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MAPPING THE THEME UNDERLYING THE LITERATURE ON GREEN FINANCE: A CONTEMPORARY STRATEGY FOR SUSTAINABILITY

Muhammad Akram[1], Muhammad Umer Quddoos[2], Muhammad Aamir[3]

[1] PhD Scholar, Department of Commerce, Bahauddin Zakariya University, Multan, Punjab, Pakistan.

[2] Assistant Professor, Department of Commerce, Bahauddin Zakariya University, Multan, Punjab, Pakistan. ORCID: http://orcid.org/0000-0002-1498-6822

[3] Assistant Professor, Department of Commerce, Bahauddin Zakariya University, Multan, Punjab, Pakistan.

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ABSTRACT

With growing global concern towards world sustainability, Green Finance has been growing as one of the tools to achieve sustainable development goals. Sustainable development has directed the attention of policymakers and researchers towards green finance. This study aims to formulate the strategy of sustainability by conducting a bibliometric analysis exploring the growth and academic evolution of green finance. The study is grounded on a sample of 649 articles retrieved from the Scopus database during the period of three decades from 1994 to 2023. VOS viewer software was employed to display and analyze the data. The results investigate the several facets of green finance as publication trends, citations, country collaboration, core sources, authorship networks, and development phases. The results indicate a significant rise in academic and industry interest. China is observed as a leader in the realm of green finance. UK ranked second, similarly after that USA, Japan, and Pakistan ranked in the swift growth of green finance. The analysis delves into highly role of public policies, government decisions and initiatives, private sector motivation in green investments, green projects, and sustainability development. The analysis also investigates critical developments, the researcher and scholar's influential publications and contributions, geographical and conceptual domain, and concentration on defining this critical emerging field. The results provide some practical implications for the bankers, individuals, financial institutions, researchers, policymakers, government, and society for achieving sustainable development goals with a number of prospective future research avenues, including green investment, green policies, green financial regulation, Artificial Intelligence, and green financial technology applications.

Corresponding Author's Email: umerattari@bzu.edu.pk

INTRODUCTION

In today's polluted world, Green Finance has become a hot and emerging topic. Green Finance is gaining huge attention in the field of research around the world (Zhang et al. 2021). Green finance is a developing word and has been used synonymously with green bonds, green instruments, carbon finance, and climate finance (Meo

and Karim, 2021). Billions of dollars have been spent by the US being at the top on Green Finance (Reuters, 2021) but, still it is unclear regarding the contribution in solving the environmental problems by green finance. There has been much research by scholars, governments, academia, institutions, researchers, and practitioners around the world regarding policy implementation, instruments of green finance, and government role but there are empirical pieces of evidence in this field. Such a piece of evidence describes a vibrant image regarding what the range of green finance has contributed to solving or can solve these problems. Green finance has gathered more attention after the Paris Agreement 2015 on Climate Change. Green finance, also known as green investments (Zheng et al, 2021) is broadly employed in business and academia and has a variety of meanings (Dorry, S.; Schulz, C. 2018). Green finance is an under-developing concept (Liu, N. 2020) that lacks a universal definition (Rawat, S.K. 2020).

However, the objective and aim of Green Finance is to parallel balance the advancement of monetary events, environmental stability, and ecological protection to achieve durable developments (Zhou, X 2020). Wang and Zhi (2016) explored that Green Finance is a modern monetary concept and phenomenon that combines economic benefits with environmental conservation. Therefore, it represents the optimal choice for funding environmentally friendly developments. It provides the best plate form for optimal projects and organizations that prioritize environmental protection (Zheng et al, 2021). It takes environmental outcomes in various ecofriendly activities such as renewable energy, solid and liquid waste management, clean and alternative energy, strategies for climate change mitigation, green brick production, green industry innovation, and development, paper waste management and recycling, efficient energy and green technology and so on.

For emerging economies, green finance has become a key concern. The 13th five-year plan of China has proposed the creation of a green financial system to encourage the private sector to play a vital role in sustainable development. Although green finance is an important policy issue, still barriers exist at the macro and meso levels (Zhang et al, 2020). In recent years most countries all over the world, especially developing countries, have focused only on one of the aspects of sustainability, i.e. economic growth while downplaying and ignoring ecological improvement. Consequently, different environmental problems such as air pollution, climate change, land loss, biodiversity loss, deforestation, environmental damage, etc. Therefore, this study will focus on the bibliometric analysis of green finance towards sustainability.

Sustainability is the capacity to maintain a process over time. This concept is divided into three categories-economic, environmental, and social. The government and the businesses are committed to the sustainable goals of reducing their environmental footprints and conserving resources. These sustainable goals are the Sustainable Development Goals (SDGs), which are also known as “the Global Goals”. The global goals were adopted in 2015 by the United Nations. The aim is as a universal call by 2030 to end poverty, protect the planet, and ensure all people enjoy equal peace and prosperity. In 2015, the United Nations integrated seventeen SDGs. They recognized that action in one area will affect outcomes in others, and that development must balance social, economic, and environmental sustainability. All the countries commit to prioritize the progress of all those countries who are furthest behind. These Sustainable Development Goals were designed and integrated focusing on areas such as ending poverty, zero hunger, controlling AIDS, and discrimination against women and girls. Creativity, knowledge, skills, know-how, technology advancement, and financial

development and resources for all societies are necessary to achieve and accomplish these global goals in every context.

These seventeen global goals i.e. SDGs were designed and presented as No Poverty, Zero Hunger, Good Health and Well-being, Gender Discrimination, Quality of Education, Clean and pure Water and Sanitation, Clean Energy, affordable and decent Work and Economic Growth, Industry Innovation and Infrastructure, Inequalities, Sustainable Cities and Communities, Responsible and reasonable Consumption, usage and Production, Climate Action, Life below Water, Life on Land, Peace and Justice Strong Institutions and Partnership to achieve these Goals.

Environmental degradation is mainly caused by energy consumption and other factors that also stimulate emission concentration during economic activity and growth path (Woodruff, 2019). Sustainable Development Goals (SDGs), the global goals have been focused on the United Nations' concentration on clean and affordable energy (United Nations, 2015). Many developing economies were furthest behind and unable to focus and attain these goals (Dalhammar and Richter, 2019). The United Nations in 2018 highlighted that the developing countries have four times the environmental degradation than the developed countries (United Nations, 2018). One of the most important indicators of environmental degradation is the rise in average global temperature which is also one of the targets set by the Paris 2015 Agreement. Carbon emission (CO_2) from the incineration of fossil fuel is caused as the major contributor to the rise in the average global temperature and the greenhouse effect (OECD, n.d).

OBJECTIVES OF THE STUDY AND RESEARCH METHOD

Research Objective and Questions

The primary objective of this study is to explore the current research trend and implications of green finance for sustainability strategies. The main objective of this study is to explore the systematic main theme in the literature on green finance while responding to the following research questions.

1. **RQ1.** What is the descriptive bibliometric information available in the publications in the green finance research domain?
2. **RQ2.** What are the major themes and practical dimensions emerging from the green finance-based literature?
3. **RQ3.** What are the current trends in green finance publications in terms of time, authors, disciplines, journals, institutions, affiliated countries, study type, and economy for sustainable development?
4. **RQ4.** How can we understand the intellectual structure of green finance research and its evolution over multiple years?
5. **RQ5.** What are the feasible suggestions and future agendas based on the significant research gaps found in the context of research conducted on green finance for sustainable development?

The study seeks a coherent network to examine the influence of green finance and predict useful information for future research by aligning the research questions with stated objectives. The method for answering the questions and achieving the objectives is bibliometric analysis.

Database Selection, Identifying Keywords and Eligibility Criteria

This study identified 649 research articles about green finance that have been published since 1994 in journals from the database of Scopus using the following query:

(TITLE-ABS-KEY (Green AND Finance) OR TITLE-ABS-KEY (Sustainable AND Finance) AND TITLE-ABS-KEY (Sustainability) OR TITLE-ABS-KEY (Sustainable AND development)) AND PUBYEAR > 1993 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar"))

The present study intends to fill research gaps and better understand the green finance-based literature using bibliometric analysis. Notably, this study explores the influential aspects (i.e., top studies, authors, institutions, and countries) and hidden themes of the green finance-based literature using science mapping (a tool of bibliometric analysis) based on intellectual structure and conceptual structure. Science mapping is a quantitative and systematic approach to exploring a literature review's hidden themes (Aria, M, 2016). Intellectual and conceptual structure are two frequently used methods to segregate similar articles based on citations and textual analysis (Aparicio G, 2019; Tipu, S.A.A, 2020). This research combines intellectual structure and conceptual structure to segregate the green finance-based literature into similar clusters. Such thematic information will help practitioners and policymakers to understand the width and depth of this field of research. This research also explores desirable future research agendas by including information regarding clustering and the influential aspects mentioned above. Therefore, the outcome of this research is vital for practitioners, policymakers, and researchers. The objectives of the present study are four-fold. Firstly, we aim to explore the current trends in green finance-based literature in terms of time, authors, disciplines, journals, institutions, affiliated countries, study type, and economy. Secondly, we intend to determine the major research trends and themes in the domain of green finance research. Thirdly, we aim to understand the intellectual structure of green finance research and its evolution throughout the past few years. Lastly, we attempt to suggest significant research gaps for future agendas. The remainder of this paper is arranged as follows: Section 2 describes the methods used; Section 3 reports the findings and results of the study; Section 4 discusses the future research agenda; and Section 5 presents the study's conclusions.

Zainuldin and Lui (2021), reviewed that the existing literature is a common practice to explore the concepts from prior work and convert it into meaningful, systemic, and objective forms to explain, measure, define, assess, and map the contents however by conventional review method the intellectual structure of any domain can't be extracted but a traditional method like SLR (Systematic Literature Review) resolved this problem. Jain et al. (2021), explored the SLR as well as defined procedures for skimming the various databases to enhance the research quality by making them more transparent, precise, and scientific. The bibliometric method involves the quantitative analysis of the database under the SLR technique.

Khatib et al. (2023), explored the bibliometric method as a systemic process that refers to the published contents in the form of journals, authors, and specific research.

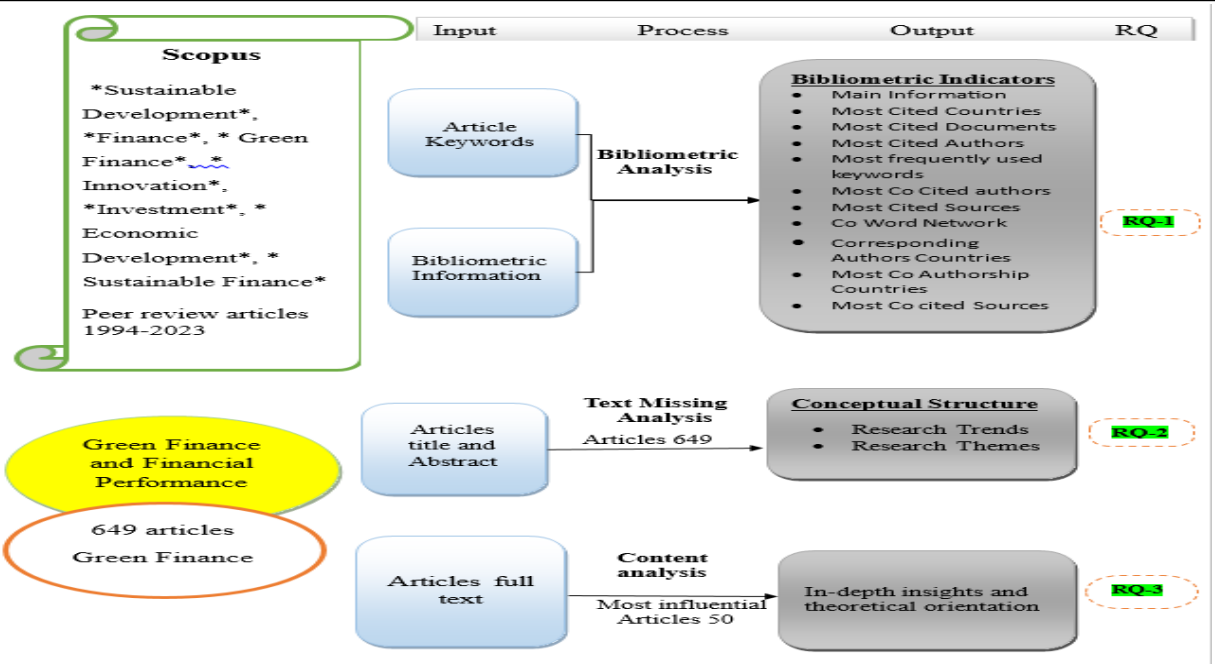


Fig 1. Workflow of bibliometric analysis

DATA ANALYSIS AND FINDINGS

The current study as shown in Table 1 spread over the 1994-to-2023 time span. The selected time frame 1994-2023 analysis arrived by stringent filtering and pertinent keywords by which the primarily published articles that fit to study were selected. It involved 649 articles in the Scopus database with 271 sources. Moreover, the selected time span ensured the selection of the most relevant and up-to-date scholarly documents supporting this study. For a comprehensive understanding of the current state of knowledge, it is essential to involve recent publications. Initially, the literature was segregated into clusters by bibliometric coupling. Then each cluster was explored by co-word analysis. Such a technique helps in topic covering and depth of clusters. Similarly, the top journals, top authors, and the top citations were also analyzed. The workflow initiated with influential aspects and ended with thematic analysis. Therefore, it was explored that influential aspects of each theme in the literature offer potential information regarding specific research areas. In this approach, each cluster is defined using bibliometric coupling and analyzed with the consideration of conceptual structure. The second step of bibliometric analysis is to compile the bibliometric data. The descriptive analysis of the data provides the information as presented in the following Table 1.

Table 1: Main information about the data

MAIN INFORMATION ABOUT DATA	
Timespan	1994:2023
Sources (Journals, Books, etc.)	271
Documents	649
Annual Growth Rate %	19.81
Document Average Age	2.24
Average citations per doc	16.66
References	37840
DOCUMENT CONTENTS	
Keywords Plus (ID)	2291
Author's Keywords (DE)	1878
AUTHORS	
Authors	1654

Authors of single-authored docs	91
AUTHORS COLLABORATION	
Single-authored docs	97
Co-Authors per Doc	3.1
International co-authorships %	34.98
DOCUMENT TYPES	
Article	649

Annual Scientific Production

Table 2 shows the year-wise production of the articles on the research field of green finance. Throughout the period from 1994 to 2023, in the year 2022, there were the highest publications accounting for 210.

Table 2: List of the 649 articles numbers selected year-wise in the study

Sr	Year	Articles	Sr	Year	Articles
1	1994	1	16	2009	2
2	1995	0	17	2010	1
3	1996	0	18	2011	3
4	1997	0	19	2012	5
5	1998	0	20	2013	5
6	1999	0	21	2014	7
7	2000	2	22	2015	7
8	2001	0	23	2016	17
9	2002	1	24	2017	12
10	2003	0	25	2018	29
11	2004	1	26	2019	25
12	2005	2	27	2020	40
13	2006	1	28	2021	86
14	2007	1	29	2022	210
15	2008	2	30	2023	189
Total Articles: 649					

***Source:** Scopus

The Fig 2 shows a sharp rise in the annual production of the articles. The most output is in the period 2022 in which 230 articles on green finance were published. The increase in the production of a number of studies shows the greater focus and understanding of the study of green finance. In the field of the financial industry, the study offers more information to the government, investors, enterprises, and society in making their wise decisions. It also denotes a need to create a great response to open the doors in sustainable investment, green finance, and resource management.

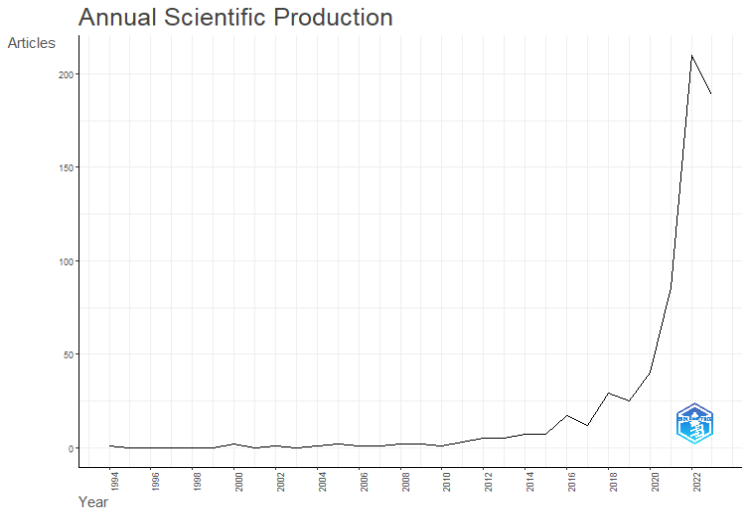


Fig 2: Year-wise production of articles on green finance

Countries Collaboration

Table 3 highlights the importance of China as a disputed leader in research output in green finance. It is unquestionable with an impressive count of 2048 document citations and is dominant in the field of green finance. In this domain, China is a frontrunner and is observed as a leader in the realm of green finance. UK ranked second with a documented count of 739 similarly USA 685 Japan 675 Italy 647 and Pakistan ranked sixth with a count of 563 in the swift growth of green finance.

Analyzing the top 20 countries, china remained dominant all over the countries. The top five countries contribute 5748 documents whereas the remaining 15 countries create 2822 documents. China produces 4 times more than the second-ranked United Kingdom skewing productivity. The top country China shows deep concentration on green finance.

Table 3: Top 20 Countries in terms of citation for research output in Green Finance

Rank	Country	TC	Average Article Citations	Rank	Country	TC	Average Article Citations
1	CHINA	3048	13.9	11	SPAIN	171	13.2
2	UNITED KINGDOM	739	23.1	12	GERMANY	169	9.4
3	USA	685	27.4	13	INDIA	150	8.8
4	JAPAN	675	84.4	14	NETHERLANDS	137	34.2
5	ITALY	647	23.1	15	SAUDI ARABIA	137	34.2
6	PAKISTAN	563	24.5	16	TURKEY	109	18.2
7	FRANCE	327	36.3	17	HONG KONG	94	31.3
8	AUSTRALIA	276	18.4	18	SINGAPORE	86	28.7
9	BRAZIL	269	53.8	19	ROMANIA	82	13.7
10	INDONESIA	179	13.8	20	LUXEMBOURG	73	18.2

The graph shows the country-wise article production of paper publications over time. Most of the publications are in 2022 majority in China with a count of 396 articles.

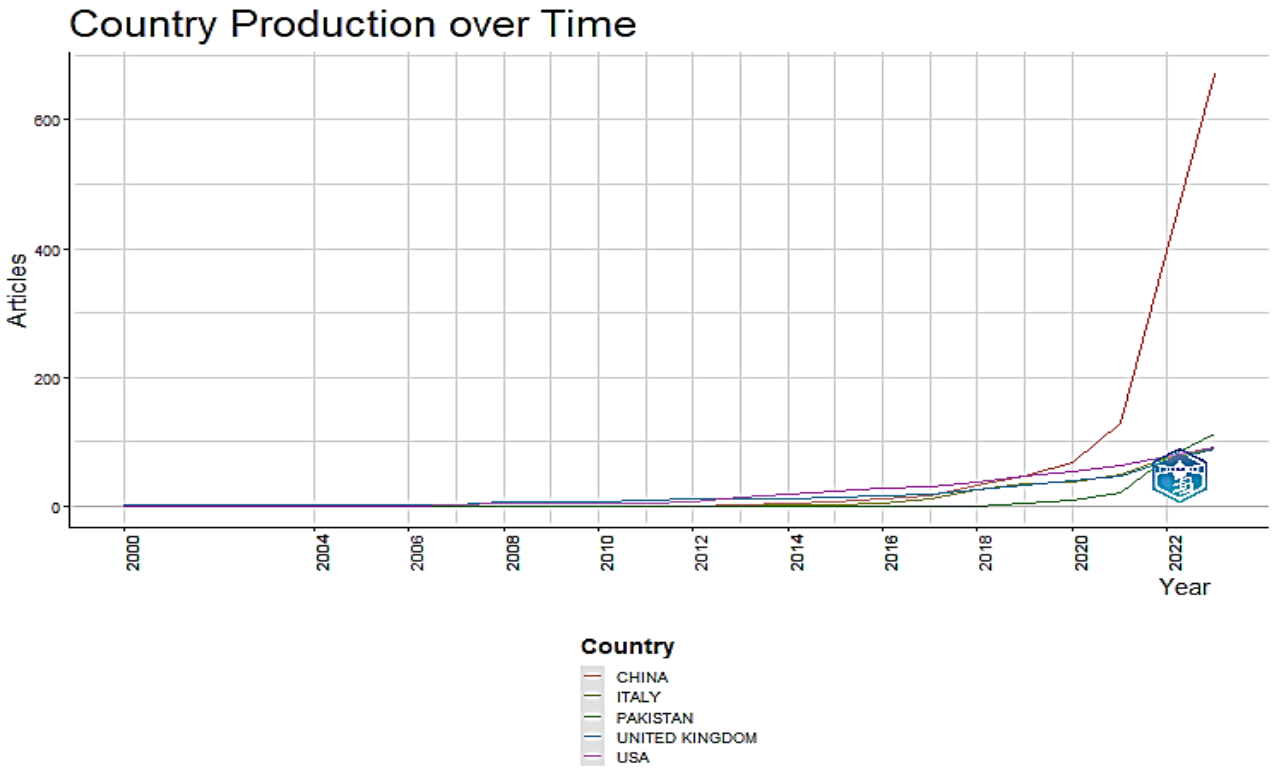


Fig 3: Top 20 most cited countries

The following figure clearly shows the dominant place over the remaining countries as highlighted as a top leader country in the research field of green finance. China's significant position shows a strong and active involvement in green finance.

Fig 4: Top 20 most cited countries

Most Cited Documents

The citation analysis was used to identify the most cited documents used in the study. These documents are so important as the other authors find them useful and insightful. The following figure shows the most cited source in the selected 649 articles in the study. This shows that Zhang is the most important work in the field of green finance research landscape and is considered the top-ranked author of this study. In the field of green finance, the figure shows the most contribution citations of the author Zhang's document. Zhang is a Chinese author and has significant work in this field of research. The majority of the researchers are using the citations of Zhang's documents.

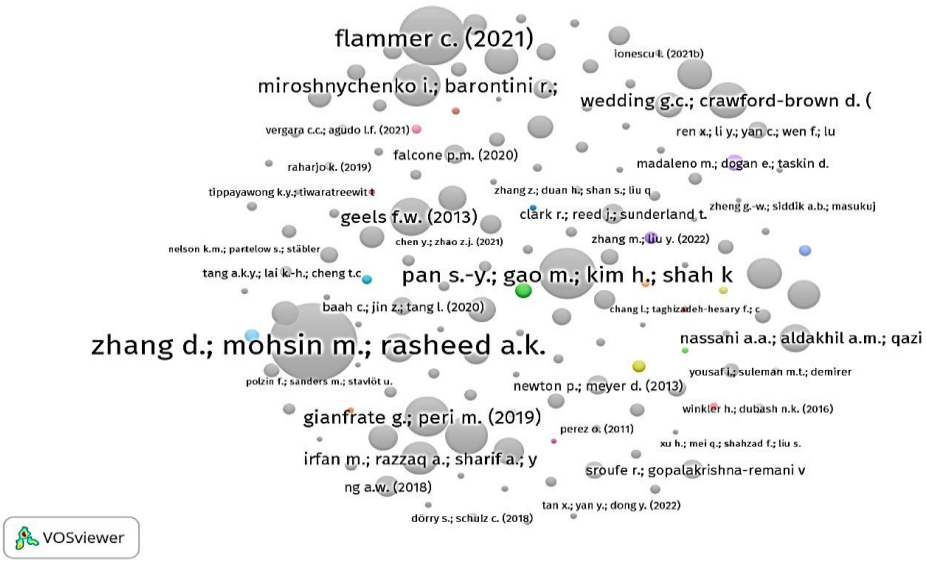


Fig 5: Most cited documents

3.4 Most Cited Authors

Table 4 shows the top 20 most cited authors. The author who has the top publication of articles in the field of green finance is Zhang D with a count of 165 articles. Pesaran M H is the 2nd top-ranked author in the research of green finance with 118 documents. The other ranked authors are represented in Table 4 depicted below. The most cited author is from China implying that Chinese scholars dominate and lead the publications in this field.

Table 4: Top 20 authors for research in green finance based on the most cited source

Rank	Sources	Articles	Rank	Sources	Articles
1	ZHANG D	165	11	PORTER M E	60
2	PESARAN M H	118	12	UMAR M	60
3	TAGHIZADEH-HESARY F	116	13	ZHU Q	58
4	SHAHBAZ M	115	14	IRFAN M	56
5	MOHSIN M	110	15	CHEN Y	53
6	WANG Y	109	16	LIU X	52
7	CHIEN F	65	17	ZHANG Y	52
8	LEE C C	62	18	LI J	51
9	LI W	62	19	HAIR J F	50
10	LI Z	62	20	AHMAD M	49

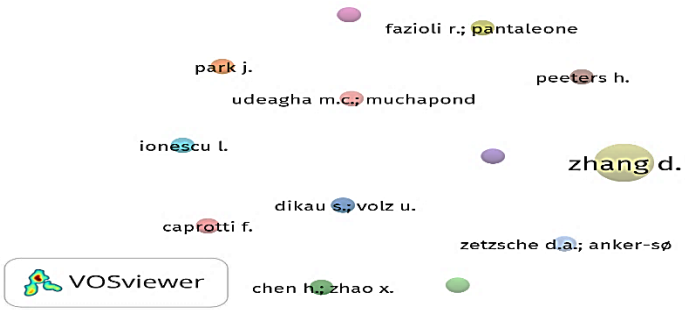


Fig 6: Top authors over time

Keywords Analysis

Green Finance shelters several areas that aim to boost economic growth while fostering environmental sustainability. The most common keyword in the green finance study is sustainable development occurring 240 times as shown in Table 5. The second most frequent word is finance repeated 226 times and third is the China 209 times which represents China's importance in green finance research and development with the strategy of sustainability. Similarly next commonly used keywords as sustainability 175 times, economic development 118 times investment 86 times showing the link between green finance and sustainability goals. The top 20 keywords include environmental economics 79, green economy 72, investment 67, carbon dioxide 62, climate change 62, innovation 56, economics 52, carbon 51, green finance 48, carbon, commerce, energy efficiency emission, alternative energy, and environmental protection. Environmental protection is one of the aspects of sustainability as sustainability comprises three aspects i.e. economic aspect, environmental aspect and third one is social aspect. The top five include high-level subjects, but the top 20 delve further into subtopics, techniques, and specific issues like carbon emissions and climate change.

Table 5: Top 20 keywords used in research on green finance

Rank	Words	Occurrences	Rank	Words	Occurrences
1	sustainable development	240	11	climate change	62
2	Finance	226	12	innovation	56
3	China	209	13	economics	52
4	Sustainability	175	14	carbon	51
5	economic development	118	15	green finance	48
6	Investments	86	16	carbon emission	47
7	environmental economics	79	17	energy efficiency	47
8	green economy	72	18	commerce	42
9	Investment	67	19	alternative energy	41
10	carbon dioxide	62	20	environmental protection	40

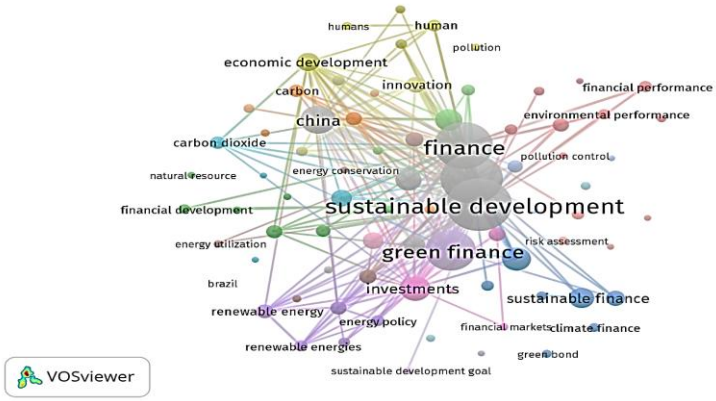


Fig 7: Most cited keywords

The analysis of the keyword shown in Figure 6 suggested that green finance is increasingly intertwined with sustainability in the economy through several major trends as follows:

1. ESG integration: The ESG (Environmental, Social, and Governance) criteria with SDGs are becoming to investment decision. Green finance boosts the intention and investments in green projects and other companies that encourage sustainable practices, promoting financial returns and long-term social and environmental benefits.
2. Financial Development: there is increasingly domain of financial products and instruments intended to encourage sustainable projects and initiatives. These include sustainable loans, green bonds, green mutual funds, and green insurance products. These instruments directly help in promoting environmental benefits and mitigating climate change and degradation risks.
3. Regulatory Support and Standards: the regulatory bodies, policymakers, and the government urge on green practices through regulation, policies, and standards. This type of conducive environment creates opportunities for businesses and the investors to engage in sustainable practices. For example mandatory disclosure of ESG risks and tax reliefs and comfort for green investments.
4. Financial Market Reporting: there is great focus on measuring the role of investment on SDGs. The growing demand for transparency in green finance is determined by the need for accountability and credibility in sustainable investing. Investors stakeholders and the society want to guarantee that their investments are truly making a positive impact on the environment and society. By measuring and reporting the environmental and social outcomes of green finance initiatives, organizations can demonstrate their commitment to sustainability and build trust with their investors and stakeholders. This transparency also helps to stimulate responsible investing, reduces greenwashing, and supports the growth of a more sustainable financial system.
5. Innovative Technology: Technology advancement is promoting the growth of green finance. The advanced technology includes blockchain, Artificial Intelligence (AI), big data, and fintech. Blockchain is being used for transparent transactions, and AI and big data are being used for ESG risks. Fintech is used as access to sustainable investment. These innovations are making green finance more productive, effective, efficient, and accessible.
6. Sustainable Policy Initiatives: The companies are making sustainability a mandatory part of their strategies. These strategies include carbon reduction goals, circular economy codes, and adopting sustainable supply chain practices. Green finance offers necessary funding and incentives to companies to adopt more sustainable business plans and models.
7. Energy conservation and pollution control: The sustainability principles awareness is growing day by day among consumers and the public. Businesses and financial institutions are offering green products and services to environmentally-conscious consumers.

Green finance is not just a niche market but it also incorporates environmental and social attention into the main financial decision-making. This development is essential for achieving long-term sustainability targets while ensuring economic growth and development.

Most Significant Affiliations in the field of green finance

Table 6 shows the top twenty institutes with higher influence of Green Finance. Jiangsu University is the leading Chinese institute contributing to research and influence of green finance by producing 24 documents. China is still dominant in global green finance research. This shows that China has the highest global interest in the field of sustainable finance.

Table 6: Top 20 most affiliated institutes in the research of Green Finance

Rank	Affiliation	Articles
1	Jiangsu University	24
2	Dalian Maritime University	17
3	Qingdao University	15
4	School of Management and Economics	14
5	Southwestern University of Finance and Economics	14
6	Xiamen University	12
7	Zhongnan University of Economics and Law	12
8	University Of Chinese Academy of Sciences	11
9	Nanjing University of Aeronautics and Astronautics	10
10	Near East University	10
11	Central South University	9
12	China University of Mining and Technology	9
13	King Saud University	9
14	Sichuan University	9
15	Beijing University of Technology	8
16	Capital University of Economics and Business	8
17	Xinjiang University	8
18	Bahauddin Zakariya University	7
19	Bocconi University	7
20	East China Normal University	7

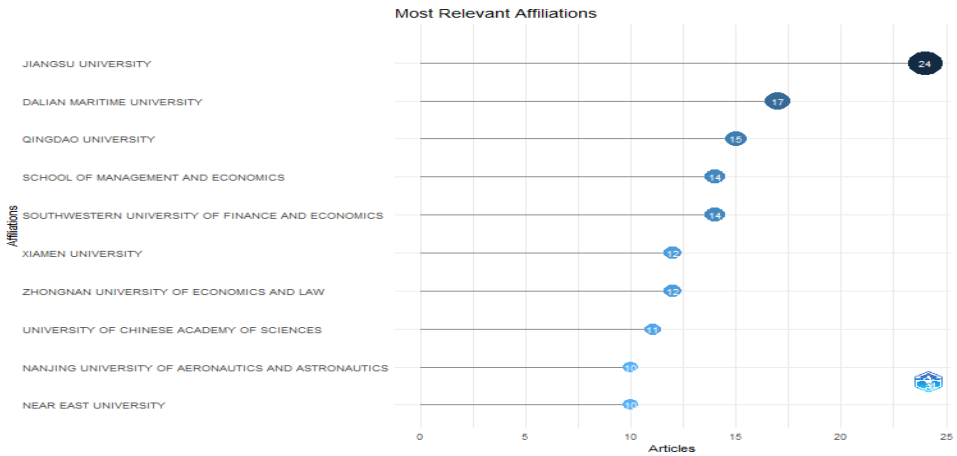


Fig 8: Institutes affiliated with the green finance research

A Three Field Plot

An even deeper analysis of influence, regions as well and the journals also be analyzed by applying a bibliometric tool “three field plot” based on the Sankey diagram. Three field plots represent three areas placing the central variable. The three-field plot shows how the side variables are interested in the central variable. In

this case, the AU in the sample publications is placed as the central variable. They visually correspond to similar rectangles on either side. The data shows that the greatest interest is in green finance.

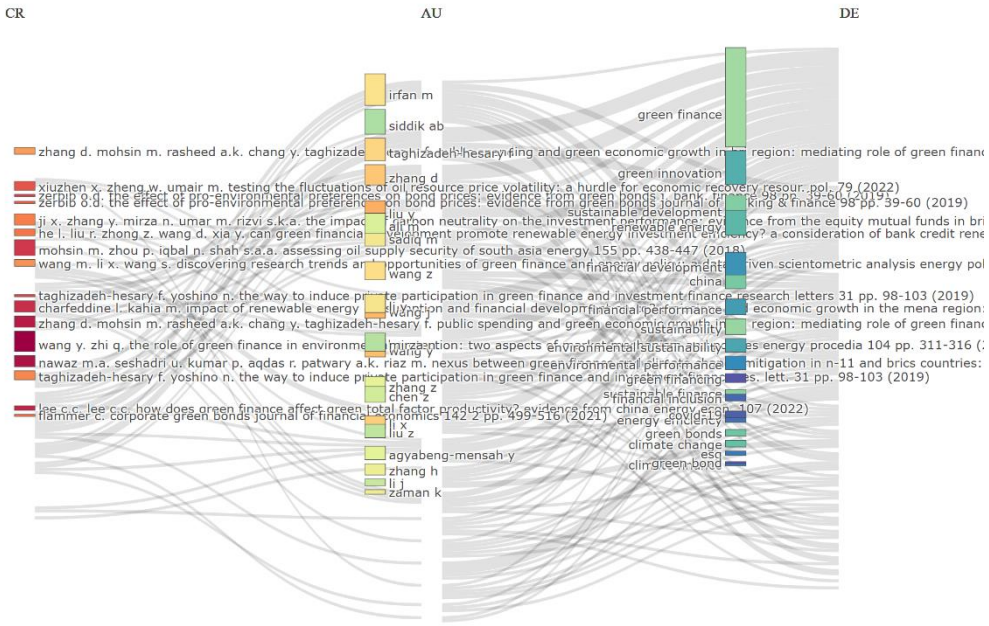


Fig 9: Three field plots

Source: Author's enumeration using Biblioshiny

3.8 Most Co-Cited Authors in the study of green finance

To examine the collaborative pattern among authors co-authorship network was constructed. The scientific map shows the organizations where the authors collaborate and create a network of co-authorship through joint publications that gained insight into the social and cooperative interaction between the organizations engaged in publications in the field of green and sustainable finance.

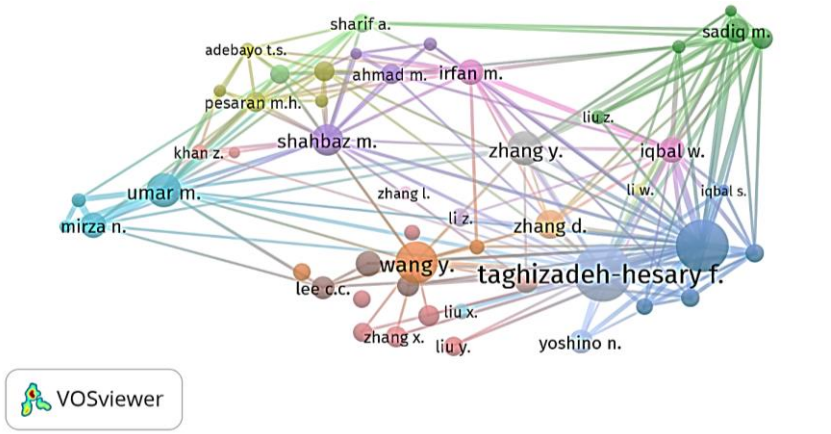


Fig 10: Most co-cited authors

Most Cited Sources (Journals) in the Research of Green Finance

Table 7 shows the top 20 ranked list of journals that are most cited in the field of green finance. The top-ranked journal is Sustainability (Switzerland) with the citation of the 56 highest articles published. The second highest cited journal is Environmental Science and Pollution Research with a count of 38 articles. Similarly, the Journal of Cleaner Production with 32 research policies 32 energy economies 20 and Renewable Energy 18 are the top five journals with the highest citations in research of green finance field. There were 649 articles

published out of 271 articles out of which the top 5 journals accounted for 178 articles accounted for 27% of overall publications. The remaining 15 journals out of the top 20 accounted for 23% contribution. The remaining 50% contribution was contributed by 251 journals with the publication of 323 articles in the field of green finance. The investigation showed that few famous journals publish green finance research with greater impact than other typical journals.

Table 7: Top 20 most cited leading journals in the field of green finance

Rank	Sources	Articles	Rank	Sources	Articles
1	SUSTAINABILITY (SWITZERLAND)	56	11	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	11
2	ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	38	12	ECONOMIC ANALYSIS AND POLICY	9
3	JOURNAL OF CLEANER PRODUCTION	32	13	CLIMATE POLICY	8
4	RESOURCES POLICY	32	14	ENVIRONMENT, DEVELOPMENT AND SUSTAINABILITY	8
5	ENERGY ECONOMICS	20	15	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	8
6	RENEWABLE ENERGY	18	16	BUSINESS STRATEGY AND THE ENVIRONMENT	7
7	ECONOMIC RESEARCH-EKONOMSKA ISTRAZIVANJA	16	17	ECONOMIC CHANGE AND RESTRUCTURING	7
8	FRONTIERS IN ENVIRONMENTAL SCIENCE	13	18	ENERGIES	7
9	JOURNAL OF ENVIRONMENTAL MANAGEMENT	12	19	ENERGY AND ENVIRONMENT	6
10	JOURNAL OF SUSTAINABLE FINANCE AND INVESTMENT	12	20	ENERGY POLICY	6

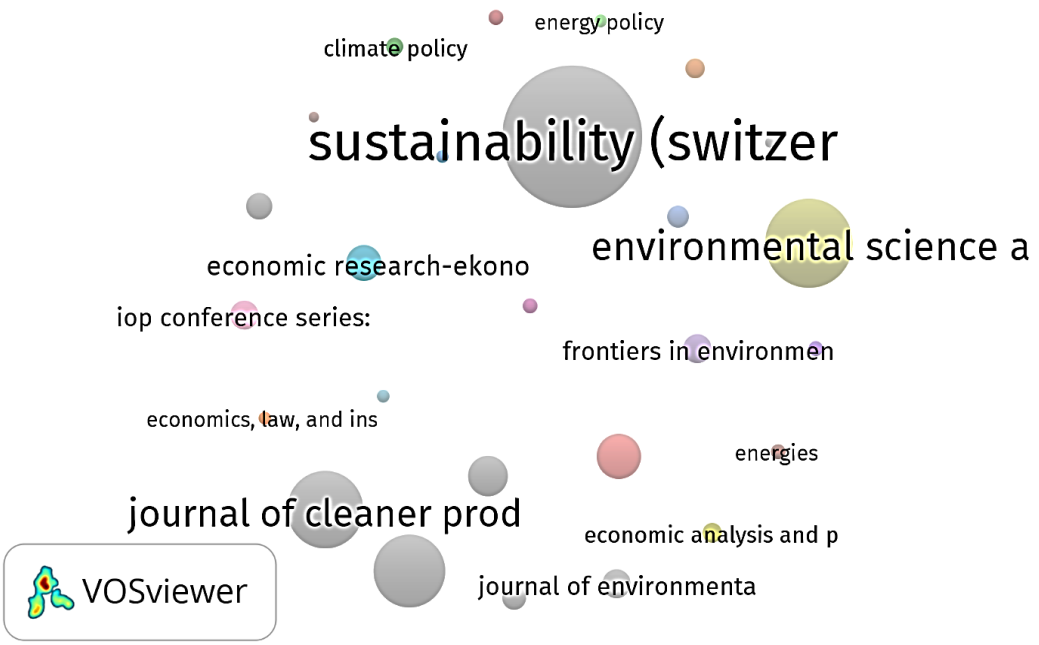


Fig 11: Top 20 most cited leading journals in the field of green finance

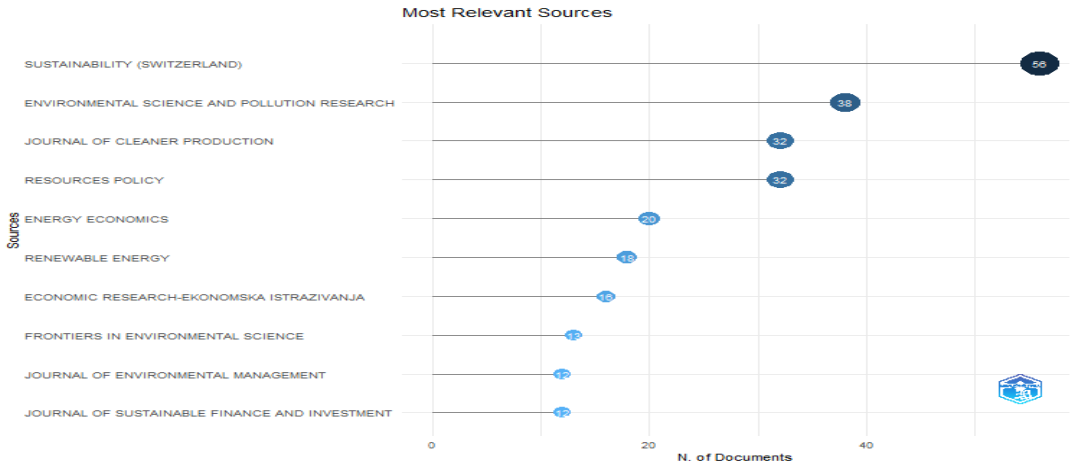


Fig 12: Most relevant sources

Core Sources by Bradford's Law

The following Figure shows the evolution of literature. The researcher has been continuously publishing the theme. Similarly, Table 7 represents the top journal publications. The top eight journals are categorized as Zone 1 by following Bradford's law by publishing more than 34% of the articles. Notably, the Journal of Sustainability (Switzerland) 56, Environmental Science and Pollution Research 38, Journal of Cleaner Production 32, Resources Policy 32, Energy Economics 20, Renewable Energy 18, Economic Research-Ekonomska Istrazivanja 16 and Frontiers in Environmental Science published the 13 latest articles.

Table 8: Core Sources by Bradford's Law

SR	Sources	Rank	Freq	cumFreq	Zone
1	Sustainability (Switzerland)	1	56	56	Zone 1
2	Environmental science and pollution research	2	38	94	Zone 1
3	Journal of Cleaner Production	3	32	126	Zone 1
4	Resources Policy	4	32	158	Zone 1
5	Energy Economics	5	20	178	Zone 1
6	Renewable energy	6	18	196	Zone 1
7	Economic research-ekonomska istrazivanja	7	16	212	Zone 1
8	Frontiers in environmental science	8	13	225	Zone 1

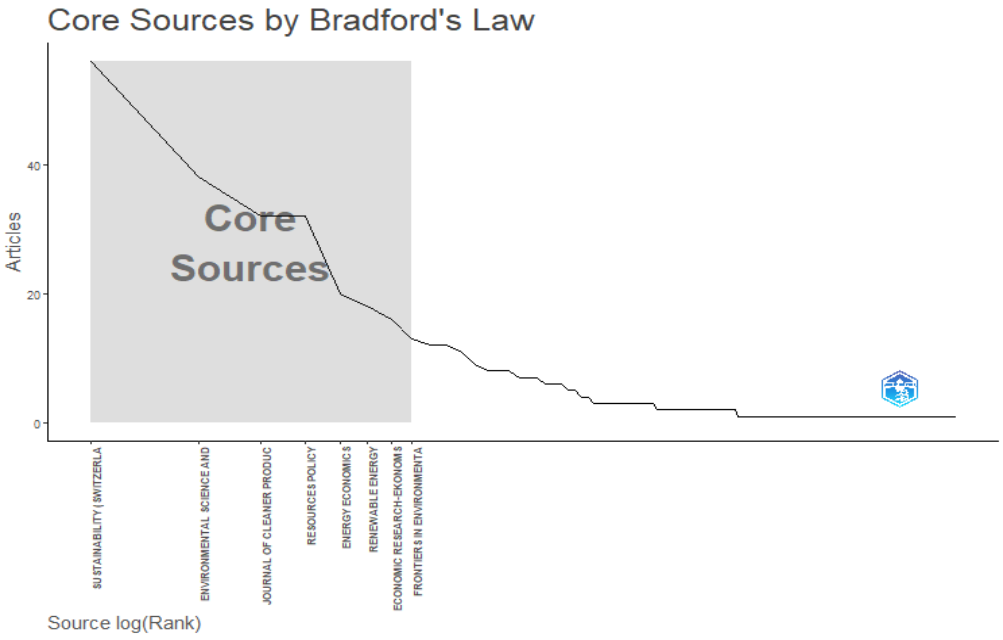


Fig 13: Ranking of journals as per Bradford's Law
Source: Authors' illustration using Biblioshiny

Co-word Network

Figure 13 shows the relationship among the key words used in the study. It is a way to visualize and analyzing the connection nodes among them to uncover insights and pattern of the study. The large nodes showing in the figure such as sustainable development, finance sustainability and china indicate the important keyword or concepts. As like table 3 china is a front runner and disputed leader in the field of sustainable finance, this strong association of the co-word network also shows the importance of china with the sustainable development and finance.

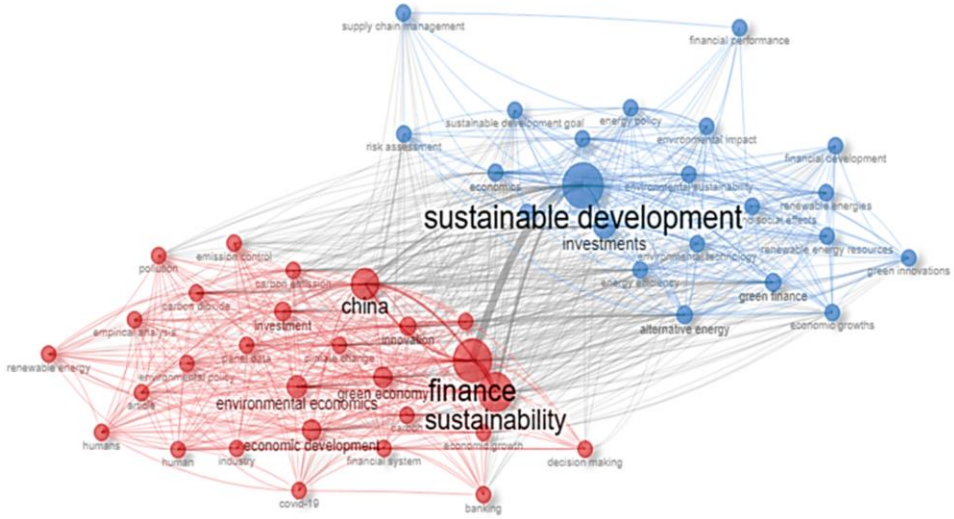


Fig 14: Co-word network

3.12 Factorial Analysis

Factor analysis is a research tool used to condense many variables into a few variables so that the research data is easier to work. It is a set of techniques for data reduction. This statistical method explores the interaction between the different variables simultaneously. It helps in understanding the researcher how multiple variables interact between factors. The following Figure shows the factor analysis of the data used in this study by the Confirmatory Factor Analysis (CFA) test method.

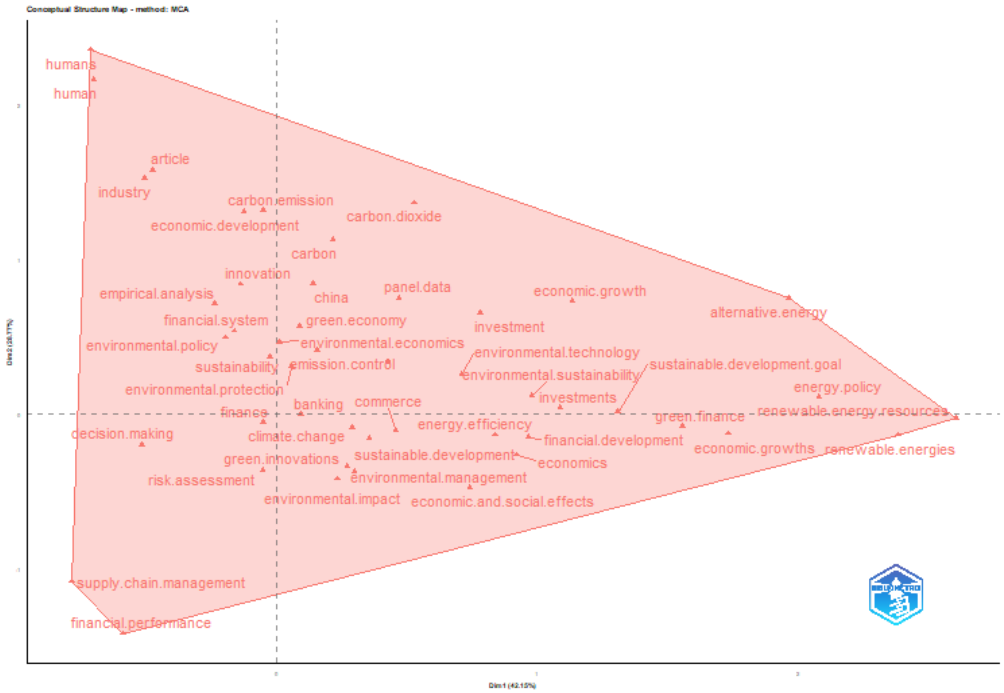


Fig 15: Factorial analysis

Corresponding Authors Countries

Table 8 shows the list of the top 20 co-authorship countries. SCP is single country production and MCP is multiple country production. In VOS viewer, closer to the two countries there is a strong relationship. The thicker line shows the strong relationship and the similarity between the two countries. In this study the country China has a strong relation with the UK and Italy. A nation with a weak, or zero network is automatically removed from the network. The networking lines provide a comprehensive display of the contributions of various nations in the field of green finance and allied aspects.

Table 8: List of top 20 corresponding author's countries

Country	Articles	SCP	MCP	Freq	MCP_Ratio
CHINA	219	146	73	0.33744222	0.33333333
UNITED KINGDOM	32	23	9	0.04930663	0.28125
ITALY	28	23	5	0.0431433	0.17857143
USA	25	16	9	0.0385208	0.36
PAKISTAN	23	7	16	0.03543914	0.69565217
GERMANY	18	13	5	0.02773498	0.27777778
INDIA	17	14	3	0.02619414	0.17647059
AUSTRALIA	15	10	5	0.02311248	0.33333333
INDONESIA	13	7	6	0.02003082	0.46153846
SPAIN	13	6	7	0.02003082	0.53846154
MALAYSIA	12	6	6	0.01848998	0.5
FRANCE	9	6	3	0.01386749	0.33333333
JAPAN	8	2	6	0.01232666	0.75
CANADA	7	3	4	0.01078582	0.57142857
IRAN	7	5	2	0.01078582	0.28571429
SOUTH AFRICA	7	3	4	0.01078582	0.57142857
HUNGARY	6	6	0	0.00924499	0
ROMANIA	6	5	1	0.00924499	0.16666667
TURKEY	6	1	5	0.00924499	0.83333333
BRAZIL	5	2	3	0.00770416	0.6

***SCP (single country production), MCP (multiple country production)

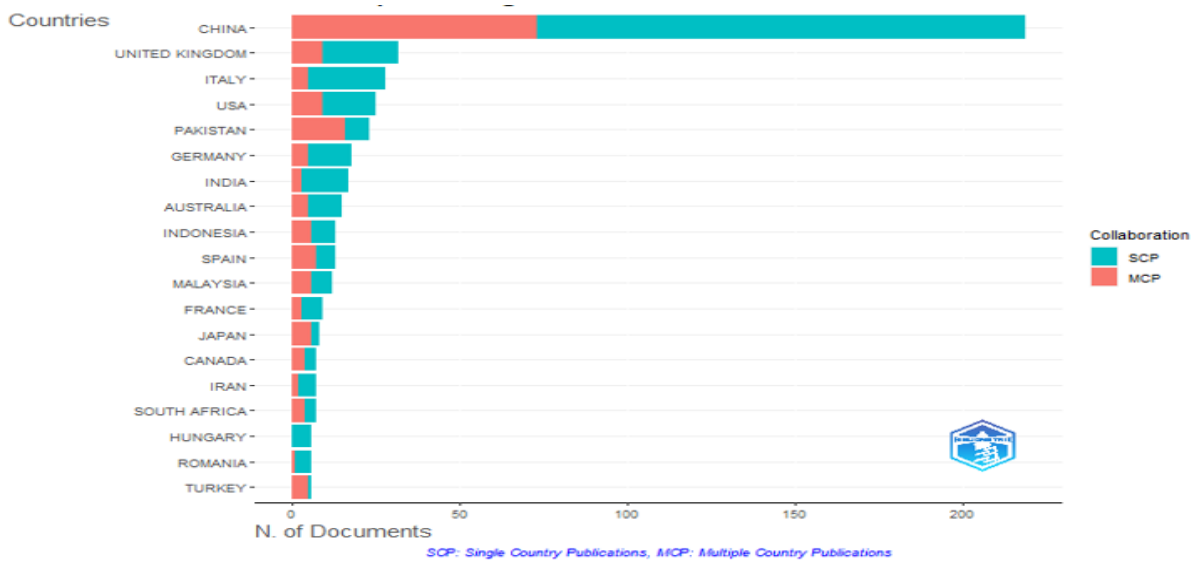


Fig 16: Top 20 corresponding author's countries

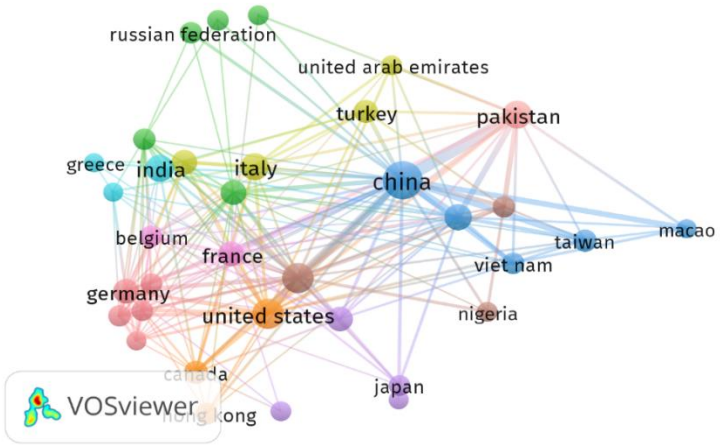


Fig 17: Co-authorship countries

Co-cited Sources

Co-cited sources are a powerful tool to enhance research and writing. The figure shows one-to-one connections among the nodes. This shows the base for the core understanding, intellectual history, development, and nuance of the study.

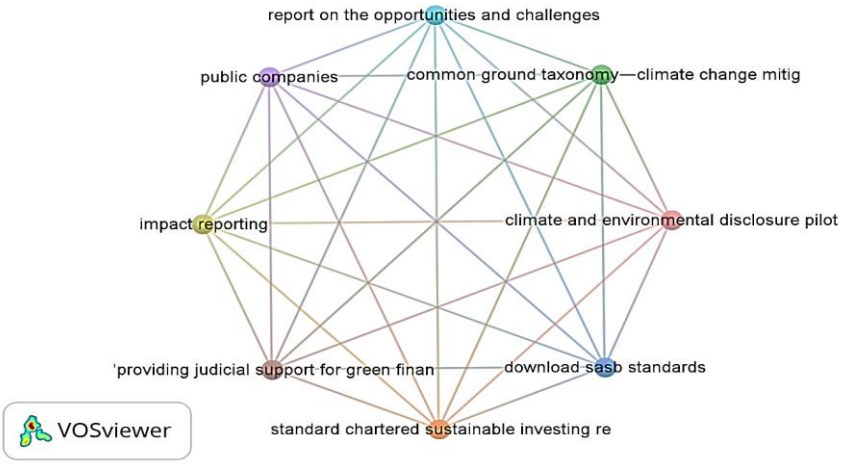
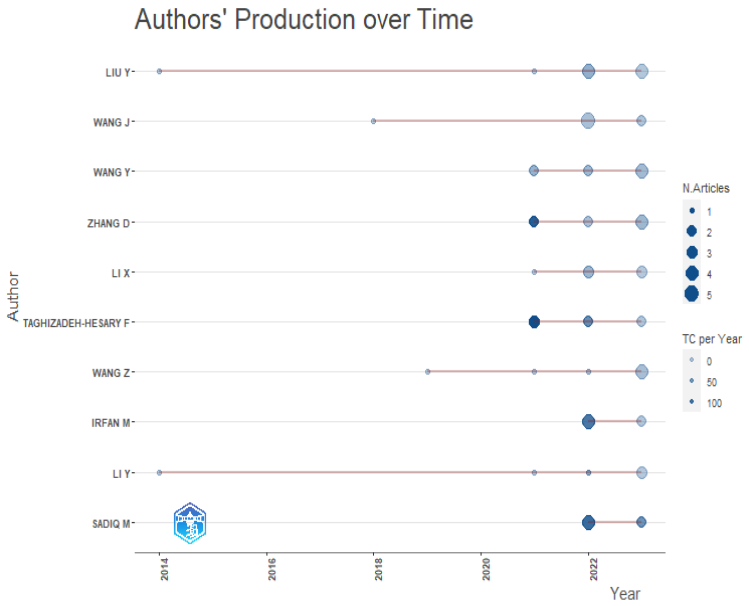


Fig 18: Co-cited Sources



Source: Authors' illustration using Biblioshiny

Fig 19: Country Collaboration Map

FUTURE RESEARCH AGENDA

Based on the researcher's subjective judgment, the following research areas are proposed for future research.

(1) The outcomes indicated a significant increase in citations and publications in the field of green finance for sustainable development. Sustainability has three aspects, economic, environmental, and social. It is observed throughout the analysis that the main focus is on economic development. The main driver of economic sustainability is the green industry. Future research may also contribute to the literature by concentrating on the environmental and social aspects of sustainability.

(2) However, there are also some constraints in this study as a problem of the English language used in the Scopus database and the Scopus database does not contain all relevant literature. In the future, additional databases, qualitative content analysis, and languages may contribute to the study of valuable insight.

(3) Only the data of 649 articles was analyzed in this study. However, future research can also use books, book chapters, and other documents and conference papers to widen the data analysis and its dimensions.

(4) Risk and Return are the two major factors in financial decisions. Therefore, the prospects of green finance projects and allied investments may well be studied from the angle of perceived risk and expected return.

(5) Last but not least further studies may also be explored connecting the green finance with blockchain technological advancements in the research domain of sustainability.

CONCLUSIONS AND IMPLICATIONS

The purpose of this bibliometric investigation was a thorough quantitative analysis of the 649 research articles in green finance over almost three decades. The main objectives were to analyze publication trends, development segments, authorship, country and institution contributions, and the conceptual linkages that have influenced this developing field by using the VOS Viewer software. All over the world, China has been identified as a leader and front-runner in the field of green finance. In achieving the sustainable development goals by 2030, China is the main contributing country.

The following significant challenges need to be overcome to achieve the green finance objectives.

1. There is no universal standard introduced that qualifies green investment which confuses the market and makes the difficult to identify and understand genuinely sustainable projects.
2. The reliable and transparent data on ESG are required for assessing the sustainable investment but unluckily there is no transparency of the data available in reporting ESG performance.
3. Some companies in the market wrongly claim their sustainability effort, such a practice is called greenwashing. Therefore, greenwashing demoralizes the green investment and initiatives.
4. Green finance investment is perceived as risky and larger payback period. This perception makes it harder for risk-averse investors to invest their capital in green projects and initiatives.

5. There is no standardized regulatory framework across different jurisdictions designed to formulate green initiatives which causes hindrance in green finance. Comprehensive guidelines are needed to encourage investments in sustainable projects.
6. The sustainable investment favors long-term incentives whereas the current financial system offers short-term gains over long-term sustainability. Therefore shifting incentives toward the long term, it is crucial to adopt green finance for investors.
7. There is a lack of capacity and knowledge to understand the risks and opportunities among investors, regulatory bodies, policymakers, and financial institutions regarding green finance. Pros and cons of green finance are necessary to understand and develop the skills to initiate and manage effectively.
8. There is a huge transitioning cost in identifying and mobilizing to a sustainable economy in the developing countries which causes the hindrance in sustainable investments.
9. There is a need to shift and integrate green finance principles into mainstream financial decision-making processes. This can be integrated by shifting the mindset and practices of financial institutions, investors, and other stakeholders.

The analysis delves into the highly significant role of public policies, government decisions and initiatives, and private sector motivation in green investments, green projects, and sustainability development. The analysis also highlights critical developments, the researcher and scholar's influential publications and contributions, geographical and conceptual domain, and concentration on defining this critical emerging field. The results provide some practical implications for bankers, financial institutions, researchers, government, and society for achieving sustainable development goals. Financial literacy and awareness of green finance are key to inculcating the green philosophy in the public. So, the government must initiate steps for financial literacy. To minimize the credit risk the government should take steps for proper training of individuals, bankers, institutional office bearers, investors, and practitioners about green technology and its applicability.

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