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Mapping research trends and dynamics in green finance: A bibliometric approach

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Abstract

In recent years, climate change, environmental risks, and the transition toward sustainable development have brought green finance to the forefront of both global economic discussions and academic research. As scholarly interest in this area continues to grow, understanding the intellectual structure and thematic evolution of green finance literature has become increasingly important. This study aims to explore the key research trends, conceptual frameworks, and collaboration networks that define the field of green finance. By identifying dominant themes and mapping the development of the literature, the study also seeks to uncover under-researched areas and provide insights for future academic inquiry.

The analysis is based on a dataset of publications indexed in the Web of Science (WoS) database. The data were examined using VOSviewer, a bibliometric mapping and visualization tool. Keyword co-occurrence analysis, author collaboration patterns, and country- and institution-level networks are used to construct a comprehensive overview of the field. The findings are expected to contribute to a better understanding of the evolution of green finance research and offer valuable guidance for researchers, practitioners, and policymakers interested in sustainable financial systems.

Keywords: Green finance, bibliometric analysis, VOSviewer.

Jel codes: G10, Q56.

1. Introduction

In recent years, climate change, environmental sustainability, and the transition to low-carbon economies have attracted significant attention from policymakers, investors, and the academic community worldwide. Within this transformation process, the financial sector plays a critical role in mitigating environmental impacts and supporting sustainable development. In this context, the concept of green finance refers to the mobilization of financial resources towards projects and activities that promote environmental sustainability. With applications ranging from green bonds to sustainable banking, green finance has become a prominent topic in both academic research and policy agendas over the past decade.

The green finance literature is inherently multidisciplinary, encompassing studies from fields such as economics, environmental science, finance, and public policy. The growing depth and breadth of knowledge in this area necessitate a comprehensive analysis of its evolution and current state. Bibliometric analysis methods provide a systematic way to examine publication trends, collaboration networks, influential works, and thematic developments within a given research domain.



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This study conducts a bibliometric analysis of the green finance literature using academic publications indexed in the WoS database and analyzed through VOSviewer software. The primary aim of the study is to uncover the developmental dynamics of green finance research, identify prominent research themes, map out collaboration structures among authors and institutions, and highlight emerging directions in the field. In doing so, the study offers a comprehensive overview of the existing literature and provides a guiding framework for future research.

2. Literature Review

Green finance has rapidly become a growing area of interest in both academic research and policy-making, as approaches that address environmental issues through economic instruments have come to the forefront. With the widespread global adoption of sustainable development goals, the development and dissemination of environmentally aligned financial models have become increasingly necessary. In a comprehensive study, Nhung and Hang (2024) emphasize that green finance originates from the broader concept of sustainable finance and highlight several key turning points in the field's evolution, such as the issuance of the first green bonds by the European Investment Bank in 2007, the establishment of the Green Bond Principles in 2014, and the signing of the Paris Agreement in 2015.

One of the earliest studies analyzing the evolution of green finance literature was conducted by Zhang et al. (2019), who examined 381 publications and noted that the field exhibited a relatively slow growth trend until 2015, followed by a sharp increase after the Paris Agreement. Muchiri et al. (2022) focused on the post-Paris Agreement period (2015–2022), using VOSviewer and R-studio software to analyze the evolution of green finance research. Their findings confirm that while academic interest in the field has grown significantly, green finance remains underrepresented in mainstream finance journals.

Further exploring thematic developments, Bhatia vd. (2024) analyzed 846 publications indexed in Scopus from 1997 to 2021. Using co-citation and keyword co-occurrence analysis, they identified “green bonds,” “financial risks,” and “climate resilience” as emerging research areas. In a similar vein, Wang et al. (2025) conducted a large-scale analysis of 1,923 publications in the WoS database and categorized the development of green finance literature into three main phases: carbon finance and markets (2008–2010), climate policy and climate change (2011–2017), and Sustainable Development Goals and financial innovation (2018–2022). Their study also highlights the increasing presence of themes such as “green energy,” “green technology,” and the “digital economy” in the literature.

Several studies have examined the green finance literature from a regional or country-specific perspective. Çevirgen and Bayrakçı (2024), for example, analyzed 1,705 publications from the WoS database using VOSviewer and revealed that China leads the field in terms of publication volume and international collaboration, while Turkey ranked 13th, reflecting its emerging contribution. Similarly, Kaplan and Kocaman (2024) examined 1,654 studies published between 2000 to 2024 and identified a significant increase in output after 2017. Their analysis suggests that the literature can be grouped into three primary clusters: green finance, sustainable development, and China. In another study using Scopus data, Sang (2024) analyzed 1,487 publications from 1997 to 2024 and confirmed China's dominant position in the field, while also recognizing significant contributions from other Asia-Pacific countries such as Japan and Malaysia. The study further emphasized that public policies, government initiatives, and private sector engagement play a critical role in accelerating green investment and promoting sustainability.

The thematic diversity within the literature is further enriched by bibliometric studies that focus on specific subfields. For example, Bagaskara et al. (2024) examined the literature on green sukuk (Islamic green bonds) and found that research activity between 2014 and 2023 was heavily concentrated in Southeast Asian countries, particularly Malaysia and Indonesia. Razi (2024) conducted a bibliometric analysis on the relationship between green financial markets and energy price volatility. Other focused studies have explored narrow topics such as green supply chain finance (Judijanto et al., 2024) and the financing of renewable energy investments (Muhmad et al., 2024). These studies provide deeper insight into thematic clustering and research directions within the broader field of green finance. Most of these works combine bibliometric tools such as VOSviewer and Bibliometrix with systematic literature review methods, enabling both quantitative mapping and qualitative interpretation. For example, the study by Muhmad et al. (2024) found that while green finance and renewable energy finance are conceptually aligned, more empirical evidence is needed to solidify the connection.

Taken together, bibliometric analyses offer a powerful approach to understanding the evolution of academic production, collaboration networks, and thematic shifts within green finance. These analyses not only help map the existing literature in a structured way but also guide future research by identifying key trends and gaps. In this context, the present study aims to contribute to the field by conducting an up-to-date bibliometric analysis based on the WoS database to explore the current structure of the green finance literature and identify potential directions for future research.

3. Bibliometric Analysis

Bibliometric analysis is a systematic and quantitative method used to explore the structure, evolution, and dynamics of scientific output within a specific academic discipline. This approach involves analyzing large-scale bibliographic data to identify trends in the literature, collaboration patterns, citation structures, and thematic developments (Donthu et al., 2021; Aria and Cuccurullo, 2017). The process typically includes three main stages: data collection from relevant academic databases, data cleaning and standardization, and finally, analysis and visualization.

The increasing popularity of bibliometric analysis can be attributed to several key factors. These include the advancement and accessibility of comprehensive academic databases such as WoS, Scopus, and Google Scholar, as well as the development of user-friendly software tools that facilitate bibliometric visualization and analysis. Notable tools include VOSviewer, Gephi, CiteSpace, and Leximancer (Van Eck and Waltman, 2010). These applications enable researchers to process large volumes of bibliographic data and map the intellectual landscape of a research field.

Bibliometric datasets commonly include variables such as the number of publications, citation counts, keywords, author names, institutional affiliations, and country information. Analyses based on these variables can reveal core research themes, landmark studies, collaboration networks, and knowledge gaps within the literature (Hota et al., 2019). Through this method, it is possible to trace the chronological development of a field, identify emerging research trends, and offer strategic directions for future scholarly inquiry (Bonilla et al., 2015).

Conducting a bibliometric analysis typically begins with the formulation of a well-defined research question, followed by a systematic literature search. The collected data must undergo a cleaning process—duplicate entries are removed, and the names of authors, institutions, and sources are standardized. Depending on the research objectives, various analytical techniques may be applied, such as co-citation analysis, bibliographic coupling, co-authorship analysis, or keyword co-occurrence analysis (Passas, 2024). The results are then presented using visual maps and network diagrams, offering a comprehensive overview of the intellectual structure and research orientation within the field.

4. Method

The primary aim of this study is to systematically examine the academic literature on the concept of green finance through the bibliometric analysis method, with the goal of mapping the intellectual structure, research trends, and collaboration networks within the field. In this context, the data acquisition process is described in detail, followed by the presentation of the findings derived from the bibliometric analyses conducted on the collected dataset.

5. Data and Analysis

Various software tools used in the bibliometric analysis process facilitate the systematic processing of large-scale datasets and the extraction of meaningful insights. Among these, VOSviewer is one of the most prominent tools, recognized for its robust capabilities in analyzing and visualizing complex bibliographic data. A key feature of VOSviewer is its ability to transform intricate datasets into accessible visual maps, enabling researchers to explore relationships among keywords, authors, journals, and citation networks with clarity. The visualizations produced by VOSviewer assist in identifying academic trends within a given field, mapping researcher collaborations, and uncovering gaps in the existing literature (Donthu et al., 2021; Şeref and Karagöz, 2019). Furthermore, the software's ability to directly extract data from multidisciplinary databases such as WoS and Scopus enhances its usability and allows for more comprehensive analyses. Thanks to these features, VOSviewer is widely regarded as an effective, user-friendly, and comprehensive tool for conducting bibliometric studies.

In this study, the WoS database was selected to investigate the literature on *green finance*. The primary rationale behind this choice lies in the database's inclusion of high-quality, peer-reviewed publications with significant international impact factors. In addition to the quality of its content, WoS provides a robust technical infrastructure for bibliometric research, offering advanced filtering capabilities, detailed search functionalities, and mechanisms for ensuring data accuracy (Dirik et al., 2023; Öztürk and Kurutkan, 2020; Yu et al., 2020). Therefore, the use of WoS is considered to enhance both the reliability of the data and the methodological rigor of the study.

A comprehensive search was conducted in the WoS database on August 26, 2025, using the keyword “green finance” across all searchable fields. The query yielded a total of 3,562 records containing the term “green finance” in their titles, abstracts, or keywords. According to publication years, the earliest identified study dates back to 2007, while the most recent is from 2026. The dataset comprises 3,279 research articles, 116 review

papers, 80 conference proceedings, 77 book chapters, and 38 editorial materials. The top five scientific categories represented within these publications are: Environmental Sciences (1,102), Green and Sustainable Science and Technology (846), Economics (696), Environmental Studies (692), and Business and Finance (690) (WoS1, 2025).

The retrieved publications were analyzed using VOSviewer software, employing various bibliometric techniques, including author analysis, citation analysis, keyword co-occurrence, journal analysis, country-level analysis, institutional analysis, and bibliographic coupling.

6. Findings and Discussion

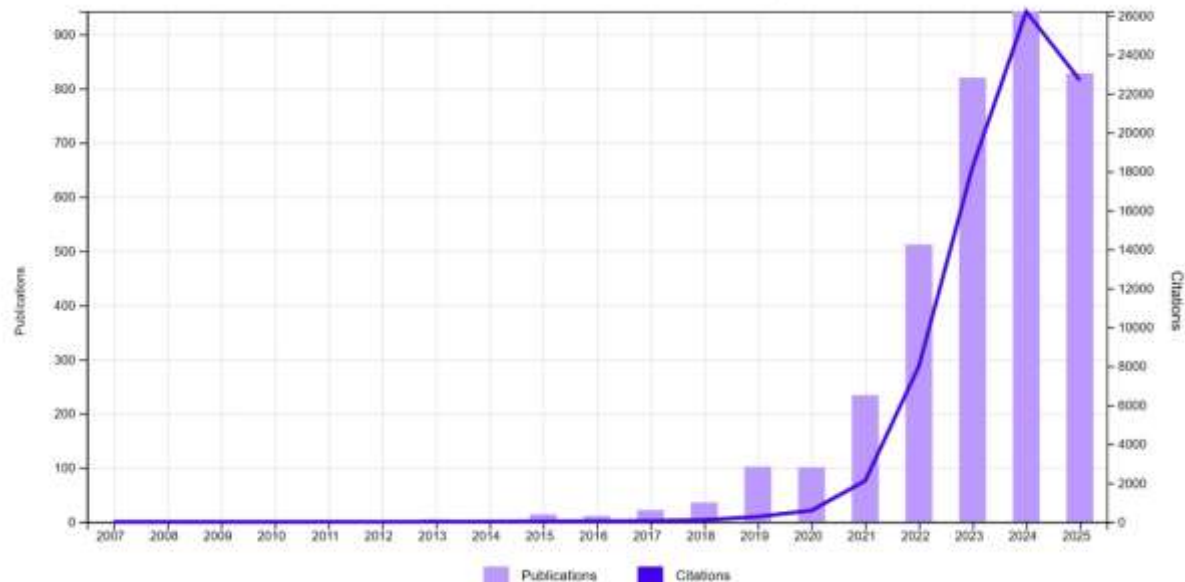


Figure 1: Trends in the Number of Publications and Citations Related to the Concept of Green Finance

Source: WoS2, 2025

Figure 1 illustrates the trend in the number of publications and citations related to the concept of green finance, based on data obtained from the WoS database. Upon examination, a significant increase in the number of publications is observed particularly after 2019. Similarly, citation counts also show a marked rise following 2019. This trend is associated with the Paris Agreement, signed in 2015 which committed to collective action against the climate crisis.

Author citation analysis is used to evaluate the impact and productivity of researchers within a specific field. This type of analysis measures how influential an author is within the scientific community working on the examined topic, based on the number of citations their publications have received. In the author citation analysis conducted for the topic of “green finance,” a threshold of at least two publications and one citation was applied. As a result, out of 8,417 authors, 1,469 authors met the criteria. The analysis, which was conducted on 1,322 interconnected items, identified 35 clusters, with 20,061 links and a total link strength of 24,377. The five most cited authors were Taghizadeh-Hesary, F. (3,680 citations) Lee, C. (2,143 citations) Zhang, D. (1,499 citations) Mohsin, M. (1,390 citations) and Lee, C. (1,342 citations).

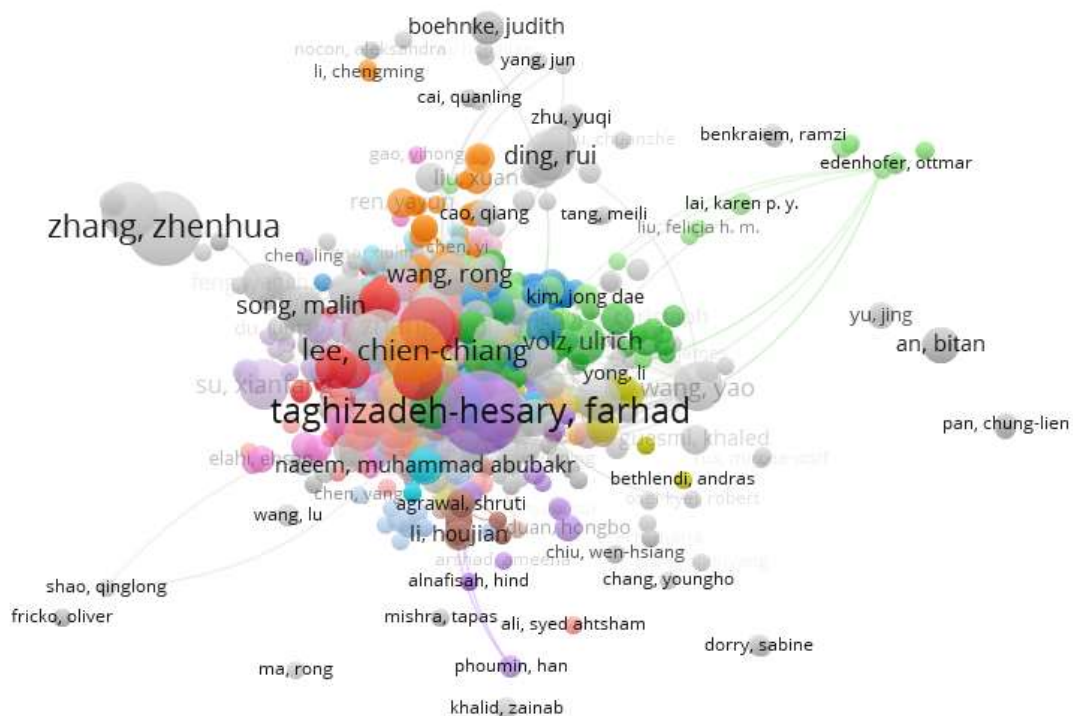


Figure 2. Network map of the most cited authors

Source: The data from WoS (1) 2025, was analyzed using the VOSviewer software.

Table 1 displays the ten most impactful articles within the field.

Table 1. Top 10 most influential articles in the field based on citation counts

Title	Number of Citation
Lee, C. C., and Lee, C. C. (2022). How does green finance affect green total factor productivity? Evidence from China. <i>Energy economics</i> , 107, 105863.	824
Yu, C. H., Wu, X., Zhang, D., Chen, S., and Zhao, J. (2021). Demand for green finance: Resolving financing constraints on green innovation in China. <i>Energy policy</i> , 153, 112255.	790
Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y., and Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: mediating role of green finance. <i>Energy policy</i> , 153, 112256.	559
Irfan, M., Razzaq, A., Sharif, A., and Yang, X. (2022). Influence mechanism between green finance and green innovation: exploring regional policy intervention effects in China. <i>Technological Forecasting and Social Change</i> , 182, 121882.	549
Zhang, W., Liu, X., Wang, D., and Zhou, J. (2022). Digital economy and carbon emission performance: evidence at China's city level. <i>Energy Policy</i> , 165, 112927.	506
Taghizadeh-Hesary, F., and Yoshino, N. (2019). The way to induce private participation in green finance and investment. <i>Finance Research Letters</i> , 31, 98-103.	475
Zhang, S., Wu, Z., Wang, Y., and Hao, Y. (2021). Fostering green development with green finance: An empirical study on the environmental effect of green credit policy in China. <i>Journal of</i>	458

environmental management, 296, 113159.

Zhou, X., Tang, X., and Zhang, R. (2020). Impact of green finance on economic development and environmental quality: a study based on provincial panel data from China. *Environmental Science and Pollution Research*, 27(16), 19915-19932. 450

Wang, J., Ma, M., Dong, T., and Zhang, Z. (2023). Do ESG ratings promote corporate green innovation? A quasi-natural experiment based on SynTao Green Finance's ESG ratings. *International Review of Financial Analysis*, 87, 102623. 432

Li, C., and Umair, M. (2023). Does green finance development goals affects renewable energy in China. *Renewable Energy*, 203, 898-905. 427

Source: WoS3, 2025.

In bibliometric analyses, **co-authorship analysis** is used to evaluate the collaborations a researcher establishes with other scholars, as well as the scientific impact of these collaborations. This analysis helps reveal the structure of collaboration networks, levels of interaction, and the positions of individuals within academic networks. Based on the network mapping conducted using the criteria of a minimum of 2 publications and 1 citation, a total of 41 clusters, 1,761 links, and a total link strength of 2,812 were identified (Figure 3). Upon examining the network map, the three most prominent authors were found to be Taghizadeh-Hesary, F., Zhang, Z. and Lee, C.

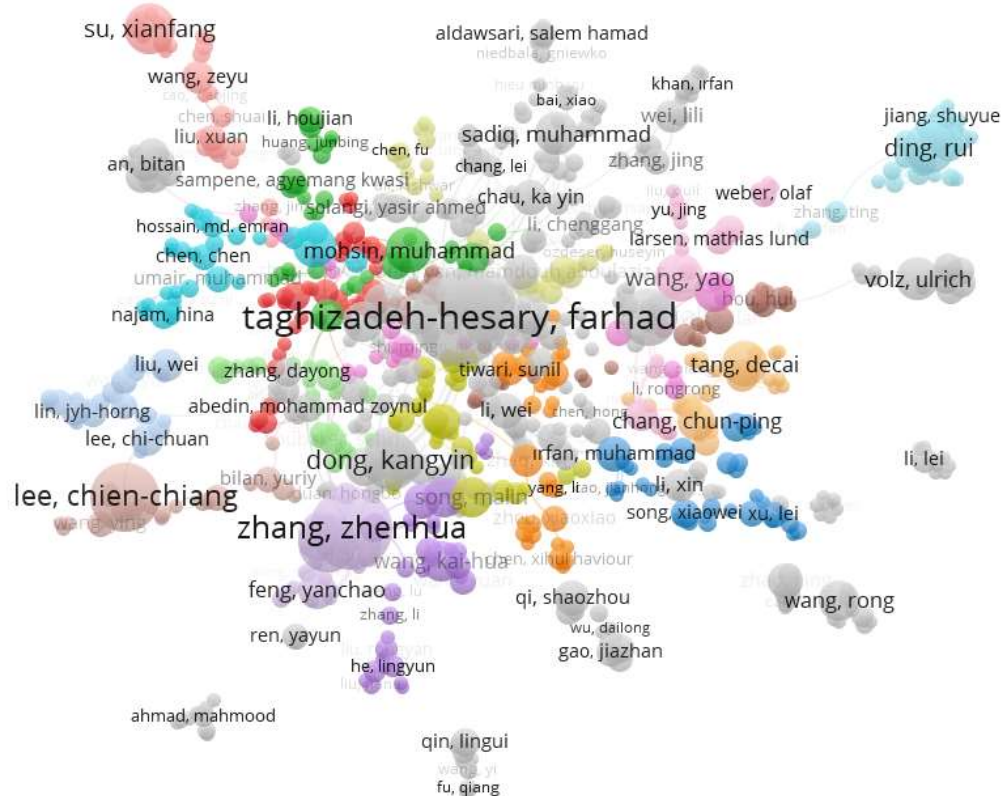


Figure 3. Co-authorship network map

Source: The data from WoS (1) 2025, was analyzed using the VOSviewer software.

Source citation analysis aims to identify the academic journals with the highest number of publications on a given topic and to examine the relationships among citations to these sources. Using the criteria of at least 2 publications and 1 citation, 257 out of 715 sources were included in the analysis. The results revealed 28 clusters, 2,087 links, and a total link strength of 7,662. Among the evaluated sources, the top three journals with the highest number of publications were Sustainability (267 articles), Environmental Science and Pollution

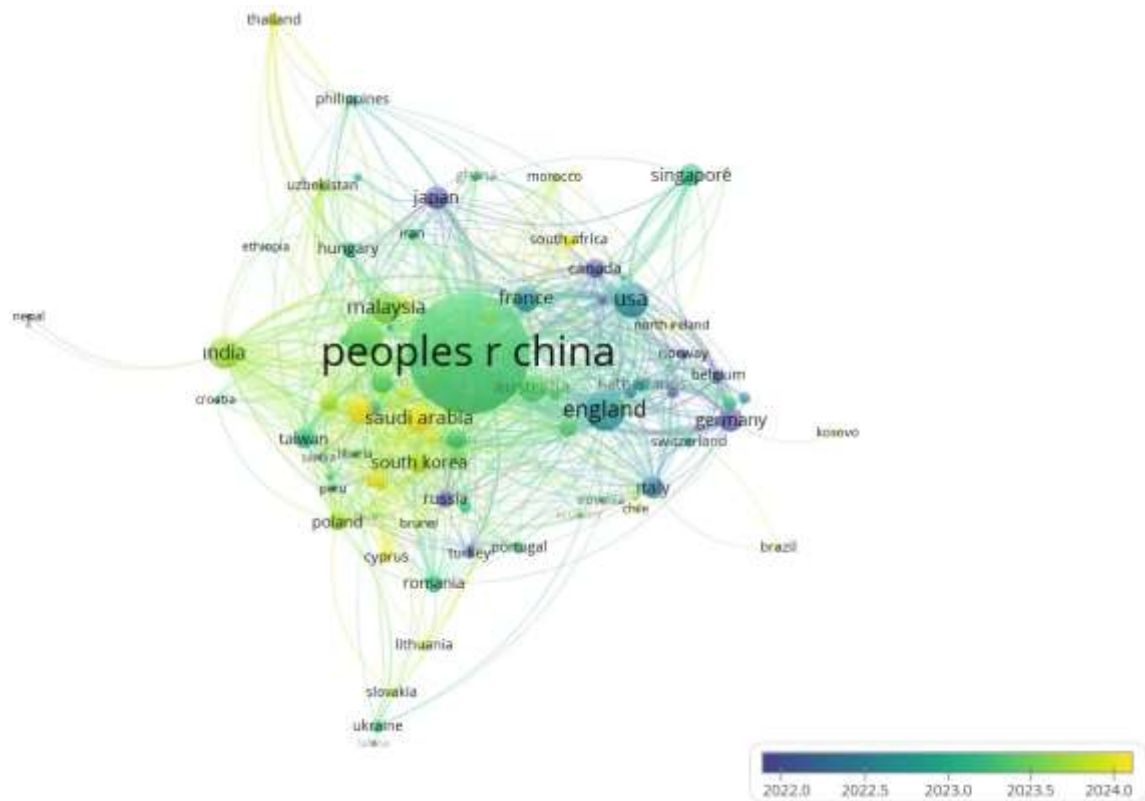


Figure 5. Timeline of Country–Author Analysis

Source: The data from WoS (1) 2025, was analyzed using the VOSviewer software.

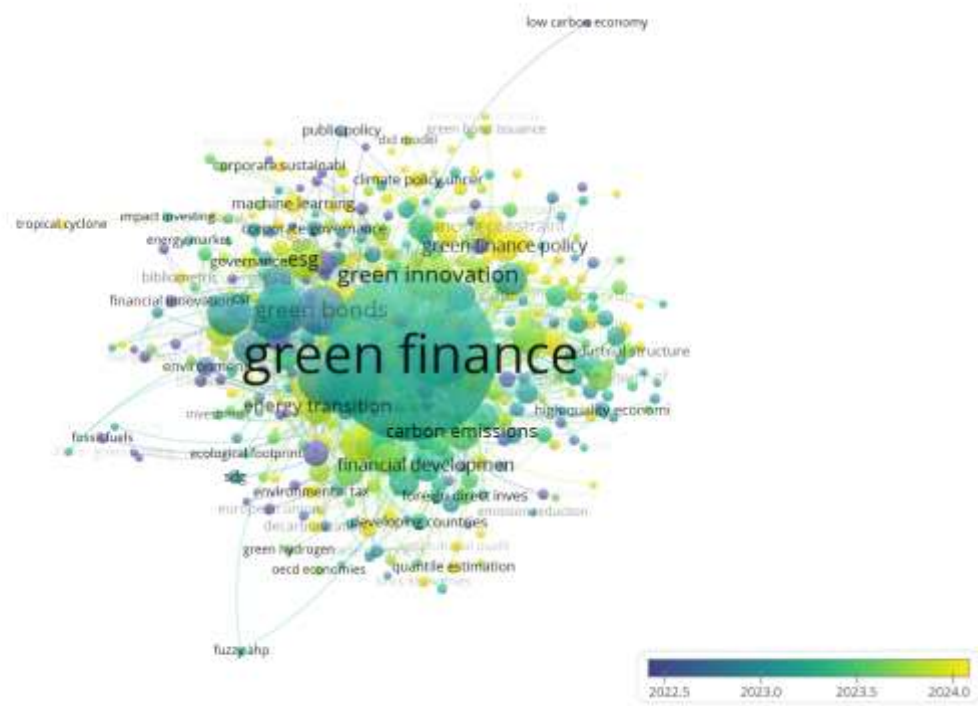
Institutional citation analysis examines the extent to which the scientific publications of universities, research institutes, and other academic organizations are cited, as well as the areas in which these institutions are most influential. This analysis aims to assess the scientific performance of institutions and provides comprehensive insights into their academic reputation, research capacity, and position within global academic collaboration networks. According to the institutional citation analysis conducted for the green finance literature, Guizhou University is identified as the most productive institution with 67 publications, followed by Southwestern University (65), Lanzhou University (61), Jiangsu University (54), and Wuhan University (53). In terms of citation counts, Southwestern University ranks first with 3,663 citations, followed by Tokai University (3,038) and Jiangsu University (2,684).

Table 2. Publication and Citation Counts of Institutions

Institution Name	Number of Publications	Number of Citations
Southwestern University	65	3663
Tokai University	36	3038
Jiangsu University	54	2684
Nanchang University	29	2436
Beijing Institute Tech.	42	2392
Capital University	37	2120
Gingdao University	44	1805
Anhui University	46	1804
Xiamen University	48	1568
Dalian University Techn.	19	1472

Source: Compiled using data obtained from the WoS database.

A closer examination of the keyword co-occurrence analysis reveals a recent shift in thematic focus. While keywords such as carbon neutrality, green economy, and green bonds were more commonly used in earlier studies, recent publications have increasingly incorporated terms like green finance policy, machine learning, blockchain, and fintech. This trend indicates an evolving research agenda that integrates technological advancements and policy dimensions into the green finance discourse.

**Figure 6.** Keyword Co-Occurrence Analysis

Source: The data from WoS (1) 2025, was analyzed using the VOSviewer software.

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