

Article

Challenges and Trends in Green Finance in the Context of Sustainable Development—A Bibliometric Analysis

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Abstract: Green finance in the context of sustainable development sits within the broader discourse of environmental economics and sustainable finance. Their integration has become imperative in addressing global challenges, with the aims of understanding how financial mechanisms can be aligned with sustainability goals, investigating the role of green finance in promoting environmentally friendly investments, and fostering sustainable development. This bibliometric analysis explores the evolution, trends, and challenges in green finance research. It examines 436 articles published between 2016 and 2024, revealing insights into influential publications, authors, journals, institutions, and countries engaged in green finance for sustainability. The study identifies China, the UK, and Pakistan as leaders in research output and citation impact. Furthermore, it highlights the interdisciplinary nature of green finance, reflected in diverse publication outlets spanning environmental, social, and economic domains. The analysis underscores the increasing global interest in green finance, as evidenced by the growing citation rates over time. Key findings include the pivotal role of green finance in energy efficiency, renewable energy development, and the promotion of sustainable economic growth. Overall, this research provides valuable insights for policymakers, researchers, and practitioners, emphasizing the importance of interdisciplinary collaboration and continued research efforts in advancing sustainable finance agendas.



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Keywords: green finance; sustainable development; environmental, social, and governance (ESG); bibliometric analysis

1. Introduction

In recent decades, green finance instruments have attracted considerable attention due to their role in international cooperation and national policies regarding sustainability and climate change. To understand the concepts of green finance, it is important to start by understanding the definition of “sustainability”. It is imperative to note that there are several definitions available to explain this term. Sustainability was presented as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” in the publication *Our Common Future* by the United Nations in 1987 (United Nations 1987). Sustainable finance generally involves the integration of sustainability with economic and financial practices. Green finance is part of sustainable finance and concerns financial instruments facilitating environmentally sustainable development, energy transition, and the fight against global warming. Investors and financial institutions can actually contribute to combating climate change by investing in enterprises and projects pursuing objectives related to energy transition and environmental protection. Although green finance is expanding significantly, a fully harmonized regulatory framework and categorical criteria for determining what is green and what is not are not yet available. For this reason, the European Union and competent financial regulatory authorities are developing rules on green finance. These will enable investors interested in green finance to avoid the

risk of greenwashing, that is, unsubstantiated or false claims that investments are green. According to the European Commission, sustainable finance (or green finance) refers to the “process of taking environmental, social and governance (ESG) considerations into account when making investment decisions in the financial sector, leading to more long-term investments in sustainable economic activities and projects” (European Commission 2021). This leads to a greater focus on long-term investments in sustainable economic activities and projects. The European Commission further elaborates on ESG considerations, highlighting environmental factors like climate change and pollution, social factors such as human rights and inequality, and governance factors, including institutional policies and employee relations. In simpler terms, green finance is a segment of finance aimed at supporting economic growth while also alleviating environmental pressures, all while taking into consideration ESG factors. In recent times, there has been increasing recognition of the significance of ESG factors. ESG factors, previously viewed as non-financial aspects of businesses, are now fundamental values embraced by companies, major financial institutions, and shareholders worldwide. These factors are now given utmost importance in core management strategies adopted by businesses for sustainable management and investment.

Hence, green finance can be seen as a financial instrument crafted with the noble goal of aligning financial choices with the evolving requirements of both society and the environment. Its aim is to encourage investments that foster sustainable development. Green finance has been the subject of extensive research, with various aspects related to greenhouse gas emissions (Saeed Meo and Karim 2022; Wu et al. 2023), climatic disasters (Ezroj 2020), environmental disclosures (Brooks and Schopohl 2020; Lyon and Shimshack 2015; Steuer and Tröger 2022), the economic consequences of global warming and temperature shifts (Burke et al. 2015; Dell et al. 2012), the relationship between temperature and aggregate risk (Lamperti et al. 2021), and the influence of climate policy risk on the financial system (Lin et al. 2022) being examined. Green finance manifests in various forms, such as green bonds, which fund eco-friendly projects (Yu 2016); socially responsible investing (SRI), which evaluates ESG factors in investment choices (Walls 2024); and impact investing, which strives to yield financial gains alongside positive social and environmental effects (Yaşar 2021). Governments, organizations, and individuals are recognizing the need for a more sustainable and responsible approach to finance, and are taking steps to integrate ESG factors into financial decision-making. As awareness of the importance of sustainability continues to grow, it seems likely that green finance will become an increasingly important part of the financial system.

The current trends in the development of academic research and practices in the field of green finance have been outlined so far by numerous authors by means of a range of scientific methods, including bibliometric analysis (Bhatnagar and Sharma 2022; Debrah et al. 2023; Mohanty et al. 2023; Zhang et al. 2019). They share a common goal, but focus on different aspects and offer unique contributions to the literature. They all emphasize the importance of regulatory and policy support, technological innovation, and the role of stakeholders. Bhatnagar and Sharma (2022) outline the factors that influence the implementation of green financial practices, emphasizing regulatory support in the process of integrating green financial products into traditional financial markets. Mohanty et al. (2023) highlight the broad spectrum of the research topic by revealing the relationship between economic performance and the social value of green finance, with an emphasis on green bonds and renewable energy. Their conclusion is that financial literacy should be increased, reporting and risk management should be improved, and digital technologies should be integrated in the context of green finance. Debrah et al. (2023) combine bibliometric and systematic analysis, focusing on the gap between theoretical concepts and the practical application of green finance. They find that this scientific field is both insufficiently mature and extremely wide-ranging and multi-layered. Green finance “needs to be fully understood”, according to the authors, and therefore they propose research hot topics such as the green bond market and greenium, green credit (loans), carbon investment and market, green banking, market stress, and domestic and international climate finance policies.

We take the topic of green finance as relatively broad, but also strongly related to sustainable development. In the context of building a better future for people, businesses, and the planet, the potential of green finance to drive positive change should be explored. This task is characterized by complex challenges and uncertainties that require careful and rigorous academic review and analysis for a deeper understanding. The main role in this process is played by the information on both sustainable development and green finance, reflected in the specialized scientific literature. To process this information, the application of bibliometric analysis, which is the focus of this article, is suitable.

The direction of this research process is determined by the research objective and research questions. Driven by the need for science-based adequate strategies for the transition to sustainable economies, we focus mainly on the integration of ESG criteria in the process of conceptual understanding and the practical application of green finance.

Thus, the main objective of this study is to identify the current state of research on the field of green finance for sustainable development, as well as to propose recommendations for future research and practice. In such a case, it is logical that this study addresses the following research questions:

- RQ1: What are the most influential publications, authors, journals, and institutions involved in green finance research for sustainable development?
- RQ2: How has green finance in the literature on sustainability developed over time and what is the trend of citation impact?
- RQ3: What are the most common and influential keywords used in green finance research?
- RQ4: What are the geographic distributions and institutional affiliations of the research?
- RQ5: What is the scope of this research, and what are the key trends for future research in green finance for sustainable development?

2. Materials and Methods

A bibliometric analysis was performed with the collected information from the published research and citations to determine their impact. Bibliometric analysis “summarizes large quantities of bibliometric data to present the state of the intellectual structure and emerging trends of a research topic or field” (Donthu et al. 2021). The objects of analysis can be scientific publications (articles, reports, books, etc.), sources (scientific journals, collections of reports, etc.), keywords and terms characteristic of the research field, authors, including teams of co-authors, institutions (universities, departments, research groups and teams, business organizations, NGOs, etc.), countries, or regions.

The research data were generated by Scopus. When selecting a database for scientific research in the field of green finance, we relied on the valuable conclusions from the article by Singh et al. (2021). This article provides a detailed comparative analysis of journal coverage in three major global databases, including Web of Science and Scopus. The analysis reveals that nearly all journals in Web of Science are covered by Scopus (99.11%), with only a small percentage of unique journals exclusive to Web of Science. These data are for 2021, but we believe that the trend continues in 2024 as well. Additionally, we carried out a study in 2024, from which it was established that the relative share of the number of journals in the subject area of Social Sciences (9729) compared to the total number of sources in Scopus (46,702) is approximately 20.8%. This is significantly larger than the same indicator for Web of Science (approximately 12.3%), with numbers of sources of 3076 and 24,990, respectively. This further motivated the choices made in this research article. In addition to broad coverage with open access content, Scopus provides a wide range of metrics and tools for assessing research impact and author profiles for collaborating and creating collaborative networks. Therefore, it is widely used for bibliometric studies (Vieira and Gomes 2009).

As the first step of the scientific research, keywords and terms, a database search field, additional search criteria, and the data sample for the study were generated.

We conducted bibliometric analysis in the following directions: (1) performing a descriptive analysis; (2) a citation analysis (by source, by publications, by author(s), by

country, and by organization); and (3) a structural analysis of the scientific field (conceptual structure, intellectual structure, and social structure). In this way, the contribution of the objects of analysis to the given scientific field is shown. However, the relationships between them can be well visualized through scientific mapping (Donthu et al. 2021).

We used the features of the Biblioshiny 4.1 application, a configurable web interface package from bibliometrix of the R programming language for bibliometric analysis, as well as VOSviewer (version 1.6.19) (Van Eck and Waltman 2010).

We started our process by searching for keywords in the Scopus database. Determining the keywords was the result of a panel discussion among specialists from academic and practical backgrounds in the fields of finance, sustainability, and accounting. A query in the database using the keywords “green financ*” and “sustainab*” was conducted on 25 March 2024 in a specifically selected field in Scopus—(Article title, Abstract, Keyword)—generating a result of 1429 documents. In terms of the number and type of documents in the sample, the criteria included inclusive and exclusive criteria. The selected options for exclusive criteria limited the sample as follows:

- Open access: Only including documents with open access, resulting in 531 documents.
- Year: Studies published between 2016 and 2024 were selected, resulting in 525 documents.
- Document type: Only articles were of interest, resulting in 451 documents.
- Source type: Only articles published in journals were chosen, resulting in 451 documents.
- Language: Only articles in English were included, resulting in 436 documents.

The remaining filters, Subject area, Publication stage, Author name, Source title, Keyword, Affiliation, Funding sponsor, and Country/territory, were not utilized. They served as inclusive criteria. Querying the database after applying these additional criteria organized the data in the results into a sample of 436 documents.

3. Results

The conduct of bibliometric analysis is profiled by sources, publications, and authors. In order to establish their influence, so-called citation analysis is used. Citation analysis is a way of measuring the influence of a journal, publication, or author according to the total number of citations (of the journal, publication, or author) in other scientific works. The impact of a study is beneficial to other researchers (Bornmann et al. 2008).

Citations are intended to show that a publication has used the content of several other publications (in the form of other people’s ideas, research results, etc.). Thus, the number of citations used in evaluating a study serves as a determinant of its impact (Bornmann and Daniel 2007).

Bibliometrix and VOSviewer enable citation analysis to be profiled in the following directions: by source, by publications, by author(s), by country, and by organization.

3.1. Descriptive Analysis

The sample consists of 436 scientific articles, authored by a total of 1131 authors, published in 159 scientific journals. Out of the 436 articles, 55 are authored by a single author, while the co-authored articles amount to 381. The temporal scope of the study spans nine years, between 2016 and 2024. The average number of published articles per year is approximately 48 (precisely 48.4).

We used information generated as a result of the query in Scopus regarding citations. The visualization was facilitated through Bibliometrix. Not all 436 articles from the sample have been cited in other research studies at least once. The number of cited articles is 351, which constitutes 80.5% of the sample. The total number of citations in other research studies for these 351 articles (including self-citations) is 7351. The average number of citations per article is 16.92. The trend in article citations over time is positive, indicating a rapidly growing overall interest in the issues of green finance and sustainable development (see Figure 1).

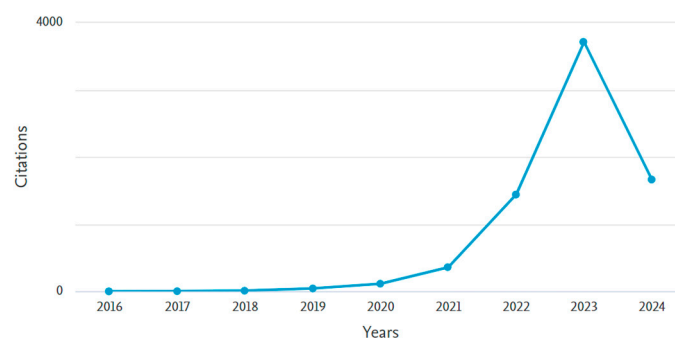


Figure 1. Distribution of the number of cited articles from the sample by year.

3.2. Citation Analysis

3.2.1. Citation Analysis by Source

Table 1 presents the top five prolific journals and their publishers on green finance in the sustainability context with metrics of Scopus coverage years (SCY), total publications (TP), total citations (TC), h_index (h), Cite Score for 2022 (CS 2022), and Source-Normalized Impact per Paper (SNIP).

Table 1. Citation analysis by source—ranking of the top 5 most influential and most relevant sources.

Journal	Publisher	SCY	TP	TC	h	CS 2022	SNIP
<i>Sustainability</i>	MDPI	2009	80	1445	19	5.8	1.198
<i>Environmental Science and Pollution Research</i>	Springer Nature	1994	26	670	14	7.9	1.214
<i>Frontiers in Environmental Science</i>	Higher Education Press	2013	21	147	4	9.8	1.257
<i>Economic Research-Ekonomska Istrazivanja</i>	Taylor & Francis	2000	20	417	9	6.2	1.408
<i>Humanities and Social Sciences Communications</i>	Springer Nature	2020	14	47	4	3.0	1.620

The analysis reveals that “*Sustainability*” is the most influential and relevant journal in the field, with a total of 80 publications, accounting for the highest number of total citations (1445), and an h-index of 19. This suggests that it not only publishes a significant number of articles, but also that these articles are widely recognized and cited within the academic community. The journal’s Cite Score of 5.8 and SNIP of 1.198 further highlight its impact and relevance in the domain of green finance and sustainability. “*Environmental Science and Pollution Research*”, published by Springer Nature since 1994, follows with 26 publications and a total of 670 citations, demonstrating an h-index of 14. Its Cite Score of 7.9 and SNIP of 1.214 indicate its strong influence and the quality of research it publishes. “*Frontiers in Environmental Science*”, with 21 publications and 147 citations, shows a lower h-index of 4 but stands out with a high Cite Score of 9.8 and an SNIP of 1.257. This suggests that while it has fewer publications, the articles it does publish are of significant quality and impact. “*Economic Research-Ekonomska Istrazivanja*”, published by Taylor & Francis since 2000, has 20 publications and 417 citations, with an h-index of 9. Its Cite Score is 6.2, and it has an SNIP of 1.408, indicating a steady contribution to the field of green finance and sustainability. Lastly, “*Humanities and Social Sciences Communications*”, a relatively new journal from Springer Nature starting in 2020, has quickly made its mark with 14 publications and 47 citations. Its h-index is 4, with a Cite Score of 3.0 and an SNIP of 1.620. Despite being the newest journal in the top five, it shows a promising start in contributing to the discourse on green finance and sustainability. These journals collectively highlight the diversity and depth of research being conducted in the area of green finance and sustainability, each contributing uniquely through their publication volumes, citation impact, and overall influence in the academic community.

From a dynamic aspect, journals have different behaviors: all of them show a relative increase in the number of publications over time, but the rates of increase are different. The jump in publication activity during the period 2018–2024 for the first journal in the

ranking—*Sustainability*—is huge, while the satisfactory trend of increasing publications is observed in the remaining journals later, in the period 2021–2024, but on much smoother and smaller scales (see Figure 2).

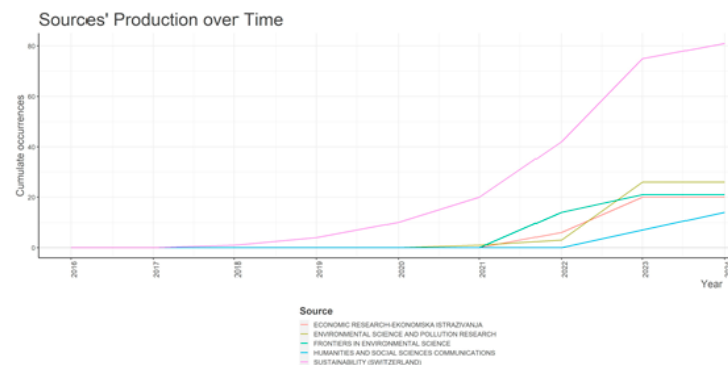


Figure 2. Publication activity by sources (top 5 sources for the period 2016–2024).

3.2.2. Citation Analysis by Publications

This type of analysis of publications intuitively focuses on their thematic content. To reveal the content, the keywords in the publications of the sample are used. In our sample, the total number of keywords is 1171. Bibliometrix allows the set of keywords to be “cleaned” to make them suitable for further work. This was completed by drawing up a list of words to remove. After this manipulation, the following most common keywords from the 436 documents in the sample were identified according to their frequency of occurrence: green bonds, climate change, renewable energy, green economy, and ESG. For the top 20 most common words, a word tree was created to identify their structure in the overall set of keywords, as well as a word cloud to further visualize their influence (see Figures 3 and 4).



Figure 3. Top 20 most common author keywords (structural ratio shown in word tree).



Figure 4. Top 20 most influential author keywords (impact strength shown in word cloud).

In seeking the most influential publications, articles from the sample were ranked according to their total number of citations in other documents across the entire Scopus

database. Only 351 documents of the sample gathered a total of 7351 citations. Another 85 documents have not been cited yet. At this stage, VOSviewer allows the user to choose the minimum number of citations per publication for selection. In the current study, this number was chosen to be 160 citations. According to this criterion, five documents from the sample met this requirement, which is approximately 1.15% of the total volume of 436 articles. An additional indicator of the impact of publications is the average number of citations per year, which is generated by the Bibliometrix tool. Ranking by the two indicators of “total number of citations in Scopus (TCS)” and “average number of citations per year (ACy)” yields different results—the first may reflect nominal impact (NI), while the second reflects the real impact (RI) of the publication. It is considered that the real impact carries more weight. The results from this more in-depth analysis are shown in Table 2.

Table 2. Citation analysis of top 5 publications (with rankings).

Publication	TCS	ACy	Rank	
			NI	RI
(Rasoulinezhad and Taghizadeh-Hesary 2022)	267	89.00	1	1
(Taghizadeh-Hesary and Yoshino 2020)	254	50.80	2	2
(Dikau and Volz 2021)	190	47.50	3	3
(Sinha et al. 2021)	173	43.25	4	4
(Soundarrajan and Vivek 2016)	168	18.67	5	5

These five articles collect 1052 citations, which represents an impressive result—14.31% of all citations in the sample. The data also show that the most influential articles in the field of green finance for sustainable development, which are repeatedly cited in Scopus, address issues related to the challenges of green finance, investment in renewable energy projects, the achievement of high energy efficiency, integrating the topics of sustainable and green finance in the activities of central banks around the world, accelerating a mechanism for sustainable finance through green bonds, the importance of green finance for economic and environmental well-being and growth, etc.

In addition to the metrics mentioned, the analysis underscores the significance of these top-cited articles in shaping current research trends and discussions. They not only contribute significantly to the academic discourse, but also provide practical frameworks and insights for policymakers, financial institutions, and stakeholders aiming to implement and promote green finance.

3.2.3. Citation Analysis by Author

The metric for citation analysis by publications (see Table 2) identifies E. Rasoulinezhad and F. Taghizadeh-Hesary as the most influential authors due to having the highest number of citations received for their co-authored article from 2022. Their article is dedicated to examining the relationship between the deployment of green energy and the achievement of sustainable development in the energy and environmental sectors. Using the STIRPAT model, the authors investigate the connection between CO₂ emissions, energy efficiency, the Green Energy Index (GEI), and green finance in the top ten economies supporting green finance. The findings demonstrate that green bonds serve as a suitable method for promoting green energy projects and significantly reducing CO₂ emissions. However, no causal link is found between these variables in the short term. Consequently, governments are urged to implement long-term supportive policies to incentivize private investment in green energy projects, aiming for sustainable economic growth in environmental matters. This policy may prove applicable during and after the COVID-19 era, when green projects may encounter greater difficulties accessing finance.

3.2.4. Citation Analysis by Country

The sample includes publications of authors affiliated with 646 scientific institutions and organizations from 53 countries in 159 peer-reviewed journals in the fields of business, management, economics, environmental studies, computer science, and others. For 42 of the articles, there is no information about their origin, and therefore the analysis related to the geographical distribution of the researched issues covers the remaining 394 articles.

An analysis of scientific production by country was conducted, and a ranking was made based on the number of published articles. Leading the ranking list with 204 publications from the sample is China, followed by the United Kingdom with 24 publications, and Pakistan with 15 publications. The top five countries/regions cover 264 of the published articles, which is approximately 61% of the total number (see Figure 5).

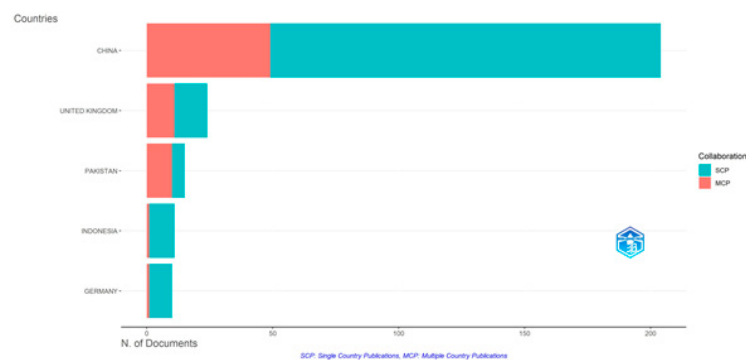


Figure 5. Top 5 most productive countries.

From a dynamic aspect, the number of publications shows a relative increase over time. There is a significant leap during the period for China, while the trend is more gradual for Pakistan, India, United Kingdom, and Indonesia (see Figure 6).

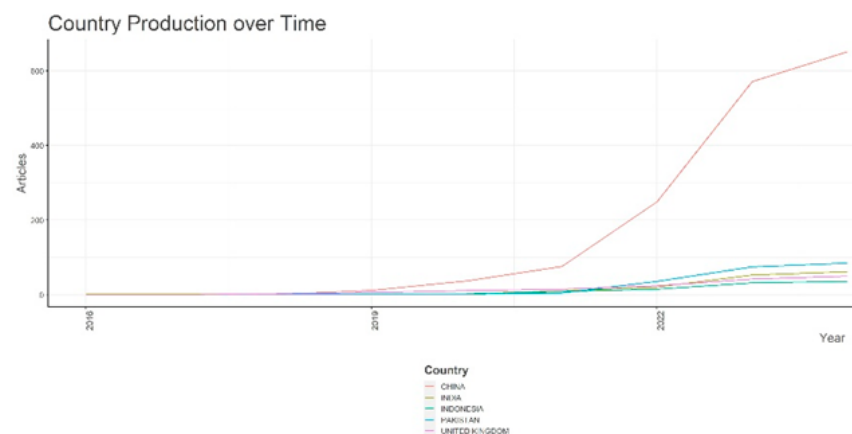


Figure 6. Production of top 5 countries over time.

Countries with the highest contribution, measured by the number of citations, are also of interest in Bibliometrix. The quantitative information on the total and average citations (TC, AC) of documents from the sample in the countries where they are published enables their ranking. The top 10 entries according to this criterion are shown in Table 3.

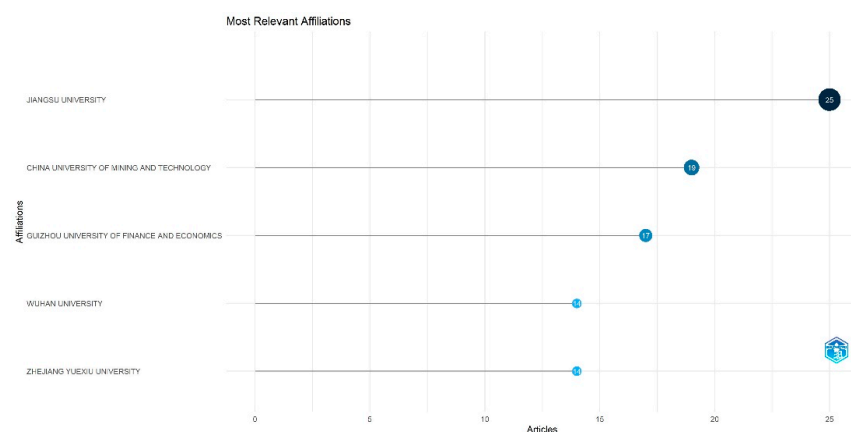
Table 3. Top 10 countries/regions with the highest number of citations in publications from the sample and average number of citations per article.

Rank	Country	TC	AC
1	China	2762	13.50
2	United Kingdom	747	31.10
3	Japan	648	129.60
4	Pakistan	483	32.20
5	India	372	53.10
6	Romania	237	33.90
7	Italy	160	20.00
8	Ireland	155	155.00
9	Indonesia	140	12.70
10	Turkey	138	17.20

In addition to analyzing the number of publications, examining the impact of research from different countries provides further insight into the global distribution and influence of scholarly work in green finance and sustainability. These data reveal that China, while leading in the number of publications, also has a substantial total citation count (TC) of 2762, with an average citation (AC) of 13.50 per article. This indicates the broad and significant impact of Chinese research in this field. The United Kingdom, although having fewer publications, demonstrates a high average citation rate of 31.10, with a total of 747 citations. This suggests that UK publications, though fewer in number, are highly influential and frequently referenced in subsequent research. Japan, with a total of 648 citations and an impressive average of 129.60 citations per article, shows exceptional impact. The analysis of these top-contributing countries not only reveals the geographical spread of research activities, but also highlights regions that produce high-impact work in green finance and sustainability. This information is crucial for understanding the global landscape of research in this domain and identifying key players and emerging contributors to the field.

3.2.5. Citation Analysis by Organization

The measurement of the most relevant affiliations (institutions, universities, organizations), which involves measuring the scientific output generated by authors in the field of green finance and sustainability from a given institution, is assessed by number of publications. According to this indicator, of the 646 affiliations in the sample, Jiangsu University (Zhenjiang, China) has the largest number of articles (25), followed by China University of Mining and Technology (Xuzhou, China) with 19 articles, and Guizhou University of Finance and Economics (Guiyang, China) with 17 articles (see Figure 7).

**Figure 7.** Top 5 most relevant organizations (affiliations).

The leadership of Jiangsu University (Zhenjiang, China) is also praised because this institution has seen a remarkable growth in the number of publications in the research area (see Figure 8).

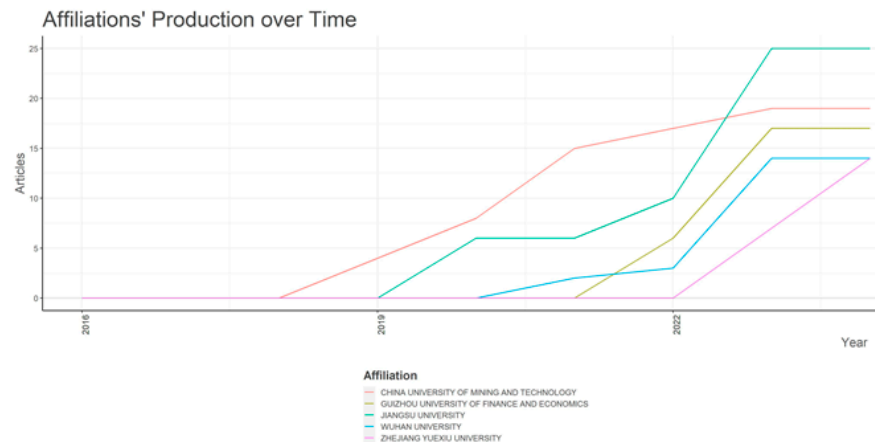


Figure 8. Publication activity by organization (affiliations) for the period 2016–2024.

An even deeper analysis of the influence and interest of countries/regions, as well as of respective journals, can be achieved using the Bibliometrix tool “Three-field plot”, developed based on the Sankey diagram. The diagram allows a user-defined number of values of a given variable (e.g., keywords describing the research topic) to be placed in the central position, followed by values of two other variables (e.g., authors, countries, universities, sources, etc.) on either side. The three-field plot shows how the side variables are interested and/or active in relation to the central variable. In this case, the keywords in the sample publications are placed as the central variable, and their number is set to 10, resulting in the terms appearing in rectangles of different colors and sizes. They visually correspond to similar rectangles on either side, which in this example are countries/regions and sources (see Figure 9).

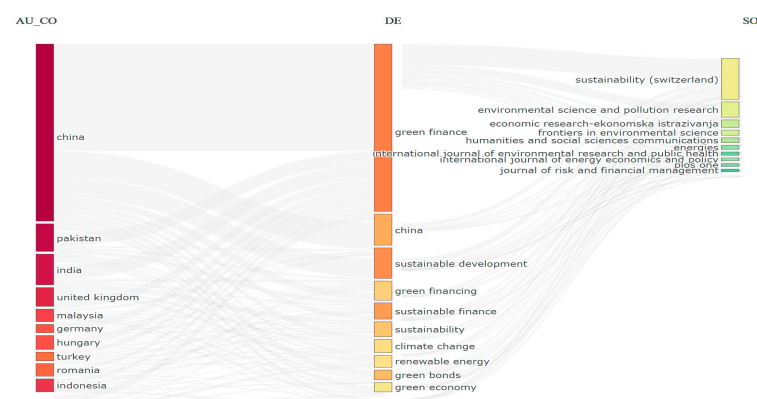


Figure 9. Three-field plot for keywords, country/region, and source.

The data show that the greatest interest is in green finance. This is most prominent in scientific publications from China, Pakistan, and India, but featured to a lesser extent in other countries. It is also the subject of scientific articles published most often in the journal “Sustainability”, but is focused on less often in some of the other journals in the example.

The visual presentation of the graph of the three fields forms the basis for other similar, more in-depth analyses that may provide insight into individual fragments of the studied topic (in the example, these are sustainable development, climate change, renewable energy, and green bonds), as well as the attitude towards them by different countries and journals.

3.3. Structural Analysis

The considerable expansion of green finance in response to multiple global initiatives, guidelines from task forces or special networks, and the institutional frameworks of various countries has triggered an exponential growth in the literature on green finance and sustainable development over the last decade (see Figure 1). Therefore, it is fundamental to explore the structures of knowledge in green finance research, i.e., the intellectual structure, the network of research collaborations, and the conceptual structure.

3.3.1. Intellectual Structure (Co-Citation Analysis)

Co-citation analysis involves identifying sets of publications that are frequently referenced together, which can hint to emerging research areas or specialized fields within a particular discipline. By examining the connections among highly cited articles, researchers can gain valuable insights into the foundational concepts of their field and potential directions for further investigation. This method relies on a *co-citation matrix*, which tracks how often pairs of articles are cited jointly. Each article is represented by a row and column in the matrix, with cell values indicating the frequency of co-citation between them. Ultimately, this process creates a network of interconnected citations, offering a visual depiction of the intellectual progress within a field of study.

The VOSviewer tool has capabilities for co-citation analysis by references, sources, and authors. In this study, only co-citation analysis by references is applied.

VOSviewer requires a threshold to be set, i.e., a maximum number of identical references of at least two articles from the sample. In the studied sample of 436 articles, the total number of references is 23,658. At a selected threshold of 10 co-cited references (cited 10 times), 20 references correspond, 1 of which occurs 40 times in the sample articles. Another is cited 25, 18, 15, 14, and 13 times. Two are cited twelve times, six references are used in the sample articles eleven times each, and the remaining six references are cited ten times. Four clusters are formed, showing a relative “clustering” of joint citations around individual topics.

It can be argued that the subject matter, i.e., the intellectual structure, in the clusters is as follows:

- Red cluster (eight items)—“Green investments and finance”—supporting sustainability and renewable energy development through financial mechanisms (Eyraud et al. 2013; He et al. 2019; Rasoulinezhad and Taghizadeh-Hesary 2022; Taghizadeh-Hesary and Yoshino 2020; Taghizadeh-Hesary and Yoshino 2019; Wang and Zhi 2016; Xu and Li 2020; Zhou et al. 2020);
- Green cluster (six items)—“Green finance: empirical insights and sustainable solutions”—analyzing the nexus between green finance, renewable energy, and carbon intensity, as well as exploring sustainable financial mechanisms and investments in renewable energy projects (Khan et al. 2021; Ren et al. 2020; Taghizadeh-Hesary and Yoshino 2020; Taghizadeh-Hesary and Yoshino 2019; Yu et al. 2021; Zhang et al. 2019);
- Blue cluster (four items)—“Green finance: impact and opportunities”—examining the effect of green finance on green total factor productivity, exploring research trends and opportunities in green finance and energy policy, addressing financing constraints on green innovation, and investigating the role of public spending in green economic growth within the BRI region (Lee and Lee 2022; Wang et al. 2021; Yu et al. 2021; Zhang et al. 2021a);
- Yellow cluster (two items)—“Green finance and environmental impact”—examining the relationship between green finance, renewable energy, and carbon intensity in selected Asian countries, as well as investigating the environmental effects of green credit policies in China (Xu and Wu 2023; Zhang et al. 2021b).

Thus, the analysis of joint citations groups in a certain way outlines the current aspects of the problems of green finance in the context of sustainable development and demonstrates the intellectual structure of the thematic area.

The scientific map of the analysis, produced using VOSviewer, is shown in Figure 10.

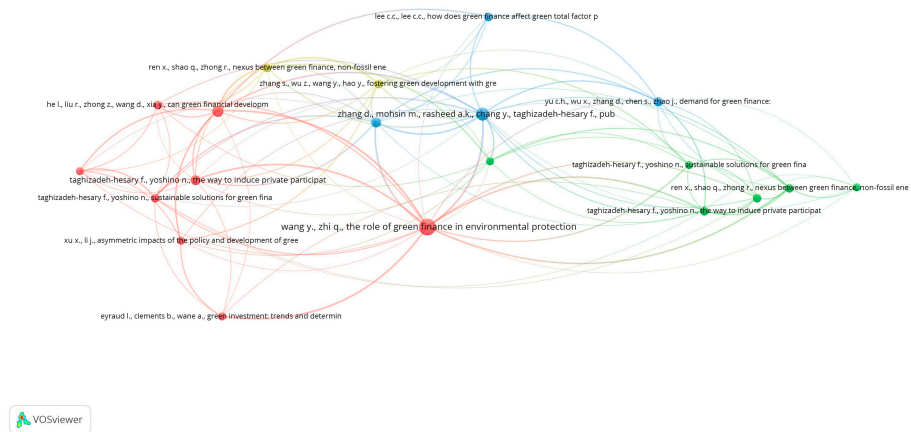


Figure 10. Co-citation analysis (by references) (scientific map).

3.3.2. Social Structure

The importance of the interaction between authors, institutions, and countries in the process of joint research work in the field of the green finance in a sustainability context is indisputable. As a result of this interaction, the realization of joint fundamental scientific and practical projects is possible, the sharing of good practices between individual authors, institutions, and collectives is strengthened, experience is exchanged, and, most valuably, added value is generated in the context of globalization and the sustainable development of society and the planet.

The disclosure of the social structure in the studied issues was carried out with the help of Bibliometrix, where it is possible to follow the collaboration between the individual authors, institutions, and countries of all 436 articles from the sample. For the purposes of the present development, the analysis of social cooperation, co-authorship, and joint research work was carried out only by institution. This refers to analyzing and visualizing collaboration patterns between authors from different organizations (academic, teaching, research, practice, non-governmental) based on their joint co-authorship.

The object of the social interaction analysis was actually the 646 institutions to which the authors of the published articles from the sample under investigation are affiliated. The purpose of this type of analysis is to outline the inter-institutional collaboration network within the research topic and understand the extent of collaboration between authors from different organizations. At this point, Bibliometrix allows the user to select only those articles whose authors have affiliations to various organizations. Twenty-one organizations corresponded to the restrictions. Countries were ranked simultaneously according to the number of articles in the sample that were published by the individual institution and the number of citations of an article from one organization to an article from another organization.

The scientific map shows the organizations where authors have collaborated through joint publications and created a network of co-authorship. Thus, an insight is gained into the social interaction and cooperation between organizations that are engaged in publications in the field of green and sustainable finance.

Bibliometrix identified eight clusters or groups of authors from the same or different institutions who often collaborate. Visualization can help to identify the main centers of interinstitutional cooperation and to understand the overall structure of the network.

The most active institutions regarding social interaction are clearly defined: Zhejiang Yuexiu University (China), Wuhan University (China), and Bahauddin Zakariya University (Pakistan).

The results of this deeper analysis are visualized by the scientific map in Figure 11.

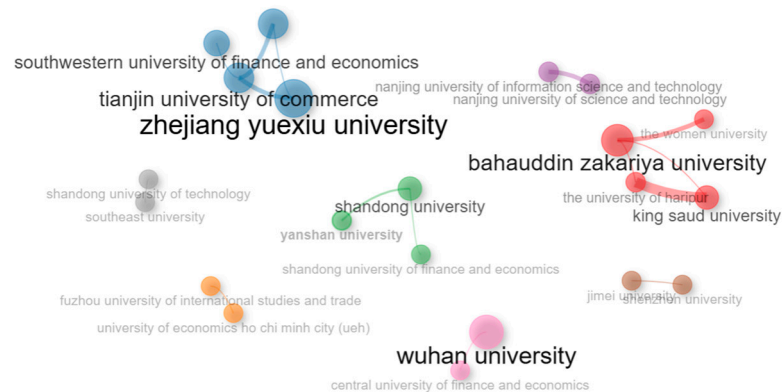


Figure 11. Analysis of social cooperation (by organization) (scientific map).

Such analyses may also reveal cooperating countries and authors, but these are not the focus of this study.

The social structure reveals the leading entities (institutions, authors, or countries) that, through their mutual cooperation, demonstrate an interest in the field of scientific research.

3.3.3. Conceptual Structure

The conceptual structure of research devoted to the problems of green finance in the context of sustainable development is revealed with the help of the analysis of the co-occurrences of keywords and terms. This type of analysis focuses on the frequency with which certain terms or keywords appear together in scientific publications. By identifying common terms, the scope and connections within the researched scientific issues are outlined.

Out of the total number of 2008 keywords from all articles of the research materials of the present development, only 57 words were initially selected. The selection is a result of the option in VOSviewer to select a minimum number of occurrences for the keywords. Our choice was that a given word or term had to occur at least ten times as a keyword in the sampled articles. From the generated list of keywords, another six were manually removed, which were judged to be irrelevant to the analysis (e.g., article, human, panel data, etc.).

The remaining 51 words form 4 clusters with 886 links between them.

The analysis continues by uncovering the most common keywords and terms. The product generates a list of them and the number of their occurrences. The words most frequently present in the studies are visualized with larger circles and are in the central part of the figure. Such words include “green finance”, “green economy”, “economic development”, “China”, “innovation”, etc. (see Figure 12).

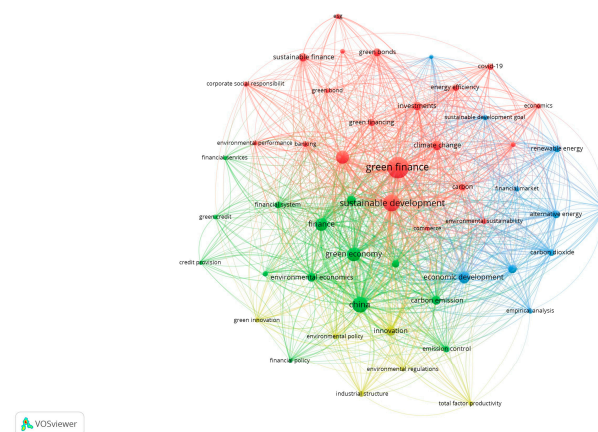


Figure 12. Analysis of the co-occurrence of keywords (scientific map).

The visualization shows the formed clusters, which are colored in different colors: red, green, blue and yellow. It can be assumed that the clusters of keywords outline the conceptual structure of the researched scientific field, namely the role of green finance in sustainable development, in a substantive, thematic way.

4. Discussion

This research, regarding the posed research questions, has yielded results which allow the following assertions to be made.

First, RQ1 aims to identify the most influential publications, authors, and institutions researching the integration of green finance within the context of sustainable development. The analysis reveals that the article by [Rasoulinezhad and Taghizadeh-Hesary \(2022\)](#), titled “Role of green finance in improving energy efficiency and renewable energy development”, published in *Energy Efficiency*, is the most influential with the highest number of citations in Scopus, totaling 267. These authors are affiliated with Jiangsu University and the Asian Development Bank Institute, showcasing the significant contributions of these institutions to the field. Similarly, notable works include [Taghizadeh-Hesary and Yoshino \(2020\)](#)’s article on sustainable solutions for green financing in *Energies* and [Dikau and Volz \(2021\)](#)’s study on central bank mandates and sustainability objectives in *Ecological Economics*. These findings highlight the prominence of certain institutions and publications in driving forward the discourse on green finance and sustainable development.

The discussion can be deepened by revealing the mechanisms and relationships between green finance and the dependent variables based on the findings from the five most significant publications listed in Table 2. The study by [Rasoulinezhad and Taghizadeh-Hesary \(2022\)](#) explores the relationship between CO₂ emissions, energy efficiency, the Green Energy Index (GEI), and green finance using the STIRPAT model across the top ten economies supporting green finance. Their key findings indicate that green bonds facilitate access to financial resources for green energy projects, leading to a significant reduction in CO₂ emissions in the long term. A 1% increase in green bonds reduces CO₂ emissions by approximately 1%. Higher values of GEI show an increased consumption of green energy, correlating with reduced CO₂ emissions. A 1% increase in GEI results in a 0.92% reduction in CO₂ emissions. Increases in population and GDP per capita without a transition to green energy may lead to higher CO₂ emissions. There are no short-term cause–effect relationships between green bonds or GEI and CO₂ emissions. However, there is a two-way relationship between issued green bonds and GEI, as well as between green bonds and GDP per capita. Green finance, mainly through green bonds, supports the implementation of green energy projects, improving energy efficiency and reducing CO₂ emissions over time. Governments need to implement long-term supportive policies to increase private sector participation in green energy investments. [Taghizadeh-Hesary and Yoshino \(2020\)](#) examine the challenges of green finance and investment in renewable energy projects, offering practical solutions to fill the gap in green finance. Key obstacles include the lack of long-term financing, low return levels, various risks, and the capacity shortfall among market players. Proposed solutions include increasing the role of Public Financial Institutions (PFIs) and Non-Bank Financial Institutions (NBFIs) in long-term green investments, using redistribution taxes, developing Green Credit Guarantee Schemes (GCGSs), and creating public trusts. Financial and political risk reduction can help mitigate investment risks in green projects. PFIs and GCGSs reduce financial risks associated with green projects, thereby increasing their attractiveness to private investors. Improving market players’ capacity and creating broader market conditions support sustainable finance. [Dikau and Volz \(2021\)](#) investigate how central banks incorporate climate risks into their mandates and policy frameworks to support sustainability. Only 12% of central banks have explicit sustainability mandates, while 40% support government policy priorities, including sustainability goals. Incorporating physical and transitional climate risks into central banks’ policy frameworks is crucial for maintaining macro-financial stability. Central banks integrate ESG factors into their core policy frameworks, addressing climate risks that affect

monetary and financial stability. Central banks play a role in promoting sustainability in the financial system by managing risks and directing capital towards green investments. [Sinha et al. \(2021\)](#) analyze the impact of green bond financing on ecological and social sustainability using advanced quantile modeling and wavelet multi-scale decomposition. The return on green bonds has a gradual negative transformative effect on ecological and social responsibility. The study provides guidelines for designing a policy framework to achieve Sustainable Development Goals (SDGs), considering the interconnectedness between green bond returns and sustainability indices. Green bonds influence ecological and social responsibility over time, highlighting the need for carefully crafted policies to maximize positive outcomes. Advanced quantile methods help us to understand the nuanced relationships between green finance mechanisms and sustainability indices. [Soundarrajan and Vivek \(2016\)](#) explore the potential and impact of green finance on sustainable economic growth in India. Green finance connects the financial industry with environmental improvements and economic growth, and thus environmental impacts are integrated into risk assessments. There are significant opportunities for Indian banks to engage in sustainable finance aligned with national priorities and Sustainable Development Goals. Green finance uses market investments and credit programs to steer business decisions towards environmental sustainability. Indian banks play a key role in promoting sustainable development, influencing investment decisions, and supporting broader social and environmental goals. The relationships between the dependent variables discussed above with green finance in the context of sustainable development are illustrated in Table 4.

Table 4. Relationships between key dependent variables and green finance in the context of sustainable development.

Publication	Key Dependent Variables	Key Findings	Links with Green Finance in the Context of Sustainable Development
(Rasoulinezhad and Taghizadeh-Hesary 2022)	CO ₂ emissions, GEI, green bonds, energy efficiency	Long-term reduction in CO ₂ emissions through green bonds and GEI; lack of short-term causal relationships; political implications for long-term investment support.	Green finance supports the implementation of green energy projects, improving energy efficiency and reducing CO ₂ emissions.
(Taghizadeh-Hesary and Yoshino 2020)	Green financing challenges, investment risks	Solutions include PFIs, NBFIs, redistribution taxes, GCGSs, and public trusts to reduce risks and increase green investments.	PFIs and GCGSs reduce financial risks associated with green projects, increasing their attractiveness to private investors.
(Dikau and Volz 2021)	Central bank mandates, climate risks, ESG factors	Central banks integrate climate risks into mandates and policy frameworks, promoting sustainability in the financial system.	Central banks play a role in promoting sustainability by managing risks and directing capital towards green investments.
(Sinha et al. 2021)	Green bond returns, sustainability indices	Green bonds gradually impact ecological and social responsibility; need for careful policy design.	Green bonds influence ecological and social responsibility over time, requiring policies to maximize positive outcomes.
(Soundarrajan and Vivek 2016)	Sustainable economic growth, environmental impact	Green finance links the financial industry with environmental improvements and economic growth; role of Indian banks in promoting sustainable development.	Indian banks promote sustainable development through investment decisions and support for social and environmental goals.

Second, RQ2 examines the trend of green finance publications over time and their citation impact. The bibliometric analysis indicates a consistent increase in the number of

publications from 2016 to 2024, with a significant surge in recent years. The “*Sustainability* (Switzerland)” journal leads the field with the highest number of publications and citations, reflecting its central role in disseminating research on green finance. The journal “*Environmental Science and Pollution Research*” also stands out with substantial contributions. The increasing trend of publication and citation counts underscores a growing interest in and recognition of green finance as a critical area of research within sustainable development.

Third, RQ3 focuses on the most common and influential keywords used in green finance research. The analysis identifies key terms such as “green bonds”, “climate change”, “renewable energy”, “green economy”, and “ESG (environmental, social, and governance)” as prevalent in the literature. These keywords reflect the core themes and research interests within the field, emphasizing the multi-faceted nature of green finance and its intersection with various sustainability aspects. The word tree and word cloud visualizations further elucidate the structure and impact of these keywords, providing a comprehensive overview of the thematic focus in the literature.

Fourth, RQ4 delves into the geographic distribution and institutional affiliations of the studies. The findings show that China leads in both the number of publications and total citations, followed by the United Kingdom and Pakistan. Institutions such as Jiangsu University, China University of Mining and Technology, and Guizhou University of Finance and Economics are identified as the most prolific in terms of publication output. This geographic and institutional analysis highlights the global spread of research activities and the significant contributions from certain regions and organizations.

In addition, to improve these findings, a Google Trends search was performed on certain criteria (two search terms: “green finance” and “sustainable development”; time range: 2004–present; region: worldwide; categories: all; search type: web search) to show the global interest in the topic. The results for interest over time show that, from 2018 to today, there has been remarkable interest in both sustainable development and green finance (see Figure 13).

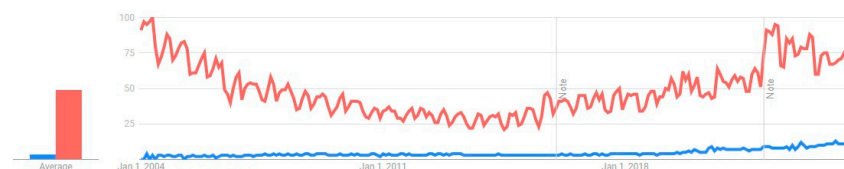


Figure 13. Interest over time in worldwide Google searches for the terms “green finance” (blue) and “sustainable development” (red) for the period 2004–present (source: Google Trends).

Another area of research interest is the analysis of the geographic distribution of the popularity of search terms. The data show that the term “sustainable development” was most popular during the indicated time frame in the regions of Malawi, Zimbabwe, and Nepal, while the term “green finance” was most popular in the regions of St. Helena, Hong Kong, and Luxembourg. These two further inputs might be useful to boost the directions of future research perspectives.

Fifth, RQ5 focuses on the scope of research and key trends for future research in green finance for sustainable development. Research in this field has expanded significantly in response to multiple global initiatives, guidelines from task forces or special networks, and the institutional frameworks of various countries. The analysis of co-citations reveals the intellectual structure in this area, creating a network of interconnected citations and visualizing intellectual progress. This includes identifying key publications and themes through co-citation analysis, such as green investments, the green financial sector, renewable energy, and their economic and ecological impacts.

The social structure of research is also an important aspect, revealing interactions between authors, institutions, and countries contributing to research in green finance. The analysis of co-authorship networks shows the collaboration network between different

organizations, highlighting leading institutions such as Zhejiang Yuexiu University, Wuhan University, and Bahauddin Zakariya University.

The conceptual structure of research is revealed through the analysis of co-occurring keywords and terms in scientific publications. This analysis outlines the scope and connections within the researched scientific issues, identifying key terms such as “green finance”, “green economy”, “economic development”, “China”, and “innovation”.

Regarding the main trends for future research, the following directions are outlined:

- Innovative financial instruments;
- Digitalization and green finance;
- Effects on poor and vulnerable communities;
- “Green financial” regulations and policies;
- Green finance and consumer behavior;
- Adequate impact measurement.

More specifically, future research should develop and investigate new financial instruments and mechanisms such as green derivatives (Saguato 2023), carbon credits (Trouwloon et al. 2023), and sustainable ETFs (Conlon et al. 2024) to facilitate investments in green projects, and explore how these instruments can improve access to capital for small- and medium-sized enterprises and innovative start-ups dealing with clean technologies. Additionally, it should analyze the impact of blockchain technologies and fintech innovations (Jiang et al. 2023; Kwong et al. 2023) on the green financial sector to enhance transparency, traceability, and trust in green investments while reducing transaction costs. Another important aspect to future research is the impact of green finance on social justice and reducing inequality, specifically how green investments can improve living conditions for poor and vulnerable communities while supporting sustainable development (Köhn 2012). Furthermore, a direction for future research could also be the impact of regulatory frameworks and government policies on the development of the green finance market. These studies should analyze how different policies, such as renewable energy subsidies (Pan and Dong 2023), tax incentives, and green bonds, can stimulate investment in sustainable projects. Additionally, research could focus on how changes in consumer preferences towards greener products and services can stimulate green investment (Gu et al. 2023). Finally, developing methodologies and tools to assess, measure, report, and audit the impact of environmental, social, and economic benefits of green investments on sustainable development in a transparent and standardized way is another important direction for future research.

Overall, this bibliometric analysis provides valuable insights into the challenges and trends in green finance research. It identifies key publications, influential authors, leading institutions, prevalent themes, and geographic distributions, offering a comprehensive understanding of the field’s landscape. These findings not only reflect the current state of research, but also guide future studies by highlighting critical areas of interest and influential contributors in the domain of green finance and sustainable development.

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References

- Bhatnagar, Sumedha, and Dipti Sharma. 2022. Evolution of green finance and its enablers: A bibliometric analysis. *Renewable and Sustainable Energy Reviews* 162: 112405. [CrossRef]
- Bornmann, Lutz, and Hans-Dieter Daniel. 2007. What do we know about the h index? *Journal of the American Society for Information Science and Technology* 58: 1381–85. [CrossRef]
- Bornmann, Lutz, Rüdiger Mutz, Christoph Neuhaus, and Hans-Dieter Daniel. 2008. Citation counts for research evaluation: Standards of good practice for analysing bibliometric data and presenting and interpreting results. *Ethics in Science and Environmental Politics* 8: 93–102. [CrossRef]
- Brooks, Chris, and Lisa Schopohl. 2020. Green Accounting and Finance: Advancing Research on Environmental Disclosure, Value Impacts and Management Control Systems. *SSRN Electronic Journal* 53: 100973. [CrossRef]
- Burke, Marshall, Solomon M. Hsiang, and Edward Miguel. 2015. Global non-linear effect of temperature on economic production. *Nature* 527: 235–39. [CrossRef] [PubMed]
- Conlon, Thomas, Shaen Corbet, and Yang Hou. 2024. Navigating the green transition: The influence of energy volatility on green and sustainable ETFs. *Applied Economics Letters* 1–7. Available online: <https://www.tandfonline.com/doi/full/10.1080/13504851.2024.2337323> (accessed on 30 May 2024). [CrossRef]
- Debrah, Caleb, Amos Darko, and Albert Ping Chuen Chan. 2023. A bibliometric-qualitative literature review of green finance gap and future research directions. *Climate and Development* 15: 432–55. [CrossRef]
- Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. 2012. Temperature Shocks and Economic Growth: Evidence from the Last Half Century. *American Economic Journal: Macroeconomics* 4: 66–95. [CrossRef]
- Dikau, Simon, and Ulrich Volz. 2021. Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics* 184: 107022. [CrossRef]
- Donthu, Naveen, Satish Kumar, Debmalya Mukherjee, Nitesh Pandey, and Weng Marc Lim. 2021. How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research* 133: 287. [CrossRef]
- European Commission. 2021. *Overview of Sustainable Finance*. European Commission. Available online: https://finance.ec.europa.eu/sustainable-finance/overview-sustainable-finance_en (accessed on 25 February 2024).
- Eyraud, Luc, Benedict Clements, and Abdoul Wane. 2013. Green investment: Trends and determinants. *Energy Policy* 60: 852–65. [CrossRef]
- Ezroj, Aaron. 2020. *Carbon Risk and Green Finance*, 1st ed. London: Routledge, pp. 1–8. [CrossRef]
- Gu, Xiao, Saba Fazal Firdousi, Bojan Obrenovic, Ayesha Afzal, Beenish Amir, and Tong Wu. 2023. The influence of green finance availability to retailers on purchase intention: A consumer perspective with the moderating role of consciousness. *Environmental Science and Pollution Research* 30: 71209–25. [CrossRef] [PubMed]
- He, Lingyun, Rongyan Liu, Zhangqi Zhong, Deqing Wang, and Yufei Xia. 2019. Can green financial development promote renewable energy investment efficiency? A consideration of bank credit. *Renewable Energy* 143: 974–84. [CrossRef]
- Jiang, Jinxing, Juncheng Li, and Wenwei Wang. 2023. How does blockchain technology affect the development of green finance? Theoretical analysis and empirical verification. *Environmental Science and Pollution Research* 30: 122774–90. [CrossRef] [PubMed]
- Khan, Muhammad Asif, Hammad Riaz, Masood Ahmed, and Abubakr Saeed. 2021. Does green finance really deliver what is expected? An empirical perspective. *Borsa Istanbul Review* 22: 586–93. [CrossRef]
- Köhn, Doris. 2012. *Greening the Financial Sector*. Berlin and Heidelberg: Springer. [CrossRef]
- Kwong, Raymond, Man Lung Jonathan Kwok, and Helen SM Wong. 2023. Green FinTech Innovation as a Future Research Direction: A Bibliometric Analysis on Green Finance and FinTech. *Sustainability* 15: 14683. [CrossRef]
- Lamperti, Francesco, Valentina Bosetti, Andrea Roventini, Massimo Tavoni, and Tania Treibich. 2021. Three green financial policies to address climate risks. *Journal of Financial Stability* 54: 100875. [CrossRef]
- Lee, Chi-Chuan, and Chien-Chiang Lee. 2022. How does green finance affect green total factor productivity? Evidence from China. *Energy Economics* 107: 105863. [CrossRef]
- Lin, Chia-Yang, Ka Yin Chau, Trung Kien Tran, Muhammad Sadiq, Le Van, and Thi Thu Hien Phan. 2022. Development of renewable energy resources by green finance, volatility and risk: Empirical evidence from China. *Renewable Energy* 201: 821–31. [CrossRef]
- Lyon, Thomas P., and Jay P. Shimshack. 2015. Environmental Disclosure: Evidence From Newsweek's Green Companies Rankings. *Business & Society* 54: 632–75. [CrossRef]
- Mohanty, Sagarika, Sudhansu Sekhar Nanda, Tushar Soubhari, Sthitipragyan Biswal, and Shalini Patnaik. 2023. Emerging research trends in green finance: A bibliometric overview. *Journal of Risk and Financial Management* 16: 108. [CrossRef]
- Pan, Yuling, and Feng Dong. 2023. Green finance policy coupling effect of fossil energy use rights trading and renewable energy certificates trading on low carbon economy: Taking China as an example. *Economic Analysis and Policy* 77: 658–79. [CrossRef]
- Rasoulnezhad, Ehsan, and Farhad Taghizadeh-Hesary. 2022. Role of green finance in improving energy efficiency and renewable energy development. *Energy Efficiency* 15: 14. [CrossRef] [PubMed]
- Ren, Xuedi, Qinglong Shao, and Ruoyu Zhong. 2020. Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. *Journal of Cleaner Production* 277: 122844. [CrossRef]

- Saeed Meo, Muhammad, and Mohd Zaini Abd Karim. 2022. The role of green finance in reducing CO₂ emissions: An empirical analysis. *Borsa Istanbul Review* 22: 169–78. [CrossRef]
- Saguato, Paolo. 2023. Climate Risk and Financial Markets: The Case of Green Derivatives. George Mason Law & Economics Research Paper No. 23–19. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4615427 (accessed on 30 May 2024).
- Singh, Vivek Kumar, Prashasti Singh, Mousumi Karmakar, Jacqueline Leta, and Philipp Mayr. 2021. The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics* 126: 5113–42. [CrossRef]
- Sinha, Avik, Shekhar Mishra, Arshian Sharif, and Larisa Yarovaya. 2021. Does green financing help to improve environmental & social responsibility? Designing SDG framework through advanced quantile modelling. *Journal of Environmental Management* 292: 112751. [CrossRef] [PubMed]
- Soundarrajan, Parvadavardini, and Nagarajan Vivek. 2016. Green finance for sustainable green economic growth in India. *Agricultural Economics (Zemědělská Ekonomika)* 62: 35–44. [CrossRef]
- Steuer, Sebastian, and Tobias H. Tröger. 2022. The Role of Disclosure in Green Finance. *Journal of Financial Regulation* 8: 1–50. [CrossRef]
- Taghizadeh-Hesary, Farhad, and Naoyuki Yoshino. 2019. The way to induce private participation in green finance and investment. *Finance Research Letters* 31: 98–103. [CrossRef]
- Taghizadeh-Hesary, Farhad, and Naoyuki Yoshino. 2020. Sustainable Solutions for Green Financing and Investment in Renewable Energy Projects. *Energies* 13: 788. [CrossRef]
- Trouwloon, Danick, Charlotte Streck, Thiago Chagas, and Glenpherd Martinus. 2023. Understanding the Use of Carbon Credits by Companies: A Review of the Defining Elements of Corporate Climate Claims. *Global Challenges* 7: 2200158. [CrossRef] [PubMed]
- United Nations. 1987. Report of the World Commission on Environment and Development: Our Common Future. Available online: <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf> (accessed on 25 February 2024).
- Van Eck, Nees, and Ludo Waltman. 2010. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84: 523–38. [CrossRef] [PubMed]
- Vieira, Elizabeth S., and José ANF Gomes. 2009. A comparison of Scopus and Web of Science for a typical university. *Scientometrics* 81: 587–600. [CrossRef]
- Walls, Annie. 2024. Investing with a Conscience: An Introduction to Socially Responsible Investing (SRI). Available online: <https://www.theethicalfuturists.com/investing-with-a-conscience-an-introduction-to-socially-responsible-investing-sri/> (accessed on 14 March 2024).
- Wang, Moran, Xuerong Li, and Shouyang Wang. 2021. Discovering research trends and opportunities of green finance and energy policy: A data-driven scientometric analysis. *Energy Policy* 154: 112295. [CrossRef]
- Wang, Yao, and Qiang Zhi. 2016. The Role of Green Finance in Environmental Protection: Two Aspects of Market Mechanism and Policies. *Energy Procedia* 104: 311–316. [CrossRef]
- Wu, Gongliang, Xu Liu, and Yueling Cai. 2023. The impact of green finance on carbon emission efficiency. *Heliyon* 10: e23803. [CrossRef] [PubMed]
- Xu, Lan, and Yang Wu. 2023. Nexus between green finance, renewable energy and carbon emission: Empirical evidence from selected Asian economies. *Renewable Energy* 215: 118983. [CrossRef]
- Xu, Xinkuo, and Jingsi Li. 2020. Asymmetric impacts of the policy and development of green credit on the debt financing cost and maturity of different types of enterprises in China. *Journal of Cleaner Production* 364: 121574. [CrossRef]
- Yaşar, Burze. 2021. Impact investing: A review of the current state and opportunities for development. *Istanbul Business Research* 50: 177–96. [CrossRef]
- Yu, Chin-Hsien, Xiuqin Wu, Dayong Zhang, Shi Chen, and Jinsong Zhao. 2021. Demand for green finance: Resolving financing constraints on green innovation in China. *Energy Policy* 153: 112255. [CrossRef]
- Yu, Kelly. 2016. Green Bonds, Green Boundaries: Building China's Green Financial System on a Solid Foundation. Available online: <https://www.iisd.org/articles/insight/green-bonds-green-boundaries-building-chinas-green-financial-system-solid> (accessed on 14 March 2024).
- Zhang, Dayong, Zhiwei Zhang, and Shunsuke Managi. 2019. A bibliometric analysis on green finance: Current status, development, and future directions. *Finance Research Letters* 29: 425–30. [CrossRef]
- Zhang, Dongyang, Muhammad Mohsin, Abdul Khaliq Rasheed, Youngho Chang, and Farhad Taghizadeh-Hesary. 2021a. Public spending and green economic growth in BRI region: Mediating role of green finance. *Energy Policy* 153: 112256. [CrossRef]
- Zhang, Shengling, Zihao Wu, Yao Wang, and Yu Hao. 2021b. Fostering green development with green finance: An empirical study on the environmental effect of green credit policy in China. *Journal of Environmental Management* 296: 113159. [CrossRef]
- Zhou, Xiaoguang, Xinmeng Tang, and Rui Zhang. 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: 19915–32. [CrossRef]

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