scholars used entropy weight method, analytic hierarchy process, principal component analysis method, BP neural network model simulation, AHP-TOPSIS method, multi-level synthesis model, econometric model, obstacle degree model

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and other methods for evaluation and analysis. However, there are still some shortcomings in the existing research. For example, some studies rely too much on quantitative data and ignore the impact of qualitative factors on the development of port logistics. There is a lack of comparative analysis and case verification of different types of port logistics and different method models, which leads to the limited applicability of evaluation results and evaluation models. The research is relatively simple in the construction of the index system, and the selection of indicators is highly subjective, which fails to fully reflect the development status of port logistics. At present, in the evaluation system of port logistics and regional development level, there are no strict standards and specific specifications for the selection of indicators, and the research in this direction can be further deepened.

Table 3. To review the literature on commonly used research methods

Theme	Model/methodology	literature sources
Evaluation of the development level of port logistics in special areas	Analytic hierarchy process, entropy weight method, BP neural network model simulation method	Xiong Qi[40]
Evaluation of influencing factors of port logistics development scale	AHP-TOPSIS	Gao Haonan[41]
An empirical analysis of the logistics service level of major coastal ports	Vague evaluations	Meng Wei et al.[42]
Evaluation of the coupling and coordinated development of "port logistics-port industry-regional economy".	Entropy weight method, obstacle degree model, gray correlation degree analysis method	Ouyang Xuelian et al.[43]
Evaluation of the synergistic development level of port logistics capacity and regional industrial structure upgrading	Composite system synergy model	Zhang Chen et al.[44]
Evaluation of the degree of greening of port logistics	Multi-level synthesis model	Nui Erxuan[45]

5. Conclusion

Through the analysis of the research literature on port logistics and regional coordinated development, the port, as a window for the external development of a city or region, occupies an important position in regional development. The coordinated development of port logistics and the region is directly related to the implementation of regional development strategies, economic growth and trade efficiency. From the perspective of research trends, the coordinated development of port logistics and regions is also an important topic for future research, including economic coordination, environmental coordination, industrial cooperation and policy assistance. Especially in the context of globalization and regional integration, how to enhance the driving role of port logistics in the regional economy will be the key. In the future, port logistics research will pay more attention to green and sustainable development, so as to achieve the purpose of adapting to regional environmental protection policies and national carbon reduction strategies. At the same time, with the development of information technologies such as big data, cloud computing, and the Internet of Things, the intelligent and digital transformation of port logistics will become a new research direction. In addition, in terms of research methodology, future research will continue to deepen the application of existing models and explore more innovative methodologies. For example, combining machine learning and artificial intelligence technologies to improve the prediction accuracy and

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decision-making efficiency of port logistics systems, or using blockchain technology to improve the transparency and security of port logistics. Interdisciplinary research methods will also be more applied to the field of port logistics, with a view to solving complex port logistics problems from multiple perspectives.

To sum up, port logistics research is in a period of rapid development and change, and the future research will be more diversified. Through continuous innovation of research methods and expansion of research fields, it is expected to provide more scientific and effective strategies for the sustainable development of port logistics.

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