SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 221

LOGISTICS SERVICES FACING THE CHALLENGES OF A GREEN ECONOMY: EXTRACTION OF KEY GREEN RESEARCH AREAS

Monika WODNICKA[1*], Łukasz Jarosław KOZAR[2], Tomasz KARKOWSKI[3]

[1] University of Lodz, Faculty of Economics and Sociology; monika.wodnicka@uni.lodz.pl,
ORCID: 0000-0002-9656-5713
[2] University of Lodz, Faculty of Economics and Sociology; lukasz.kozar@uni.lodz.pl,
ORCID: 0000-0002-8426-8471
[3] University of Lodz, Faculty of Economics and Sociology; tomasz.karkowski@uni.lodz.pl,
ORCID: 0000-0002-0526-5863
* Correspondence author

Purpose: Identification of key green research areas in scientific publications using bibliometric methods that simultaneously address logistics services and various green issues.
Design/methodology/approach: All scientific work was planned and conducted between November 2024 and March 2025. The study employed a bibliometric query, which enabled the extraction of 213 scientific publications from the Scopus database for analysis. The author's keywords assigned to the scientific publications were analysed.
Findings: As a result of the research assumptions and analyses carried out, 14 key green research areas were identified. Researchers most often referred to issues of green logistics, green supply chain management, green supply chains, or simply green innovation using the keyword ‘green’.
Research limitations/implications: The study revealed two main limiting factors. Firstly, only publications from the Scopus database were analysed. Secondly, a proprietary bibliometric query (Q1) was used to define the search scope. It is worth emphasising that these limitations also enable future replication of the study for comparative purposes.
Originality/value: The study is unique compared to other bibliometric studies on logistics services due to the bibliometric query used. The presentation of results on the bibliometric map also differs from typical visualisations of this kind, showing only the key green research areas. In the subsequent discussion, attention was drawn to the effects of the ongoing greening of logistics services. For example, the need for future research to demonstrate the impact of this phenomenon on the creation of green jobs in the logistics sector was highlighted. The article is addressed to those interested in logistics services and green research topics within this context.
Keywords: green economy, green jobs, green logistics, green supply chain, logistics services.
Category of the paper: Literature review.

1. Introduction

Numerous scientific studies focus on the changes occurring in the socio-economic environment and their impact on the functioning of not only current but also future generations. In this context, the issue of the ongoing green transformation or green transition of the economy is increasingly being addressed. Regarding the green economy, it should be noted that this concept is linked, on the one hand, to the process of socio-economic progress and, on the other hand, to minimising the negative environmental impact of economic activity. In economic practice, the greening of the economy can be observed through green products and services (Armutcu et al., 2024; Tran, 2024), green public procurement (Szydłowski, 2024), green investments (Liu et al., 2023), and the implementation of various green technologies (Ahsan Iqbal et al., 2025; Wodnicka, Królikiewicz, 2024). An important element of this process is green jobs, which are increasingly being identified and researched (Han et al., 2025; Sulich, Kozar, 2024).

With the development of the green economy, many sectors are facing the challenges of transformation resulting from the need to meet the environmental challenges posed by various stakeholders. This aspect is visible, for example, through the prism of the logistics sector and the green innovations implemented in it (Sun et al., 2025). As a result, the issue of green logistics is increasingly being discussed in scientific publications (Kozar, Wodnicka et al., 2024; Nikseresht et al., 2024; Tetteh et al., 2024). Within the framework of this research problem, as the authors of this article recognise, the most frequently discussed are sustainable or green practices aimed at sustainable transport, reducing the carbon footprint, minimising waste generated by individual logistics processes, or the use of reusable materials.

Green and sustainable programmes and activities have become a major focus for the logistics industry to improve the provision of logistics services (Wang, Hu, 2021), which can be divided into two categories: resource-based services and management skills-related services. The first group includes physical services such as transport and warehousing, while the second group includes services related to organisation, planning, and supervision (Jarocka, Wang, 2018). Logistics also encompasses services related to inventory management, customer relationship management, and customer-specific services. Examples of green logistics services include activities related to the sustainable production, procurement, and distribution of goods. These include green transport, green warehousing, green packaging, green processing, and green recycling (Yu et al., 2018). Logistics service providers and freight forwarders play an important role in promoting and delivering green logistics services. They are key players in advancing the green economy and green logistics. Their activities, operations, and awareness of the importance of environmental issues ultimately influence the practices of providing logistics services that meet the challenges of the green economy. Given the growing importance of logistics services in the context of green issues, this topic has become the subject of further analysis.

The aim of the research is to use bibliometric methods to identify key green research areas addressed in scientific publications that simultaneously cover logistics services and various green issues. To achieve this objective, it was assumed that key green research areas would be identified based on proprietary keywords assigned to the individual scientific publications analysed from the Scopus database. It was also assumed that a green research area is simply a proprietary keyword that includes a reference to 'green'. The study employed both a systematic literature review and a classical literature review method, which allowed for broader conclusions. VOSviewer (version 1.6.20) was used to map the key green research areas.

The article is divided into four interrelated parts, which together present the research conducted and the conclusions drawn. The first part, the introduction, discusses the context of the analysis, defines the research purpose, and highlights the methods used. The second part elaborates on the methodological issues in detail and presents the schedule of the research activities undertaken. This detailed presentation of the methodological aspects was intended to ensure the study can be replicated in the future and enable other researchers to compare their results with those presented in this article. The third part focuses on the results and their interpretation, while emphasising the green directions for further research, which are considered important by the authors. In conclusion, it is noted that the growing interest in green issues in the context of logistics services will lead, among other things, to the emergence of new green research areas.

2. Research methodology

All research activities presented in this article were carried out from November 2024 to March 2025. The research process, as shown in the timeline in Figure 1, was divided into four key stages. The individual research steps were designed to ensure high-quality results. Additionally, the study was planned in such a way that it can be replicated in the future. This means that the data presented can be discussed in future studies on logistics services and green issues.

In the first phase of the research, the research problem was identified to isolate the research gap that would become the focus of the study. Initially, a review and analysis of randomly selected scientific publications related to logistics services were carried out from the Scopus database. The analysis focused on scientific articles, reviews, and conference papers. The review revealed an increased interest in various green issues in the context of logistics services. This research direction results from the gradual green transition of socio-economic life, including the greening of the logistics sector.

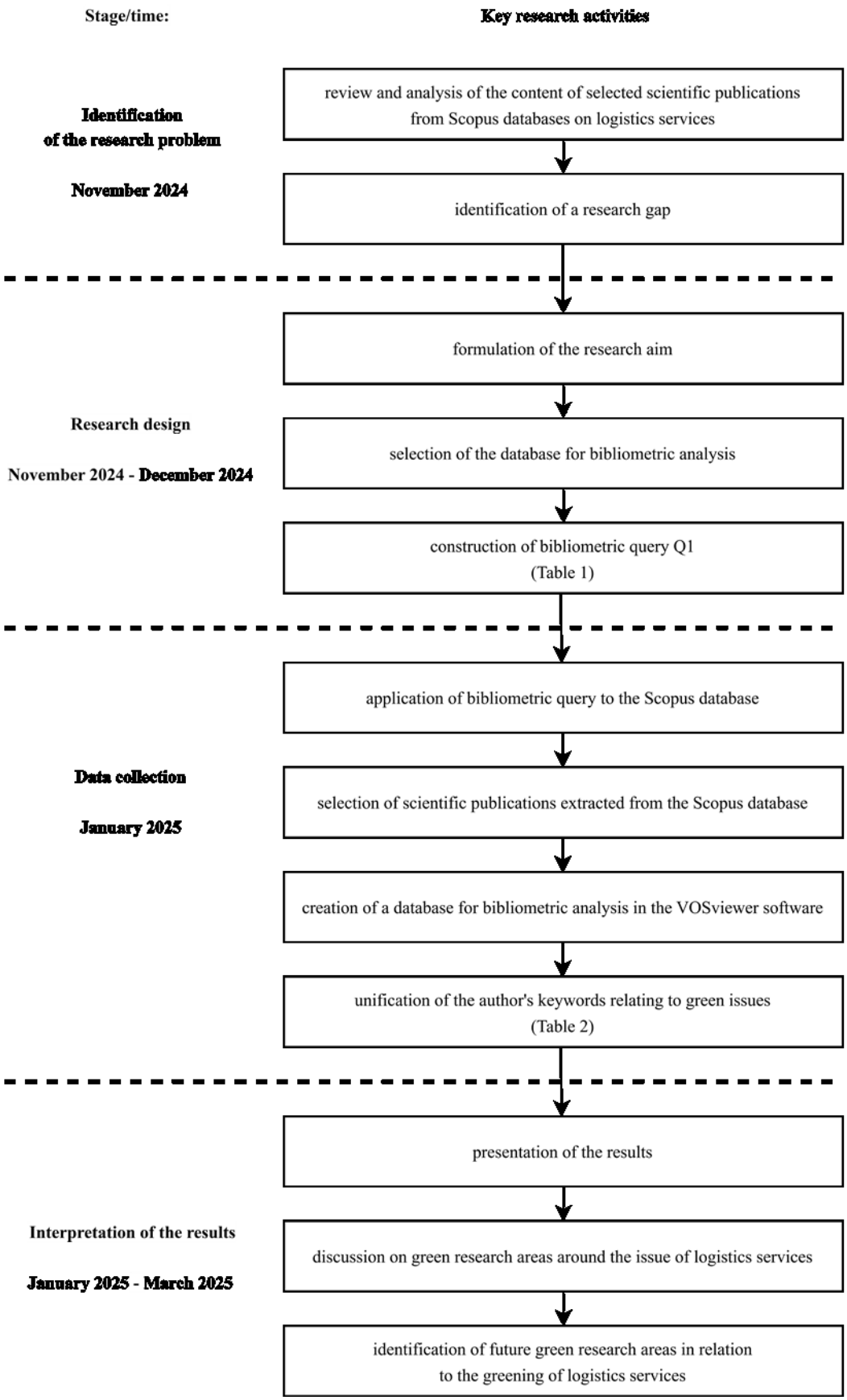

Figure 1. Research procedure stages and timeline.

Source: Authors' elaboration.

During these analyses, a notable diversity of green research areas mentioned in individual scientific publications was observed, which, in the opinion of the authors, requires scientific organization in the form of distinguishing key green research areas. Observations regarding green research directions became the basis for formulating the research objective. Therefore, it was assumed that the aim of the research would be to use bibliometric methods to identify key green research areas in scientific publications that simultaneously address logistics services and various green issues. As in the case of the research by Kozar & Wodnicka (2024), it was assumed that green research areas would simply be the author's keywords assigned to scientific publications referencing green issues. Thus, green research areas would be identified solely through the analysis of author keywords. The Scopus database was selected for the bibliometric analyses. It is widely used in bibliometric studies on logistics services, the identification of green research areas, and more broadly, in research related to sustainability issues. It is possible to construct a bibliometric query in this database by appropriately defining the search area, meaning that the study can be repeated in the future for comparative purposes. It is also worth noting that the Scopus database is highly regarded in the scientific community, and journals must meet strictly defined scientific standards to be indexed in it, further emphasizing the quality of the data source selected for the analyses undertaken.

In the final research activity, the bibliometric query Q1 was constructed during the research design phase, the syntax of which is shown in Table 1. The analysis covered scientific publications published up to 2025. Omitting publications from the year in which the bibliometric analysis is conducted is a common practice in this type of analysis. On the one hand, this makes it easier to compare studies in the future (especially in the context of citing bibliometric figures broken down by year). On the other hand, in the year the research is conducted, the publishing cycle is still ongoing, meaning there is a continuous process of adding new scientific publications to the Scopus database (including the possibility that some of these publications may meet the search parameters). As Table 1 shows, apart from the year of publication and reference to substantive issues (such as green issues and logistics services), scientific publications had to meet the following criteria: publication stage (final), source type (journal, conference proceedings), language (English), and document type (article, conference paper, review).

Table 1.
Details of search query syntax for Scopus databases

Database	Symbol	Query syntax	No. results
Scopus	Q1	TITLE-ABS-KEY (("green" OR "greener" OR "greening") AND "logistic* service*") AND PUBYEAR > 2005 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "p")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (PUBSTAGE , "final"))	213

Source: Authors' elaboration 14.01.2025.

The third stage of the research began with the bibliometric query Q1 for the Scopus database. As Table 1 shows, 213 scientific publications met the criteria set in the bibliometric query (151 articles, 54 conference papers, and 8 reviews). In the interest of high-quality research, an automatic selection of scientific publications was carried out. As a result of the review, the following were removed from further analysis:

- 1 conference paper due to duplication of the same publication in the database,
- 2 conference papers with no authors assigned (labeled 'no authors found'),
- 7 conference papers and 4 articles without assigned author keywords (a necessary criterion for identifying key green research areas based on author keywords).

Hence, 14 scientific publications were eliminated after further analysis, resulting in 199 scientific publications being subjected to further analyses aimed at achieving the intended research objective. The final research activity at the data collection stage was the procedure of unifying author keywords referring to green issues. This activity improves the data quality on the bibliometric map. This procedure was necessary due to, among other things, language differences (British English, American English) or the use of singular and plural forms for the same green author keywords. The standardisations carried out are presented in Table 2.

Table 2.
Unified author keywords relating to green issues

Identified green author keyword (original record)	Green keyword after unification
a green warehouse	green warehouse
green supply chain (gsc)	green supply chain
green initiative	green initiatives
green innovations	green innovation
green logistic	green logistics
green logistics practice	green logistics practices
green supply chain management (gscm)	green supply chain management
green transportation (gt)	green transportation
gscm	green supply chain management
“green” logistics	green logistics

Source: Authors' elaboration.

The presentation of the results and their interpretation took place in the final stage of the research, as shown in Figure 1. This stage is described in the next part of this article. At this point, it should be emphasised that, due to the limitations of the research, the results should be interpreted with the presented methodology in mind. Thus, it should be noted that the first limitation of the research stems from the choice of the Scopus database. The selection of other bibliometric databases for analysis may result in a smaller or larger number of green research areas. Additionally, it is impossible to include all publications that meet the criteria set in the bibliometric query, as some scientific publications are not indexed in any online bibliometric database (making it impossible to obtain information about all publications in the discussed subject area published within a given period). Furthermore, the bibliometric query itself and its design limit the research area. Nevertheless, these limitations mean that the research can be repeated in the future, and the constructed proprietary bibliometric query, after adjusting its syntax, can be applied to other bibliometric databases (e.g., Web of Science).

3. Results and discussion

During the process of standardising green author keywords, the phrase ‘green research area’ was added to all publications containing such specific keywords. This was necessary to visualise the isolated key green research areas, which were considered to be those that appeared in at least two scientific publications. The identification and visualisation of key green research areas, as shown in Figure 2, was made possible by the VOSviewer software. This software is commonly used to visualise various types of bibliometric data. Each of the 14 key green research areas identified in Figure 2 is marked in green. No clustering was performed in this analysis due to the addition of the phrase ‘green research area’. The individual author keywords are represented on the bibliometric map not only by a word label but also by the size of the node in the form of a uniform green dot (the more often a particular author keyword appears in the analysed scientific publications, the larger the dot).

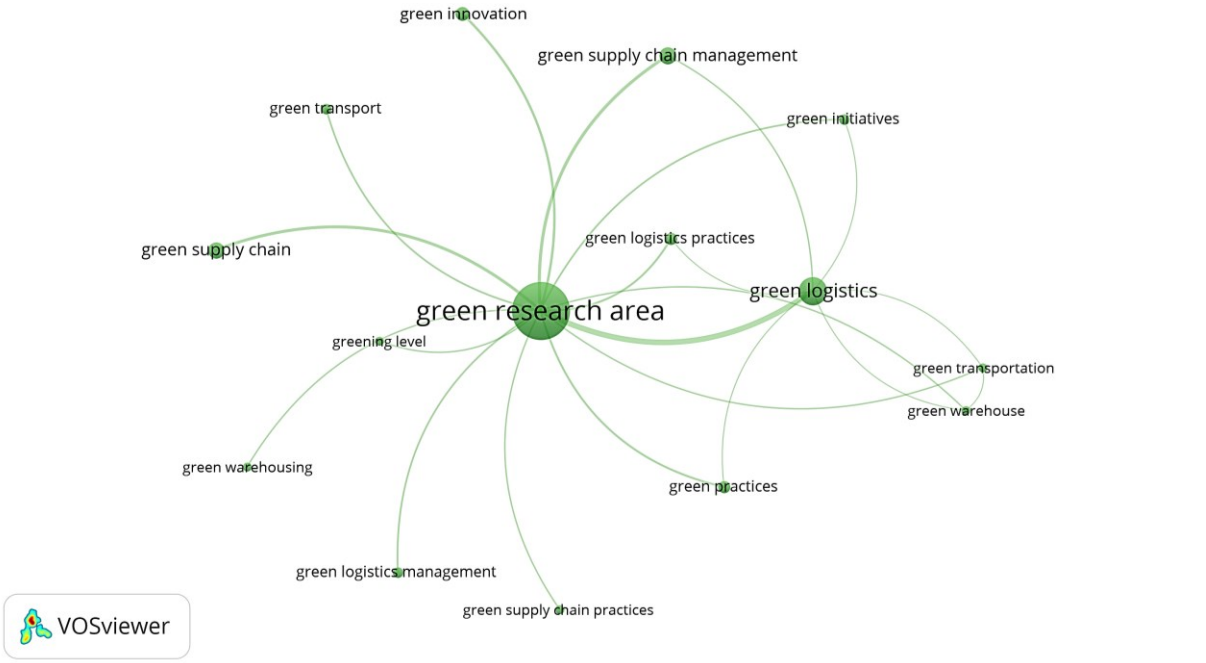

Figure 2. Bibliometric map of co-occurrence identifying key green research areas.
Source: Authors' elaboration in VOSviewer software (version 1.6.20).

On the bibliometric map in Figure 2, there are green lines between the individual words. If these lines connect the identified key green research areas, it means that these words appeared next to each other in at least one scientific study within the author keywords. As many as half of the identified green research areas did not appear with any other green author keyword in any of the analysed articles. The type of bibliometric analysis conducted primarily allowed for the identification of the number of scientific publications among those analysed in which the diagnosed key green research area was present, as shown in detail in Table 3.

Table 3.
Green keywords presented in Figure 2

Keywords	Number of occurrences	Articles (author/authors and year)
green initiatives*	3	(Evangelista et al., 2018; Froio, Bezerra, 2021; Ren et al., 2019)
green innovation*	6	(Chu et al., 2019; Karia, Asaari, 2013; Lin, Ho, 2008; L. Liu et al., 2023; D. Wang et al., 2024; Zailani et al., 2011)
green logistics*	33	(Abdullah et al., 2016; Alvarenga et al., 2023; Bahr, Sweeney, 2019; Celik et al., 2016; Cempírek et al., 2021; Čižiūnienė et al., 2024; Dong et al., 2023; Dudin et al., 2016; Dzwigol et al., 2021; Ehmke et al., 2018; Frehe, 2015; Froio, Bezerra, 2021; Huge-Brodin et al., 2020; Jazairy, von Haartman, 2020; Liu et al., 2023; Liu et al., 2019; Martins et al., 2020; Martinsen, Björklund, 2012; Martinsen, Huge-Brodin, 2014; Massaroni et al., 2016; Peng, 2010; Perotti et al., 2023; Philipp, Militaru, 2011; Rapp et al., 2021, 2024; Rüdiger et al., 2016; Sallnäs, Huge-Brodin, 2018; Singh, Roy, 2022; Sureeyatanapas et al., 2018; Vienažindienė et al., 2021; Wang et al., 2019; Wehner et al., 2021; Yu, 2016)
green logistics management	3	(Aroonsrimorakot et al., 2022; Khan et al., 2019; Rehman Khan et al., 2018)
green logistics practices*	4	(Karia, 2016; Kim et al., 2024; Osman et al., 2023; Vienažindienė et al., 2021)
green practices	4	(Liu et al., 2023; Prataviera et al., 2024; Rapp et al., 2024; Shaharudin et al., 2018)
green supply chain*	9	(Bajec et al., 2015; Bilek et al., 2024; Centobelli et al., 2017a, 2017b; Centobelli, Cerchione, Esposito, 2020; Centobelli, Cerchione, Esposito et al., 2020; Elzarka, 2020; Lu et al., 2008; Xu et al., 2016)
green supply chain management*	10	(Abdullah et al., 2016; Aityassine et al., 2021; Bask et al., 2018; Jazairy, 2020; Jazairy et al., 2021; Jazairy, von Haartman, 2020; Laari et al., 2018; Lam, Dai, 2015; Meybodi, Delshad, 2023; Sallnäs, Björklund, 2020)
green supply chain practices	2	(Gupta, Singh, 2020; Nawurunnage et al., 2023)
green transport	3	(Beškovnik et al., 2020; Petljak et al., 2014, 2016)
green transportation*	2	(Liu et al., 2023; Orji, 2024)
green warehouse*	2	(Liu et al., 2023; Margareta et al., 2020)
green warehousing	2	(Cannava et al., 2023; Perotti, Colicchia, 2023)
greening level	2	(Wang, Hu, 2021, 2022)

* for these keywords, procedures were conducted to unify the author's keywords
Source: Authors' elaboration.

None of the 14 key green research areas identified was the subject of scientific consideration expressed through the author's keyword in all 199 scientific publications included in the research. Green logistics, green supply chain management, and green supply chain had the highest number of occurrences (Table 3).

It is worth noting that in the analysed research area, publications that simultaneously featured two green research areas most often included green logistics as one of these research areas, as shown in Figure 3. The issue of green logistics was addressed alongside such green key research areas as green supply chain management (Abdullah et al., 2016; Jazairy, von Haartman, 2020), green initiatives (Froio, Bezerra, 2021), green transportation (Liu et al., 2023), green warehouse (Liu et al., 2023), green practices (Rapp et al., 2024), and green logistics practices (Vienažindienė et al., 2021). Only one publication simultaneously identified

three key green research areas: green logistics, green transportation, and green warehouse (A. Liu et al., 2023).

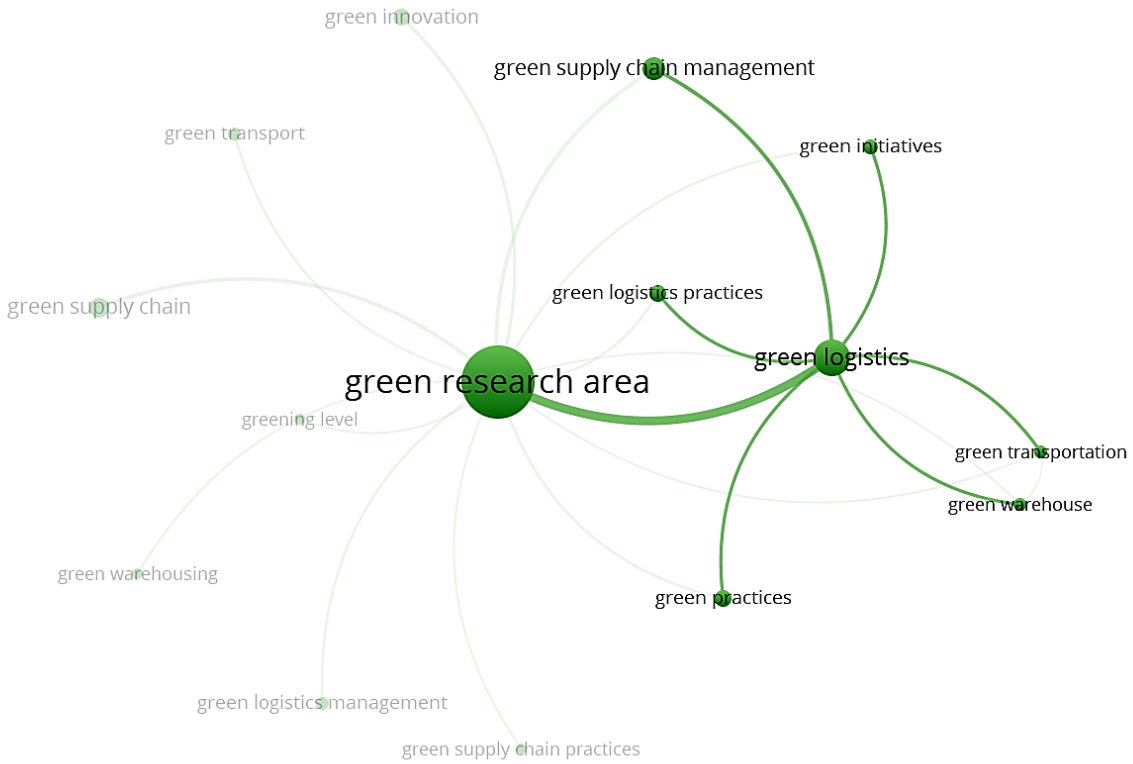

Figure 3. Visualization of connections with green logistics on a bibliometric map.
Source: Authors' elaboration in VOSviewer software (version 1.6.20).

During the analyses carried out, it was noticed that green issues are mainly raised in relation to logistics and the supply chain when the topic of logistics services is mentioned. This observation applies to both key green research areas and the totality of green keywords assigned to the 199 scientific publications analysed. Considering the increased interest of researchers in the green aspects of logistics services, the authors of this article believe that new green key research areas can be expected to emerge in the future. Even now, there is a slowly emerging interest in issues related to the management of human capital in individual logistics entities towards green practices. As a result, references to the green HRM concept or green competence management have been observed in the analysed set of scientific publications (Moczydłowska et al., 2024). In the opinion of the authors of this article, the gradual greening of logistics services in individual logistics entities will not only generate interest in green competencies among researchers but will also steer research towards the creation of green jobs (including green jobs of adequate quality and sustainability). The creation of these types of jobs in the logistics sector under the influence of the greening process is already slowly becoming noticeable to researchers (Kozar, Bednarski et al., 2024). Another area that the authors of this article believe will be further developed is the issue of green logistics services.

4. Summary

In contrast to previous bibliometric analyses that simultaneously focused on the topic of logistics services and various green issues, this study differs in both the content of the bibliometric query and the way the bibliometric map is generated by adding the term 'green research area'. In previous studies, the issue of green was addressed in bibliometric queries alongside many other topics, such as sustainable development or eco-friendly practices, and was often framed in a much broader context referring to various issues related to logistics (Ren et al., 2019). This study thus fills a research gap in the context of logistics services.

The study identified 14 key green research areas addressed in scientific papers that simultaneously discuss logistics services and various green issues. These areas do not explicitly refer to green logistics services or even to green issues related to shaping a green labour market. Nevertheless, it has been observed that these issues are slowly emerging, although, as original keywords, they have so far been mentioned only in individual scientific studies. Based on the analyses carried out, it can be clearly stated that the increased interest of researchers in green issues in the context of logistics services will lead to both the further development of research on existing green research problems and the emergence of entirely new green research areas (especially those related to new innovative technologies).

References

1. Abdullah, R., Mat Daud, M.S., Ahmad, F., Shukti, A.A., Shah, M.Z. (2016). Green logistics adoption among 3PL companies. *International Journal of Supply Chain Management*, *5*(3), 82-85.
2. Ahsan Iqbal, M., Shaheen, W.A., Shabir, S., Ullah, U., Ionel-Alin, I., Mihut, M.-I., Raposo, A., Han, H. (2025). Towards a green economy: Investigating the impact of sustainable finance, green technologies, and environmental policies on environmental degradation. *Journal of Environmental Management*, *374*, 124047. https://doi.org/10.1016/j.jenvman.2025.124047
3. Aityassine, F.L.Y., Aldiabat, B.F., Al-Rjoub, S.R., Aldaihani, F.M.F., Al-Shorman, H.M., Al-Hawary, S.I.S. (2021). The mediating effect of just in time on the relationship between green supply chain management practices and performance in the manufacturing companies. *Uncertain Supply Chain Management*, *9*(4), 1081-1090. https://doi.org/10.5267/j.uscm.2021.x.007
4. Alvarenga, T.H.P., Rodriguez, C.M.T., Peña-Montoya, C.C., Sartori, S., Oliveira, R.R. (2023). Institutional pressures, green logistics activities and efficiency performance:

a survey with logistics service providers in Brazil. *Journal of Applied Research and Technology*, *21*(2), 265-280. https://doi.org/10.22201/icat.24486736E.2023.21.2.1728

5. Armutcu, B., Zuferi, R., Tan, A. (2024). Green product consumption behaviour, green economic growth and sustainable development: unveiling the main determinants. *Journal of Enterprising Communities*, *18*(4), 798-819. https://doi.org/10.1108/JEC-05-2023-0074
6. Aroonsrimorakot, S., Laiphrakpam, M., Mungkun, S. (2022). Green logistics (GL) for environmental sustainability: a review in search of strategies for Thailand's GL management. *ABAC Journal*, *42*(2), 293-319.
7. Bahr, W., Sweeney, E. (2019). Environmental Sustainability in the Follow-Up and Evaluation Stage of Logistics Services Purchasing: Perspectives from UK Shippers and 3PLs. *Sustainability*, *11*(9), 2460. https://doi.org/10.3390/su11092460
8. Bajec, P., Tuljak-Suban, D., Krmac, E. (2015). Do ISO standards favour logistics provider efficiency, competitiveness and sustainability? A Slovenian perspective. *The International Journal of Logistics Management*, *26*(2), 275-295. https://doi.org/10.1108/IJLM-01-2013-0006
9. Bask, A., Rajahonka, M., Laari, S., Solakivi, T., Töyli, J., Ojala, L. (2018). Environmental sustainability in shipper-LSP relationships. *Journal of Cleaner Production*, *172*, 2986-2998. https://doi.org/10.1016/j.jclepro.2017.11.112
10. Beškovnik, B., Zanne, M., Dlabač, T., Ivošević, Š. (2020). Green Transport Chains Analysis: Pollution vs. Price and Time Elements on Asia – Eastern Adriatic Trade. *Naše More*, *67*(1), 36-44. https://doi.org/10.17818/NM/2020/1.6
11. Bilek, G.M., Calvi, R., Erhel, D., Mechouar, Y. (2024). Towards Green Transportation Practices Using a Buyer/Supplier Perspective: A Systematic Literature Review. *Logistics*, *8*(3), 68. https://doi.org/10.3390/logistics8030068
12. Cannava, L., Perotti, S., Najafi, B., Rinaldi, F. (2023). Assessing the impact of smart lighting systems and on-site renewable generation in a distribution warehouse: a simulation-based approach. *International Conference on Harbour, Maritime and Multimodal Logistics Modelling and Simulation*, *2023-Septe*. https://doi.org/10.46354/i3m.2023.hms.006
13. Celik, E., Erdogan, M., Gumus, A.T. (2016). An extended fuzzy TOPSIS–GRA method based on different separation measures for green logistics service provider selection. *International Journal of Environmental Science and Technology*, *13*(5), 1377-1392. https://doi.org/10.1007/s13762-016-0977-4
14. Cempírek, V., Stopka, O., Meško, P., Dočkalíková, I., Tvrdoň, L. (2021). Design of distribution centre location for small e-shop consignments using the clark-wright method. *Transportation Research Procedia*, *53*, 224-233. https://doi.org/10.1016/j.trpro.2021.02.029
15. Centobelli, P., Cerchione, R., Esposito, E. (2017a). Environmental sustainability in the service industry of transportation and logistics service providers: Systematic literature review and research directions. *Transportation Research Part D: Transport and*

Environment, *53*, 454-470. https://doi.org/10.1016/J.TRD.2017.04.032

16. Centobelli, P., Cerchione, R., Esposito, E. (2017b). Developing the WH 2 framework for environmental sustainability in logistics service providers: A taxonomy of green initiatives. *Journal of Cleaner Production*, *165*, 1063-1077. https://doi.org/10.1016/j.jclepro.2017.07.150
17. Centobelli, P., Cerchione, R., Esposito, E. (2020). Pursuing supply chain sustainable development goals through the adoption of green practices and enabling technologies: A cross-country analysis of LSPs. *Technological Forecasting and Social Change*, *153*, 119920. https://doi.org/10.1016/j.techfore.2020.119920
18. Centobelli, P., Cerchione, R., Esposito, E., Shashi (2020). Evaluating environmental sustainability strategies in freight transport and logistics industry. *Business Strategy and the Environment*, *29*(3), 1563-1574. https://doi.org/10.1002/bse.2453
19. Chu, Z., Wang, L., Lai, F. (2019). Customer pressure and green innovations at third party logistics providers in China: The moderation effect of organizational culture. *International Journal of Logistics Management*, *30*(1), 57-75. https://doi.org/10.1108/IJLM-11-2017-0294
20. Čižiūnienė, K., Matijošius, J., Sokolovskij, E., Balevičiūtė, J. (2024). Assessment of Implementing Green Logistics Principles in Railway Transport: The Case of Lithuania. *Sustainability*, *16*(7), 2716. https://doi.org/10.3390/su16072716
21. Dong, C., Huang, Q., Pan, Y., Ng, C.T., Liu, R. (2023). Logistics outsourcing: Effects of greenwashing and blockchain technology. *Transportation Research Part E: Logistics and Transportation Review*, *170*, 103015. https://doi.org/10.1016/j.tre.2023.103015
22. Dudin, M.N., Frolova, E.E., Kuznetsov, M.N., Drobysheva, L.V., Krasulya, E.V. (2016). "Green" logistics as an instrument for putting together a new model for professional and career-broadening training in global economic space. *International Journal of Environmental and Science Education*, *11*(15), 8693-8705.
23. Dzwigol, H., Trushkina, N., wilinski, A. (2021). The Organizational and Economic Mechanism of Implementing the Concept of Green Logistics. *Virtual Economics*, *4*(2), 41-75. https://doi.org/10.34021/ve.2021.04.02(3)
24. Ehmke, J.F., Campbell, A.M., Thomas, B. W. (2018). Optimizing for total costs in vehicle routing in urban areas. *Transportation Research Part E: Logistics and Transportation Review*, *116*, 242-265. https://doi.org/10.1016/j.tre.2018.06.008
25. Elzarka, S. (2020). A study on engaging employees in adopting green logistics practices: the case of logistics service providers in Egypt. *International Journal of Logistics Systems and Management*, *37*(1), 140. https://doi.org/10.1504/IJLSM.2020.109669
26. Evangelista, P., Santoro, L., Thomas, A. (2018). Environmental Sustainability in Third-Party Logistics Service Providers: A Systematic Literature Review from 2000-2016. *Sustainability*, *10*(5), 1627. https://doi.org/10.3390/su10051627
27. Frehe, V. (2015). Can target costing be applied in green logistics?-Evidence from a conjoint

analysis. *23rd European Conference on Information Systems, ECIS 2015*, *2015-May*.

28. Froio, P.J., Bezerra, B.S. (2021). Environmental sustainability initiatives adopted by logistics service providers in a developing country – an overview in the Brazilian context. *Journal of Cleaner Production*, *304*. https://doi.org/10.1016/j.jclepro.2021.126989
29. Gupta, A., Singh, R.K. (2020). Managing operations by a logistics company for sustainable service quality: Indian perspective. *Management of Environmental Quality: An International Journal*, *31*(5), 1309-1327. https://doi.org/10.1108/MEQ-11-2019-0246
30. Han, Z., Ni, M., Huang, M., Bao, Z. (2025). Environmentally-special responsible leadership and employee green creativity: The role of green job autonomy and green job resource adequacy. *Journal of Cleaner Production*, *494*, 144938. https://doi.org/10.1016/j.jclepro.2025.144938
31. Huge-Brodin, M., Sweeney, E., Evangelista, P. (2020). Environmental alignment between logistics service providers and shippers – a supply chain perspective. *International Journal of Logistics Management*, *31*(3), 575-605. https://doi.org/10.1108/IJLM-04-2019-0101
32. Jarocka, M., Wang, H. (2018). Definition and classification criteria of logistics services for elderly. *Engineering Management in Production and Services*, *10*(4), 65-75. https://doi.org/10.2478/emj-2018-0023
33. Jazairy, A. (2020). Aligning the purchase of green logistics practices between shippers and logistics service providers. *Transportation Research Part D: Transport and Environment*, *82*. https://doi.org/10.1016/j.trd.2020.102305
34. Jazairy, A., von Haartman, R. (2020). Analysing the institutional pressures on shippers and logistics service providers to implement green supply chain management practices. *International Journal of Logistics Research and Applications*, *23*(1), 44-84. https://doi.org/10.1080/13675567.2019.1584163
35. Jazairy, A., von Haartman, R., Björklund, M. (2021). Unravelling collaboration mechanisms for green logistics: the perspectives of shippers and logistics service providers. *International Journal of Physical Distribution & Logistics Management*, *51*(4), 423-448. https://doi.org/10.1108/IJPDLM-09-2019-0274
36. Karia, N. (2016). Transforming green logistics practice into benefits: A case of 3PLs. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *8-10 March*, 178-179.
37. Karia, N., Asaari, M.H.A.H. (2013). Green innovations in logistics industry: Sustainability and competitive advantage. *Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth - Proceedings of the 20th International Business Information Management Association Conference, IBIMA 2013*, *1*, 456-462.
38. Khan, S.A.R., Jian, C., Zhang, Y., Golpîra, H., Kumar, A., Sharif, A. (2019). Environmental, social and economic growth indicators spur logistics performance: From the perspective of South Asian Association for Regional Cooperation countries. *Journal of Cleaner Production*, *214*, 1011-1023. https://doi.org/10.1016/j.jclepro.2018.12.322

39. Kim, D., Na, J., Ha, H.-K. (2024). Exploring the impact of green logistics practices and relevant government policy on the financial efficiency of logistics companies. *Heliyon*, *10*(10), e30916. https://doi.org/10.1016/j.heliyon.2024.e30916
40. Kozar, Ł.J., Bednarski, G., Chomicz, G., Chrzanowski, M., Jaksik, D., Kręgiel, K., Kulawczyk, M., Śmietana, K. (2024). Shaping green competences of transport and logistics employees through green activities. *Scientific Papers of Silesian University of Technology Organization and Management Series*, *2024*(208), 233-251. https://doi.org/10.29119/1641-3466.2024.208.14
41. Kozar, Ł.J., Wodnicka, M. (2024). Blockchain in energy: literature review in the context of sustainability. *Economics and Environment*, *90*(3), 866. https://doi.org/10.34659/eis. 2024.90.3.866
42. Kozar, Ł.J., Wodnicka, M., Chomicz, G., Jaksik, D., Śmietana, K.S. (2024). Green supply chain and green logistics: a bibliometric identification of key research areas. *Scientific Papers of Silesian University of Technology Organization and Management Series*, *2024*(203). https://doi.org/10.29119/1641-3466.2024.203.11
43. Laari, S., Töyli, J., Ojala, L. (2018). The effect of a competitive strategy and green supply chain management on the financial and environmental performance of logistics service providers. *Business Strategy and the Environment*, *27*(7), 872-883. https://doi.org/10.1002/bse.2038
44. Lam, J.S.L., Dai, J. (2015). Environmental sustainability of logistics service provider: An ANP-QFD approach. *International Journal of Logistics Management*, *26*(2), 313-333. https://doi.org/10.1108/IJLM-08-2013-0088
45. Lin, C.Y., Ho, Y.. (2008). An empirical study on logistics service providers' intention to adopt green innovations. *Journal of Technology Management and Innovation*, *3*(1), 17-26.
46. Liu, A., Osewe, M., Shi, Y. (2023). Green logistics in China: a systematic literature review. *International Journal of Logistics Systems and Management, Vol. 45, Iss. 1*. Inderscience Publishers, pp. 88-107. https://doi.org/10.1504/IJLSM.2023.130972
47. Liu, J., Qiu, F., Zhang, T., Liu, H. (2023). Dynamics of green economic development in countries joining the belt and road initiative: Is it driven by green investment transformation? *Journal of Environmental Management*, *347*, 118969. https://doi.org/10.1016/j.jenvman.2023.118969
48. Liu, L., Wu, H., Hafeez, M., Albaity, M.S.A., Ullah, S. (2023). Carbon neutrality through supply chain performance: does green innovation matter in Asia? *Economic Research-Ekonomska Istrazivanja*, *36*(3). https://doi.org/10.1080/1331677X.2022.2149588
49. Liu, S., Zhang, Y., Liu, Y., Wang, L., Wang, X.V. (2019). An 'Internet of Things' enabled dynamic optimization method for smart vehicles and logistics tasks. *Journal of Cleaner Production*, *215*, 806-820. https://doi.org/10.1016/J.JCLEPRO.2018.12.254
50. Liu, Y., Chung, H.F.L., Mi, L. (2023). Fostering sustainable logistics businesses: the role of innovation ecosystems and institutional contexts for logistics firms in China. *Asia Pacific*

Journal of Marketing and Logistics, *35*(1), 35-53. https://doi.org/10.1108/APJML-06-2021-0412

51. Lu, Q., Li, W., Sundarakani, B., Cai, S., De Souza, R., Goh, M. (2008). Green supply chain: How does it affect current supply chain practice? *2008 IEEE International Conference on Industrial Engineering and Engineering Management, IEEM 2008*, 1128-1132. https://doi.org/10.1109/IEEM.2008.4738046
52. Margareta, W., Ridwan, A.Y., Muttaqin, P.S. (2020). Green Warehouse Performance Measurement Model for 3PL Warehousing. *Proceedings of the 3rd Asia Pacific Conference on Research in Industrial and Systems Engineering 2020*, 180-186. https://doi.org/10.1145/3400934.3400968
53. Martins, V.W.B., Anhlon, R., Rampasso, I.S., da Silva, D., Melo, A.C.S. (2020). Sustainability in Logistics Systems and Its Impact on the Level of Services Definition: An Exploratory Analysis Using Structural Equation Modeling. *Springer Proceedings in Mathematics and Statistics*, *337*, 127-139. https://doi.org/10.1007/978-3-030-56920-4_11
54. Martinsen, U., Björklund, M. (2012). Matches and gaps in the green logistics market. *International Journal of Physical Distribution and Logistics Management*, *42*(6), 562-583. https://doi.org/10.1108/09600031211250596
55. Martinsen, U., Huge-Brodin, M. (2014). Environmental practices as offerings and requirements on the logistics market. *Logistics Research*, *7*(1), 115. https://doi.org/10.1007/s12159-014-0115-y
56. Massaroni, E., Cozzolino, A., Wankowicz, E. (2016). Sustainability reporting of logistics service providers in Europe. *International Journal of Environment and Health*, *8*(1), 38-58. https://doi.org/10.1504/IJENVH.2016.077662
57. Meybodi, H.B., Delshad, Z. (2023). Evaluating and prioritising the factors affecting green supply chain management by using analytic hierarchy process and fuzzy logic. *International Journal of Logistics Systems and Management*, *46*(1), 121-142. https://doi.org/10.1504/IJLSM.2023.133544
58. Moczydłowska, J., Moczydłowska, Z.S., Jeseviciute-Ufartiene, L. (2024). Green competence management in the logistics services industry in Poland in the light of qualitative research. *Economics and Environment*, *90*(3), 795. https://doi.org/10.34659/eis.2024.90.3.795
59. Nawurunnage, K.R., Prasadika, A.P.K.J., Wijayanayake, A.N. (2023). TQM and Green Supply Chain Management Practices on Supply Chain Performance of Third-Party Logistics Services in Sri Lanka: A Systematic Review of Literature. *ICARC 2023 - 3rd International Conference on Advanced Research in Computing: Digital Transformation for Sustainable Development*, 274-279. https://doi.org/10.1109/ICARC57651.2023.10145644
60. Nikseresht, A., Golmohammadi, D., Zandieh, M. (2024). Sustainable green logistics and remanufacturing: a bibliometric analysis and future research directions. *The International Journal of Logistics Management*, *35*(3), 755-803. https://doi.org/10.1108/IJLM-03-2023-

0085

61. Orji, I.J. (2024). Adopting electric bus for improving efficiency in the local public transport sector: Analysis of facilitating conditions and their nonlinear relationships. *Transportation Research Part A: Policy and Practice*, *180*, 103967. https://doi.org/10.1016/j.tra.2024.103967
62. Osman, M.C., Huge-Brodin, M., Ammenberg, J., Karlsson, J. (2023). Exploring green logistics practices in freight transport and logistics: a study of biomethane use in Sweden. *International Journal of Logistics Research and Applications*, *26*(5), 548-567. https://doi.org/10.1080/13675567.2022.2100332
63. Peng, J. (2010). Development strategy of green logistics based on swot matrix - A case study. *Proceedings - 2010 International Conference on Optoelectronics and Image Processing, ICOIP 2010*, *1*, 432–435. https://doi.org/10.1109/ICOIP.2010.71
64. Perotti, S., Colicchia, C. (2023). Greening warehouses through energy efficiency and environmental impact reduction: a conceptual framework based on a systematic literature review. *International Journal of Logistics Management*, *34*(7), 199-234. https://doi.org/10.1108/IJLM-02-2022-0086
65. Perotti, S., Coslovich, M., Granata, E. (2023). Transitioning towards Net-Zero Warehouses: Empirical Insights and Best Practices in Italy. *ACM International Conference Proceeding Series*, 82-87. https://doi.org/10.1145/3613944.3613957
66. Petljak, K., Renko, S., Rasic, S. (2014). Greening transport activities in the food retail supply chain. *International Conference on Industrial Logistics, ICIL 2014 - Conference Proceedings*, 216-224.
67. Petljak, K., Renko, S., Rasic, S. (2016). Greening transport activities in the food retail supply chain. *International Journal of Logistics Systems and Management*, *25*(1), 129. https://doi.org/10.1504/IJLSM.2016.078492
68. Philipp, B., Militaru, D. (2011). Shippers' ecological buying behaviour towards logistics services in France. *International Journal of Logistics Research and Applications*, *14*(6), 413-426. https://doi.org/10.1080/13675567.2011.649547
69. Prataviera, L.B., Creazza, A., Perotti, S. (2024). A call to action: a stakeholder analysis of green logistics practices. *International Journal of Logistics Management*, *35*(3), 979-1008. https://doi.org/10.1108/IJLM-09-2022-0381
70. Rapp, A., Simonovic, A.L., Large, R.O. (2021). Let's get greener!. Environmental strategies of logistics service providers. *Revue Europeenne d' Economie et Management Des Services*, *12*, 93-123. https://doi.org/10.48611/isbn.978-2-406-12261-6.p.0093
71. Rapp, A., Simonovic, A.L., Large, R.O. (2024). A case study-based analysis of environmental strategies among German Logistics Service Providers. *Supply Chain Forum: An International Journal*, *25*(2), 148-164. https://doi.org/10.1080/16258312.2023.2253137
72. Rehman Khan, S.A., Zhang, Y., Anees, M., Golpîra, H., Lahmar, A., Qianli, D. (2018). Green supply chain management, economic growth and environment: A GMM based

evidence. *Journal of Cleaner Production*, *185*, 588-599. https://doi.org/10.1016/j.jclepro.2018.02.226

73. Ren, R., Hu, W., Dong, J., Sun, B., Chen, Y., Chen, Z. (2019). A Systematic Literature Review of Green and Sustainable Logistics: Bibliometric Analysis, Research Trend and Knowledge Taxonomy. *International Journal of Environmental Research and Public Health*, *17*(1), 261. https://doi.org/10.3390/ijerph17010261
74. Rüdiger, D., Schön, A., Dobers, K. (2016). Managing Greenhouse Gas Emissions from Warehousing and Transshipment with Environmental Performance Indicators. *Transportation Research Procedia*, *14*, 886-895. https://doi.org/10.1016/j.trpro.2016.05.083
75. Sallnäs, U., Björklund, M. (2020). Consumers' influence on the greening of distribution – exploring the communication between logistics service providers, e-tailers and consumers. *International Journal of Retail and Distribution Management*, *48*(11), 1177-1193. https://doi.org/10.1108/IJRDM-07-2019-0213
76. Sallnäs, U., Huge-Brodin, M. (2018). De-greening of logistics? – Why environmental practices flourish and fade in provider-shipper relationships and networks. *Industrial Marketing Management*, *74*, 276-287. https://doi.org/10.1016/j.indmarman.2018.07.001
77. Shaharudin, M.R., Akbar, J., Zainal, N.N., Hassam, S.F., Zainoddin, A.I., Nizam, M.F.M. (2018). Factors that influence green practices adoption amongst logistics services providers. *International Journal of Supply Chain Management*, *7*(6), 242-253.
78. Singh, S.K., Roy, S. (2022). Greening the grey: measuring adoption of green logistics in the Indian logistics sector. *International Journal of Logistics Systems and Management*, *41*(4), 395-420. https://doi.org/10.1504/IJLSM.2022.123452
79. Sulich, A., Kozar, Ł.J. (2024). Green Jobs in Computer Sciences: Identifying Current and Future Key Research Directions. *Procedia Computer Science*, *246*(C), 3333-3341. https://doi.org/10.1016/j.procs.2024.09.224
80. Sun, Y., Zhang, X., Huang, X., Cao, W. (2025). Research on Logistics Service Supply Chain Coordination in the Context of Green Innovation. *Sustainability*, *17*(2), 646. https://doi.org/10.3390/su17020646
81. Sureeyatanapas, P., Poophiukhok, P., Pathumnakul, S. (2018). Green initiatives for logistics service providers: An investigation of antecedent factors and the contributions to corporate goals. *Journal of Cleaner Production*, *191*, 1-14. https://doi.org/10.1016/j.jclepro.2018.04.206
82. Szydłowski, C. (2024). Environmental aspects in public procurement in Poland: a case study of selected supply tenders. *Scientific Papers of Silesian University of Technology Organization and Management Series*, *211*. https://doi.org/10.29119/1641-3466.2024.211.37
83. Tetteh, F.K., Owusu Kwateng, K., Mensah, J. (2024). Green logistics practices: A bibliometric and systematic methodological review and future research opportunities.

Journal of Cleaner Production, Vol. 476. Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2024.143735

84. Tran, T.K. (2024). Can sustainable entrepreneurship be achieved through green knowledge sharing, green dynamic capabilities, and green service innovation? *Environmental Science and Pollution Research International*, *31*(2), 3060-3075. https://doi.org/10.1007/s11356-023-31308-8
85. Vienažindienė, M., Tamulienė, V., Zaleckienė, J. (2021). Green Logistics Practices Seeking Development of Sustainability: Evidence from Lithuanian Transportation and Logistics Companies. *Energies*, *14*(22), 7500. https://doi.org/10.3390/en14227500
86. Wang, D., Liu, W., Liang, Y. (2024). Green innovation in logistics service supply chain: the impacts of relationship strength and overconfidence. *Annals of Operations Research*, *343*(3), 949-979. https://doi.org/10.1007/s10479-022-04621-7
87. Wang, J., Lim, M.K., Tseng, M.L., Yang, Y. (2019). Promoting low carbon agenda in the urban logistics network distribution system. *Journal of Cleaner Production*, *211*, 146-160. https://doi.org/10.1016/J.JCLEPRO.2018.11.123
88. Wang, S., Hu, Z.-H. (2021). Green Logistics Service Supply Chain Games Considering Risk Preference in Fuzzy Environments. *Sustainability*, *13*(14), 8024. https://doi.org/10.3390/su13148024
89. Wang, S., Hu, Z.H. (2022). Logistics Service Supply Chain Decision-Making Analysis Considering Impact of Environment and Service Level. *Polish Journal of Environmental Studies*, *31*(6), 5285–5297. https://doi.org/10.15244/pjoes/151861
90. Wehner, J., Taghavi Nejad Deilami, N., Altuntas Vural, C., Halldórsson, Á. (2021). Logistics service providers' energy efficiency initiatives for environmental sustainability. *International Journal of Logistics Management*, *33*(5), 1-26. https://doi.org/10.1108/IJLM-10-2019-0270
91. Wodnicka, M., Królikiewicz, B. (2024). Blockchain in logistics in the context of sustainable development. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, *202*, 605-620. https://doi.org/10.29119/1641-3466.2024.202.37
92. Xu, Y., Zhang, X., Zhang, H. (2016). Research on the E-commerce Platform Performance and Green Supply Chain based on Data Mining and SVM. *International Journal of Database Theory and Application*, *9*(12), 141-150. https://doi.org/10.14257/ijdta.2016.9.12.14
93. Yu, J.C.P. (2016). 3PL implementing corporate social responsibility in a closed-loop supply chain: A conceptual approach. *International Journal of Supply Chain Management*, *5*(2), 7-15.

94. Yu, Z., Golpîra, H., Khan, S.A.R. (2018). The relationship between green supply chain performance, energy demand, economic growth and environmental sustainability: An empirical evidence from developed countries. *LogForum*, *14*(4), 479-494. https://doi.org/10.17270/J.LOG.2018.304
95. Zailani, S., Amran, A., Jumadi, H. (2011). Green innovation adoption among logistics service providers in Malaysia: An exploratory study on the managers' perceptions. *International Business Management*, *5*(3), 104113. https://doi.org/10.3923/IBM.2011.104.113