Evolution of Green Finance: A Comprehensive Science Mapping Analysis by using the lens of Bibliometrix

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ABSTRACT

Current study focuses on analyzing the evolution of green finance since the inception of the concept. Apart from a conventional approach which may study the evolution in terms of definitions, policy implementations, projects' expansion, etc. this study tries to analyze the evolution in terms of academic expansion and contribution. A bibliometrics approach has been employed to achieve this objective. Analysis has been carried out by mapping and visualizing the top articles, leading authors, dominating journals, prominent institutes, and countries, emerging themes, and keywords. The study has been carried out using Biblioshiny, a shiny app for the Bibliometrix, programmed in R language specifically useful for comprehensive science mapping analysis. Along with it, VOS viewer has also been utilized for enriched visualizations. The analysis is carried out on a dataset of 450 articles extracted from Scopus. Key indicators of Bibliometrix depicted that the concept grasped academic attention in 2013 and is significantly growing after 2015. Journals such as Sustainability, Environmental Science and Pollution Research, etc. are some of the dominating sources. China and UK are leading countries in terms of academic studies on green finance. The analysis also provides an in-depth insight into green finance by mapping the frequently used keywords. The word clusters and thematic map formation is valuable as they present emerging themes and provide directions for future research in green finance.

Keywords: Green Finance, Science Mapping, Biblioshiny, Bibliometric Analysis, VOSviewer, Cluster

INTRODUCTION

The world is gradually heading towards severe environmental crises such as pollution, biodiversity losses, energy crisis, deforestation, etc. Such calamities require immediate human attention as these crises are giving the path to economic and financial crises (Zhou, Tang and Zhang 2020). According to National Oceanic and Atmospheric Administration (NOAA)'s Global Monitoring Lab, the global average atmospheric carbon dioxide level in 2021 is recorded at 414.72 parts per million in 2021. It is setting a new highest record as the annual rate of atmospheric carbon dioxide has increased 100 times over the past six decades. Realization of the severity of environmental issues and their dreadful impact on the economic and financial health of the countries have urged humans to work on green projects. To promote such kinds of projects, the concept of Green Finance has emerged in the last decade. According to Green Finance Platform (n.d.) Green Finance is used for sustainable development initiatives, projects, and environmental policies aimed to achieve green economic growth by fostering low carbon, inventing alternative energy resources, discovering efficient ways to enhance agricultural production and conservation of natural resources, etc.

According to UN Environment Program, the goal of green financing is to enhance the financial flows from the public, private, and not-for-profit sectors (from banking, microcredit, insurance, and investment) to priorities for sustainable development (Lee, 2020; Khan, Riaz, Ahmed and Saeed, 2022). An important aspect of this is to increase accountability to better manage social and environmental risks and seize opportunities that will improve the environment and provide a respectable rate of return. Green financing development projects are managed through a comprehensive system that mainly focuses on economic, environmental, and financial activities (Zhang and Wang, 2021). According to World Economic Forum (2019), the United States, The United Kingdom, and France are the leading nations in Green Financing instruments like Green Bonds (Steffen, 2021). China is extensively working on Green Finance projects while India has also launched a project under the name Green India (Gilchrist, Yu and Zhong, 2021; Mishra and Sharma, 2010; Singh and Sharma 2020).

Significant academic work on green finance started in the last few years of the previous decade. Extensive research work on green finance can be witnessed after 2018 when the concept grasped the attention of academic researchers. The fast rise in academic research on green finance urged us to explore the field by employing the bibliometric analysis approach. This scientific computer-assisted method helps to statistically analyze books, articles, and other publications. This analysis is helpful in many aspects, especially in the ways it provides comprehensive information on the prominent authors, sources, countries, etc. related to a given field. This study aims to explore green finance by employing the key indicators of bibliometric analysis. This research objective has been achieved by focusing on and addressing the following research questions:

1. What are the publication trends and growth in the academic research of green finance
2. Who are the leading sources, dominating authors, top countries, and institutes with their significant academic contributions to green finance?
3. Which countries, authors, and institutes are collaborating?
4. What are emerging themes in the field of green finance?

DATA AND METHODOLOGY

This study mainly employs the technique of bibliometric analysis to analyze the key aspects of green finance. Through this analysis, one can analyze the prominent sources, leading authors, dominating keywords, top countries, references etc. related to his/her given area of interest.

Data collection and sampling

The bibliometric analysis presented in the study mainly relies upon the data retrieved from the well-known academic database Scopus. In the field of Social Sciences, Scopus is considered as one of the largest databases (ALSHARIF, Salleh, & BAHARUN, 2020). Thus, the dataset extracted from Scopus provides a comprehensive overview of the research conducted in numerous fields such as Business, Finance, Economics, Environmental Sciences, Social Sciences, etc. with a focus on Green Finance.

From the Scopus database's search engine, initially, 649 records with the keyword "Business Finance" were searched out for this study. The concept of Green Finance emerged during the last decade thus the period for analysis selected ranges from 2010 to 2022. It is worth mentioning that the database was extracted from Scopus on July 29, 2022, thus the articles published till this date have become part of the bibliometric analysis for the current study. Considering the scope of Green Finance in numerous fields, research articles from different fields such as business, finance and accounting, economics, finance, social sciences, etc. were collected. Language, journals, and knowledge domains are used for the selection of dataset to conduct analysis. Thus, the subsequent final sample extracted from Scopus contains 450 articles in total for the analysis.

Research design

The bibliometric analysis of the articles evolving between the years 2010 and 2022 is conducted to ascertain the advancement in green finance. The themes on Green Finance are identified in numerous fields such as business, finance and accounting, and economics literature. This enables us to understand how the scope of Green Finance expanded during the last decade. Analysis is conducted by using biblioshiny app developed for bibliometrix. Bibliometrix is an R-tool that provides comprehensive science mapping analysis (Aria & Cuccurullo, 2017). Another software employed to conduct bibliometric analysis includes VOSviewer science mapping (Derviş, 2019). Table presentation, visualization techniques, clustering, and mapping are collectively employed for the compilation of different bibliometric analyses.

Table 1: *Steps followed for Database Selection from Scopus*

Sr. #	Search Steps	Number of Articles
1	Initial Articles with keyword "Business Finance"	649
2	Limit to Language: English	631
3	Limit to Year: 2010-2022	628
4	Limit to: Journal Articles	473
5	Data Screening (excluded rows with incomplete records)	450

DATA ANALYSIS AND INTERPRETATION OF KEY FINDINGS

Different types of analyses conducted for the current study have been clubbed under different heads presented in Table 2:

Table 2: *Unit of Analysis and Data Analysis Types Included in the Study*

Unit of Analysis	Analysis Type
Data set	Main Information About Data
	Articles and Average Number of Citations
	Three-field plot
Sources	Most Relevant Sources through Bradford's Law
	Source Impact, Dynamics, and Density Visualization
Authors, Affiliations, and Countries	Most Relevant Authors and their Impact
	Most Relevant Affiliations
	Most Relevant Countries
Documents	Top Cited Articles
Keywords	Frequently Used keywords
	Word Tree, Mapping, and Clustering
Clustering and Conceptual Structure Mapping	Clustering Map
	Thematic Map
	Factorial Analysis
Intellectual Structure	Co-Citation Network of Papers
	Co-Citation Network of Authors
Social Structure	Collaboration Network of countries
	Collaboration Network of Authors
	Collaboration Network of Institutes

An overview of Data

This section provides a general overview in terms of description such as document content, authors, articles, citations, and a visual presentation in form of three field plot.

Table 3 provides the main information about the database retrieved from Scopus by using the keyword of "Green Finance". Total of 450 documents from 151 different sources covering the period 2010 to July 29, 2022, were reviewed. Table 3 also provides information about total keywords such as DE and ID. Here DE epitomizes the frequency distribution of the author's keywords and ID denotes the frequency distribution of keywords associated with manuscripts by Scopus (Kirilmaz & Simsir, 2022). Information regarding authors, collaborations, etc. are also available in table 3.

Table 3: *Key Information about Data*

| Description	Results
Timespan	2010:2022*
Sources (Journals, Books, etc)	151
Documents	450
Annual Growth Rate %	54.57
Average citations per doc	7.747
References	29297
DOCUMENT CONTENTS	
Keywords Plus (ID)	1515
Author's Keywords (DE)	1420
AUTHORS	
Authors	1237
Authors of single-authored docs	45
AUTHORS COLLABORATION	
Single-authored docs	45
Co-Authors per Doc	3.42
International co-authorships %	31.33
DOCUMENT TYPES	
Article	450

*Database was retrieved by using Scopus on July 29, 2022

Table 4 shows that academic work on "Green Finance" was initiated in 2013. However, idea started to grasp the attention of academic writers after 2015. Publications gradually increased in each upcoming year with the highest number of 186 in 2022 so far. Average Total Citations per Article Gradually decreased over the years, this was the highest in 2013 with an average value of

36.75 while lowest in 2022 with an average of 1.98. Average total Citations per year are above six in most of the study years.

Table 4: *Articles per year and Average number of Citation*

Year	No. of Art	Avg. TC per Art	Avg. TC per Year
2022	186	1.98	
2021	137	6.75	6.75
2020	63	12.30	6.15
2019	36	20.14	6.71
2018	14	27.43	6.86
2017	7	15.71	3.14
2016	4	36.75	6.13
2015	1	5.00	0.71
2013	1	0.00	0.00
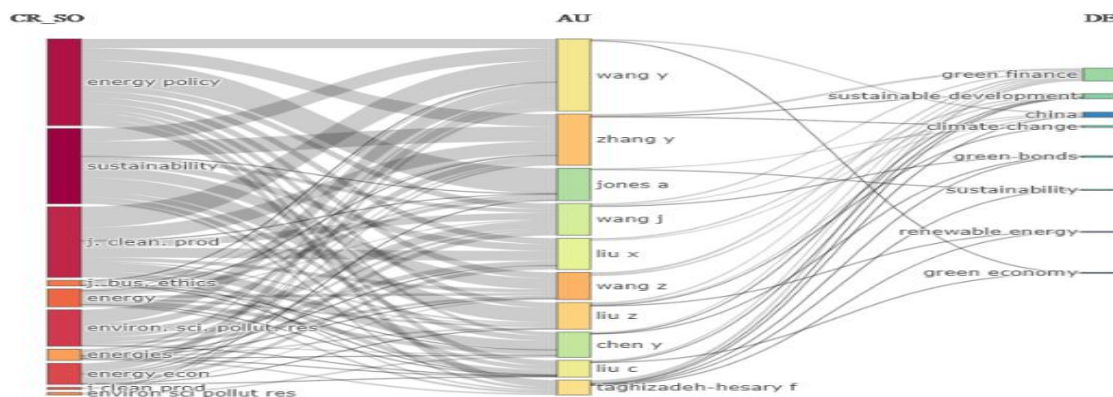
Figure 1: **Three Field plot**

Figure 1 shows a visual connection among cited resources (left), authors (middle), and keywords (right). Along with green finance, other top keywords such as sustainability, green bond, green economy, and renewable energy have also been discussed in the studies. The authors who mainly used these keywords can be seen in the middle of three field plot. The prominent sources in which the work of these authors is published such as journals of Energy Policy, Sustainability, Journal of Cleaner Production, etc. have been displayed on the left side. Larger the size of rectangle means more relationship among different elements.

Information about Sources

Table 5 provides information about the top 15 sources based upon number of articles published on Green Finance. The journal leading the list is of Sustainability with 124 publications and 1,041

citations in total followed by Environmental Science and Pollution Research with 33 publications and 248 citations.

Table 5: Source clustering through Bradford's Law

Sr.#	Source	Rank	No. of Art	TC	Avg. TC per Art
1	Sustainability (Switzerland)	1	124	1041	8.4
2	Environmental Science and Pollution Research	2	33	248	7.5
3	Energies	3	22	172	7.8
4	IJ of Environmental Research and Public Health	4	18	52	2.9
5	Frontiers in Environmental Science	5	17	37	2.2
6	Ecological Economics	6	8	216	27.0
7	Economic Research-Ekonomska Istrazivanja	7	8	11	1.4
8	Frontiers in Energy Research	8	8	13	1.6
9	Climate Policy	9	6	20	3.3
10	Energy Policy	10	6	221	36.8
11	Journal of Cleaner Production	11	6	171	28.5
12	Risks	12	6	8	1.3
13	Journal of Sustainable Finance and Investment	13	5	53	10.6
14	Energy Economics	14	4	19	4.8
15	Environmental Research Letters	15	4	63	15.8

Figure 2 presents the top 10 journals with publications related to Green Finance with the highest impact. According to the information displayed, the Journal of Sustainability is on top in terms of its citations with h-index of 17. Second group represents journals with h-index six and includes the journals of Ecological Economics, Energies, Energy Policy, Environmental Science and Pollution. Third group of leading journals carries h-index 4 and comprised of the Journal of Cleaner Productions, Environmental Research Letters, Frontiers in Environmental Sciences. Fourth cluster of top journals represents h-index 3 and comprised of the journal of Advances in Climate Research, Climate policy.
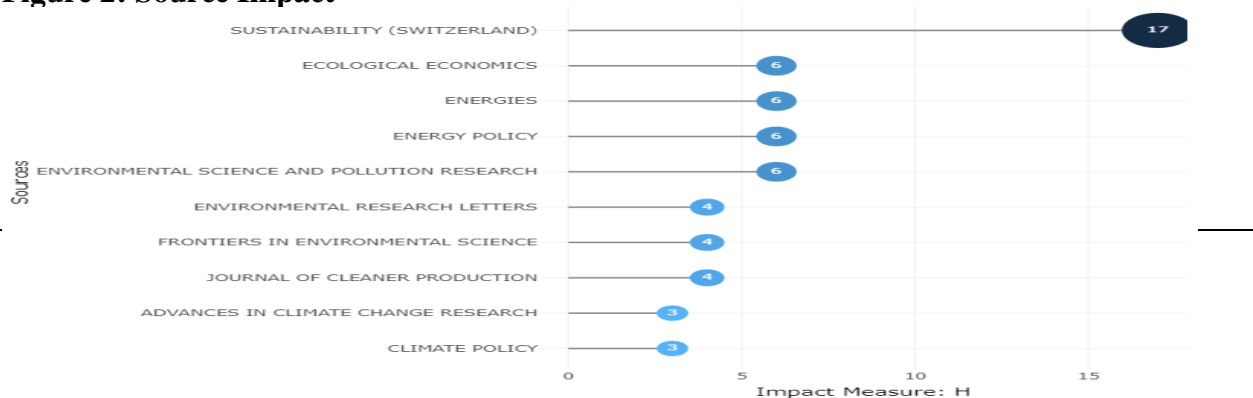
Figure 2: Source Impact

Figure 3 further shows yearly trend of publications in topmost five journals. Publications on Green Finance in these journals have been started from 2017 and continuously growing since then. Journal of sustainability is the topmost journal with highest number of publications. Other journals included in the top five list are Environmental Science and Pollution Research, Energies, Frontiers in Environmental Science, International Journal of Environmental Research and Public Health.
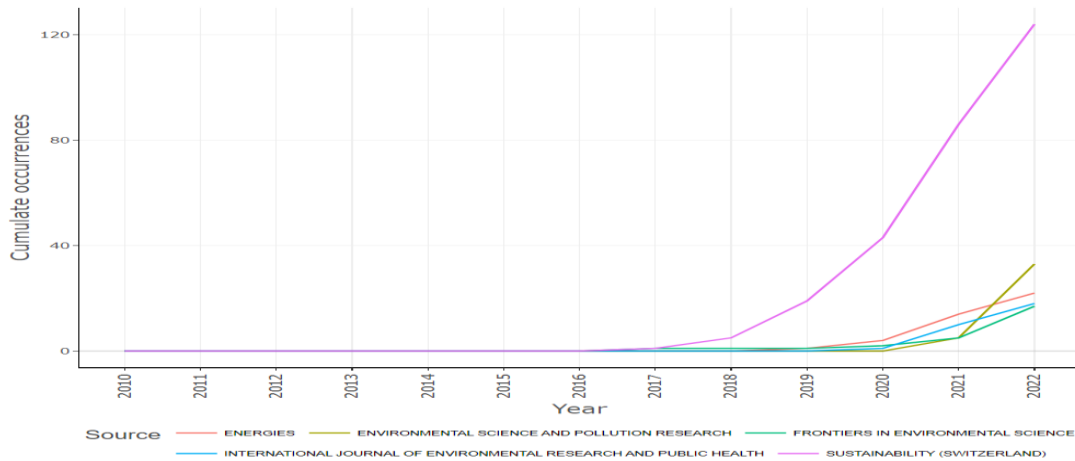
Figure 3: Source Dynamics

Figure 4 is Item Density visualization of source which depicts the journals with the most citations. Color ranges from blue to green to yellow. Yellow represents the sources of highest density, that is, the most cited sources such as the journals of Sustainability, Environmental Science and Pollution Research fall in this yellow dense area and thus categorized as the most cited journals.

Figure 4: Density Visualization of Most Cited Sources
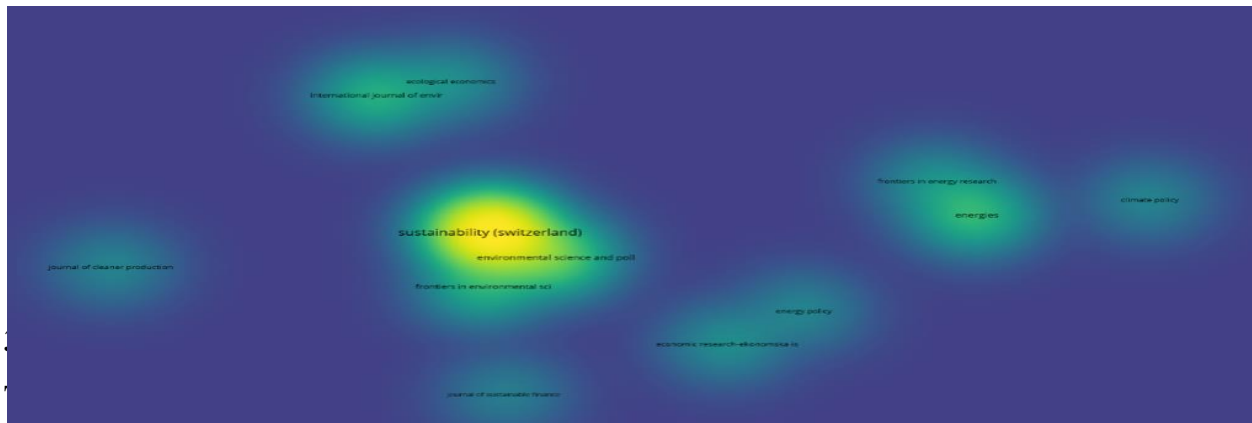
publications. According to the information displayed, Wang Z. and Zang Y. are the top authors with nine publications each. Total citations of Wang Z. are 54 with 6 avg. total citations per article. From the table, it can also be observed that the highest total citations are 156 for the work of Taghizadeh-Hesary F. for seven publications.

Table 6: Most Relevant Authors

Sr. #	Author	No. of Art	TC	Avg. TC per Art
1	Wang Z.	9	54	6.0
2	Zhang Y.	9	23	2.6
3	Liu Z.	8	28	3.1
4	Taghizadeh-Hesary F.	7	156	17.3
5	Wang Y.	7	44	4.9
6	Liu C.	6	54	6.0
7	Wang J.	6	22	2.4
8	Chen Y.	5	8	0.9
9	Jones A.	5	75	8.3
10	Li X.	5	2	0.2
11	Liu X.	5	28	3.1
12	Siddik A.B.	5	27	3.0
13	Zhang J.	5	26	2.9
14	Chien F.	4	107	11.9
15	Hafner S.	4	75	8.3

Figure 5 presents the top 10 authors with highest impact that their publications carry on the work related to green finance. According to the information displayed, Liu C. is on top with h-index of 5. Total articles written by Liu C. are six and H-Index 5 means that out of six articles, five articles carry at least five citations per article.

Figure 5: Authors Impact
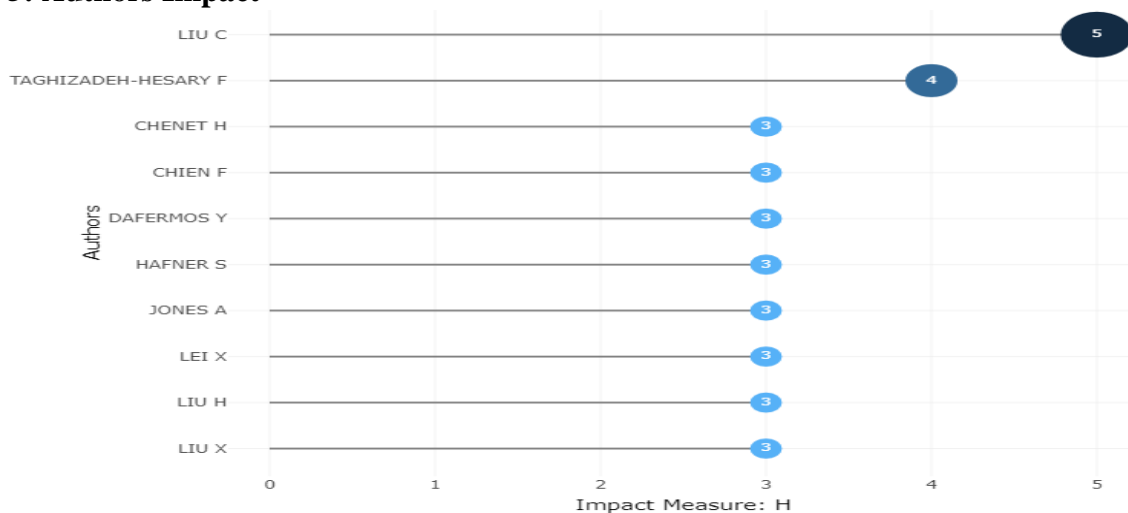
Figure 6 displays the data of top 10 institutes with their publications on Green Finance. According to the information displayed, China University of Mining and Technology is on top with 27 publications followed by University College London with 25 publications.

Figure 6 : Most Relevant Affiliations
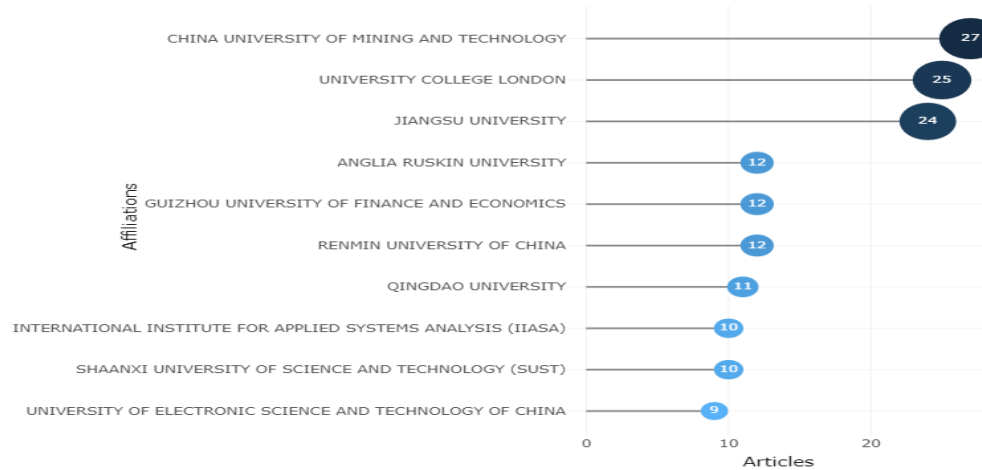
Table 7 presents the top 10 countries with their highest publications. According to the information displayed, China is on top of the list with 621 publications followed by United Kingdom with 139 publications. In Figure 7, blue areas represent the countries that have publications on Green Finance while Gray colored areas represent the countries with no publication on the topic under study.

Table 7: Countries Scientific Production

Figure 7: Countries Scientific Production

SR. #	Region	Freq
1	CHINA	621
2	UK	139
3	ITALY	46
4	PAKISTAN	44
5	POLAND	37
6	USA	34
7	ROMANIA	31
8	GERMANY	29
9	JAPAN	29
10	INDIA	26
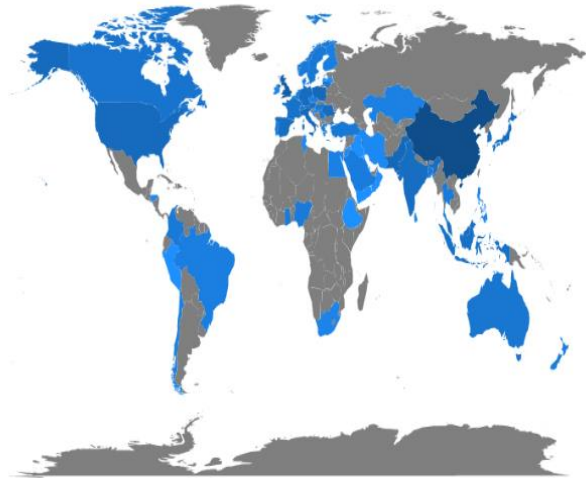
Figure 8 represents top 10 countries in terms of corresponding authors. SCP represents the Single Country Publications with corresponding author from the same country. MCP represents Multiple Country Publications with corresponding author from different country.

Figure 8: Corresponding Author's Country
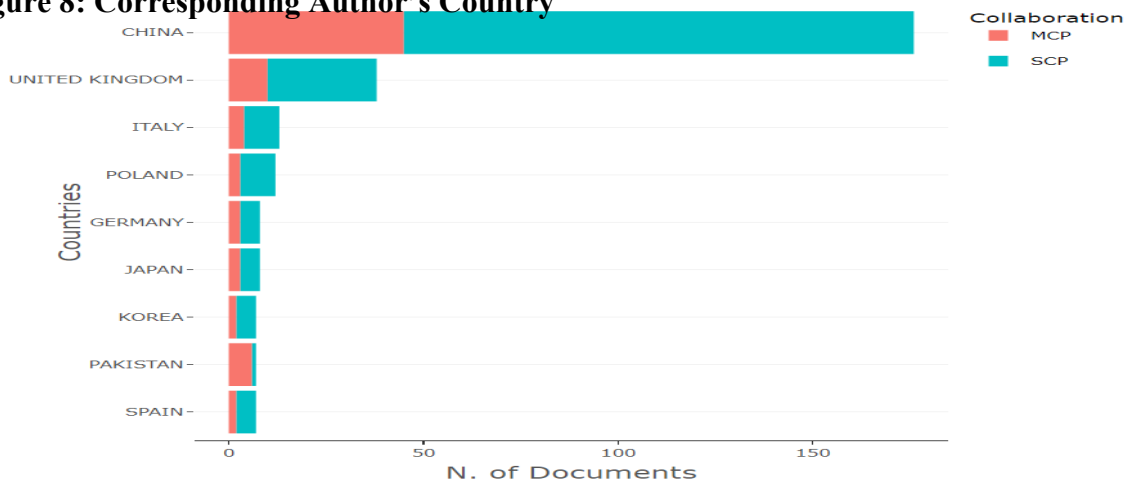
Information about Documents

Table 8 provides the information of top 10 articles based upon the highest global citations. Table also provides information about local citation. Local citations are within the dataset selected for the study while global citations made by the articles outside the dataset but somewhat within the scope of the study under consideration (Kirilmaz & Simsir, 2022). For each document, DOI has been mentioned in the table. The most globally cited document is of Taghizadeh-Hesary F, 2020, published in Energies which fetched GC score of 106 followed by the research paper of Gianfrate G, 2019, in the Journal of Cleaner Production that carries GC score 99 and the research paper by Bachelet MJ, 2019, published in Sustainability with GC score of 84. In terms of Local Citations in comparison of Global Citations among the top 10 publications presented in Table 7, research paper by Liu N, 2020, published in Sustainability is on top with LC score of 15.

Table 8: *Top Global Cited Articles*

Sr. #	Document	DOI	Year	LC	GC	LC/GC Ratio (%)
1	Taghizadeh-Hesary F., 2020, Energies	10.3390/en13040788	2020	14	106	13.21
2	Gianfrate G., 2019, J. Cleaner Production	10.1016/j.jclepro.2019.02.022	2019	12	99	12.12
3	Bachelet MJ, 2019, Sustainability	10.3390/su11041098	2019	12	84	14.29
4	Nawaz MA, 2021, Environmental Science and Pollution Research	10.1007/s11356-020-10920-y	2021	11	78	14.10
5	D'orazio P., 2019, Ecological Economics	10.1016/j.ecolecon.2019.01.029	2019	16	70	22.86
6	Soundarrajan P, 2016, Agric Econ	10.17221/174/2014-AGRICECON	2016	14	45	31.11
7	Falcone PM, 2019, Sustainability	10.3390/su11020517	2019	14	43	32.56
8	Dikau S., 2021, ECOL ECON	10.1016/j.ecolecon.2021.107022	2021	10	41	24.39
9	Taghizadeh-Hesary F., 2021, Sustainability	10.3390/su13105719	2021	11	30	36.67
10	Liu N, 2020, Sustainability	10.3390/su12093717	2020	15	28	53.57

Analysis of Keywords

Table 9 presents the analysis of the most frequently used words by implying the criteria of the author's keywords and keywords plus. Author's keywords are those words that appear in the title of the article itself while keywords plus are those words that appear in the title of article's refences but do not appear in the title of article itself (Merediz-Solà & Bariviera, 2019). Both units of analysis depict some of the most important keywords that frequently appeared and provide a guiding point about the emerging concepts in the field. Table depicts that green finance itself appeared as most frequently used keyword along with other emerging concepts including sustainable development, economic development, sustainable finance, green bonds, renewable energy etc.

Table 9*Frequently used words*

Unit of Analysis	Words	Freq.	Unit of Analysis	Words	Freq.
Author's keywords	Green finance	144	**Keywords Plus**	China	145
	Sustainable development	58		Sustainable development	132
	Climate change	50		Climate change	95
	Sustainability	45		Economic development	84
	Green bonds	32		Sustainability	68
	Sustainable finance	26		Green economy	67
	China	25		Finance	56
	Green economy	20		Investment	51
	Renewable energy	17		Investments	46
	Climate finance	16		Environmental economics	44

Figures 9(a) and 9(b) provides the visual depiction of most frequently used Author's keywords by using the graphics of Word Tree Map and World Cloud respectively. Figure 9(a)-Tree map depicts the proportion of each keyword, according to which the keyword of green finance appeared 144 times that constitutes the proportion of 24% followed by sustainable development with a proportion of 10%. Figure 9(b)-word cloud signifies the words by visualizing in term of size. Word with bigger in size are more frequently occurred than the words which are smaller in size. This word cloud signifies the emerging themes such as sustainable development, climate change, green bonds, climate finance, sustainable finance, green economy, corporate social responsibility, sustainable development goals etc.

Figure 9(a) Word Tree Map – Author's Keywords   **Figure 9(b) Word Cloud**
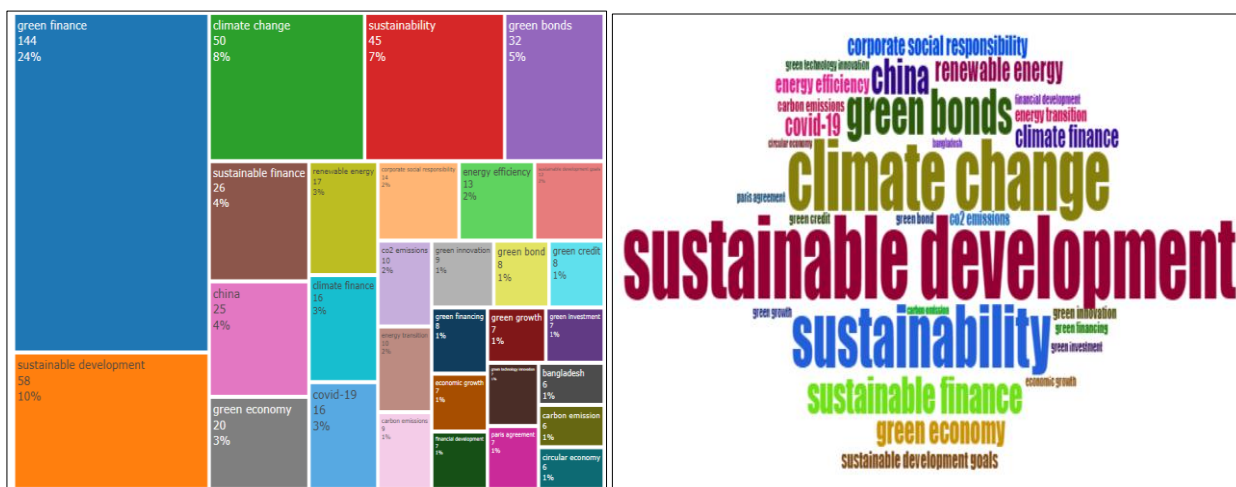
Figure 10 shows the clusters of keywords that co-occur. It depicts five main clusters including red, green, blue, yellow, and purple. Cluster in red shows that the keyword of green finance co-occurs with green development, green technology innovation, green investment, CO_2 emissions etc. Similarly, cluster in green labels the keywords like green bond, green finance, climate finance, sustainable finance etc. Cluster in blue labels green economy, green growth, green innovation, environmental pollution etc. Cluster in yellow labels the keywords like climate change, sustainability, SDGs etc. Cluster in purple labels the keywords like energy efficiency, energy transmission, renewable energy etc.

Figure 10 Cluster of Co-Occurrence of keywords
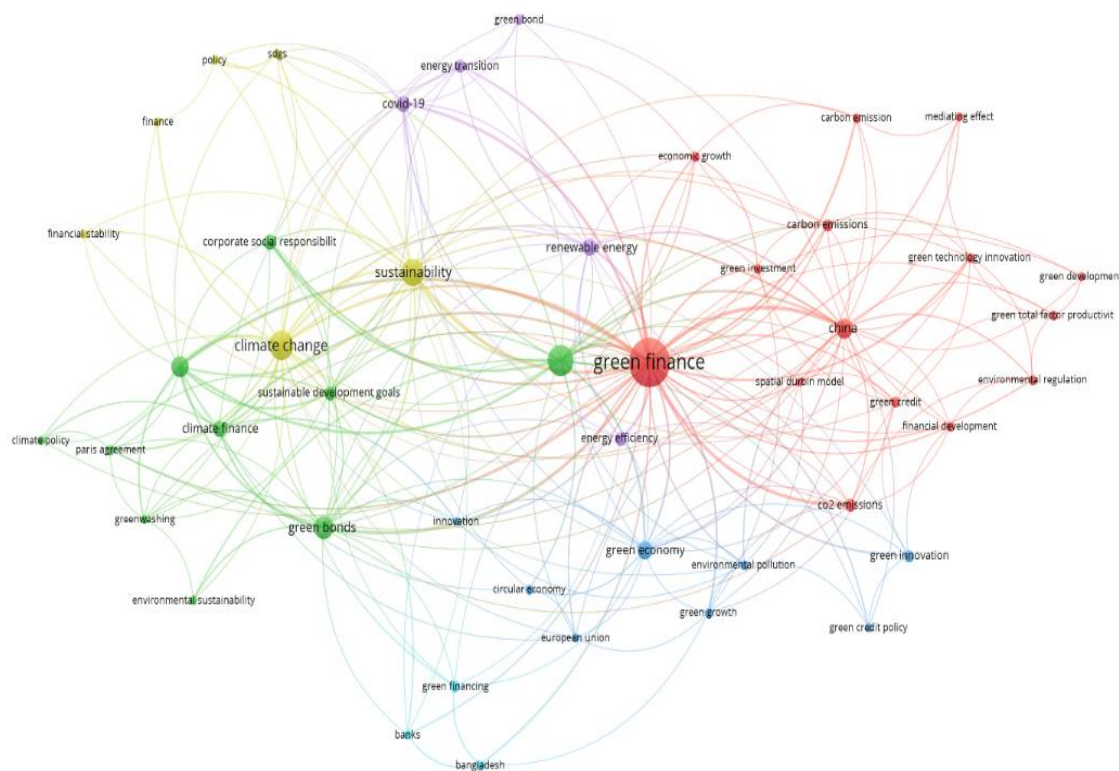
Clustering and Conceptual Structure Mapping

In Figure 11 coupling networking analysis is performed by using the unit of analysis as documents and coupled it with unit content of Author's keywords (Yang, Wolfram, & Zhao, 2016). Cluster centrality on x-axis is measured through Callon's Centrality index (Courtial & Callon, 1991) and y-axis shows the cluster's impact. Cluster map plots four themes and the

biggest one in size with the highest impact is blue that formed based upon the keywords green finance, Co2 omissions and depicts that such studies are majorly conducted in China.

Figure 11. Clustering Map
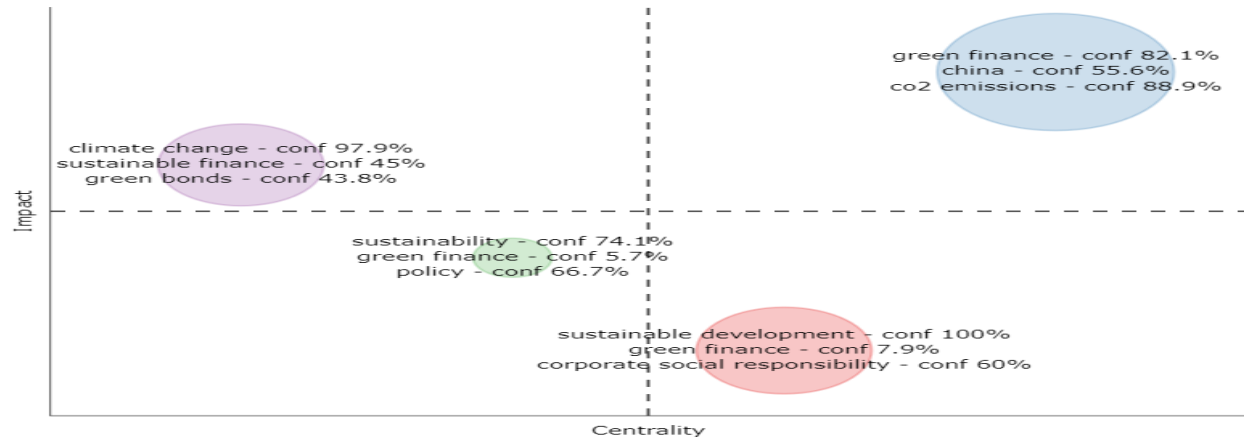
Thematic map presented in Figure 12 also uses the Callon's Centrality index (Courtial & Callon, 1991), however, extends the analysis by categorizing the cluster into four themes in terms of thematic evolution: i) Motor themes with high centrality and high density. Motors themes are highly studied and evolving ideas in the field. ii) Basic themes show high centrality but at a lower degree of development. Basic themes have potential to become motor themes in near future due to their higher centrality. iii) Emerging or declining themes with low centrality and less dense. Qualitative analysis is needed to determine whether the themes in this section are emerging or declining. iv) Niche themes are highly developed, themes in this section are less important because they have been highly developed while new concepts and technologies are replacing them (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2012). Figure 12 is plotting the cluster by using keywords plus as field of analysis. According to this, cluster of motor themes includes the evolving ideas of green economy and economic development and further depicts that studies on these ideas are mostly carried out in China. Sustainable development and climate change are basic themes with a potential to become motor theme in near future.

Figure 12. Thematic Map
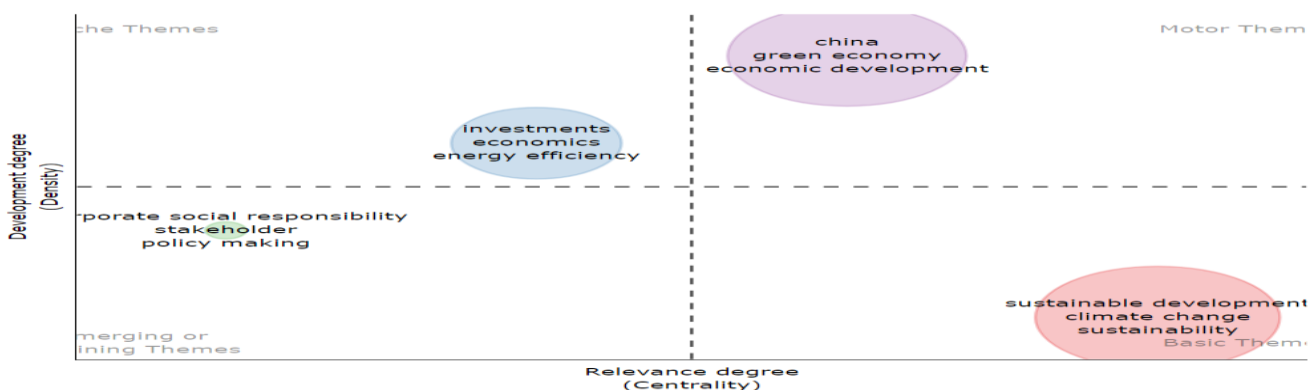
Figure 13 is presenting the factorial analysis performed by using the method of multiple correspondence analysis for the field of author's keywords. Cluster in red formed with the keywords such as Green Innovation, Green Finance, Green Credit, Corporate Social Responsibility, Energy Efficiency, Renewable Energy, Carbon Emission. This cluster depicts the studies with more focus on finding innovative energy sources that bring less harm to the environment by emphasizing Corporate Social Responsibility. Cluster in blue discusses the concepts such as green bonds, sustainable finance, climate finance, climate change, sustainability etc. This cluster provides the information about alternate terms used for green finance and its role to achieve sustainable development goals.

Figure 13 Conceptual Structure: Factorial Analysis
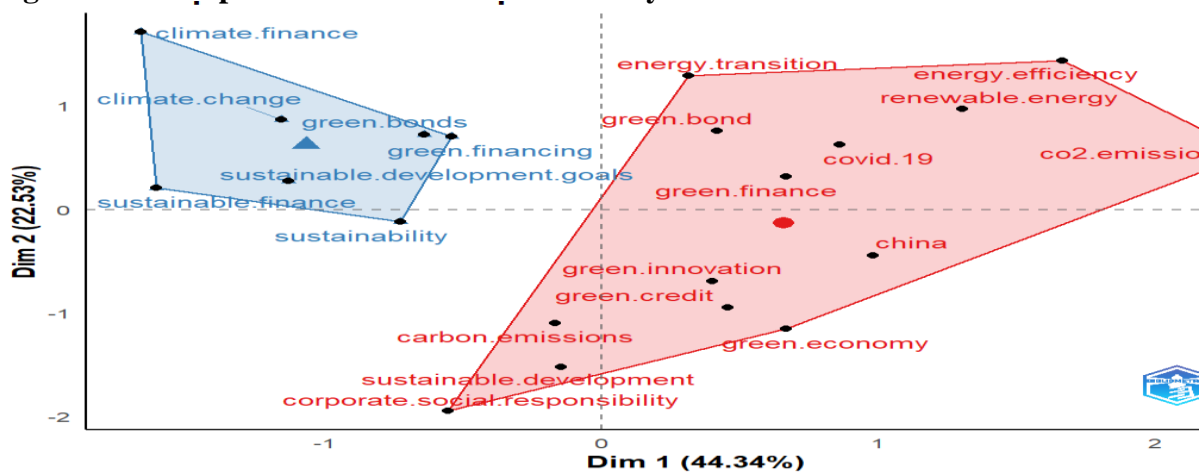
Intellectual Structure Mapping

Figures 14-a and 14-b show Co-citation network by using Paper and Source as units of analysis. Size of the node depicts the significance of the respective article or the source. Size of the Node increases with increase in number of articles co-cited with that article in question. In case of source as unit of analysis, size of node increases with the increase in sources, articles of which are co-cited with the article of that source in question. Figure 14-a represents network of three clusters including red, green and blue. It signifies the articles of Wang y. 2016, Zhou x 2020, Taghizadeh-Hersary f. 2019 etc. shown in read cluster which is the biggest one in co-citation network of Documents. Figure 14-b also arranges the co-citation network of sources in three clusters. Red cluster is the biggest one showing largest number of sources, articles of which, are co-cited. This cluster signifies the Journals such as Sustainability, Journal of Cleaner Production, Resource Policy, etc. which means articles published in these journals are mostly co-cited.

Figure 14-a. *Co-citation Network-Documents*   **Figure 14-b.Co-citation Network-Sources**

Social Structure Mapping

Figures 15-a, b & c show the social network mapping of countries, authors and institutes respectively. Figure 15-a shows three clusters in red, green and blue. The biggest cluster is of green color which shows the collaboration among the authors belong to countries such as China, Malaysia, Pakistan, India, Egypt, Korea, Australia. Second biggest cluster of red color shows the collaboration among countries like France, United Kingdom, Singapore, Sweden, Italy etc. Cluster in blue shows the collaboration among authors belong to United States, Canada, Norway, Germany, Hong Kong, Austria. Figure 15-b shows four clusters of the collaborations of authors. Cluster in blue shows the collaborative work between Taghizadeh-Hesary F. and Yoshino N. whereas the bigger size depicts that Taghizadeh-Hesary F. is as first author in most of the articles. Cluster in purple shows the collaborations between Masukujjaman M. and Siddik ab. Cluster in Green shows combined work of Wand Y. and Lei X. with Wang Y. as first author shown by bigger size. Similarly, cluster in red shows the collaborations of Jones A. and HafnerS. on Green Finance where Hafner S. is first author in most the articles. Figure 15-c is highlighting the institutes, authors of which collaborated and published their work on Green Finance. Four clusters are formed with the biggest one is blue showing collaboration among five Institutes followed by red cluster with collaborations among four institutes. Green and purple clusters are of same size showing collaboration between two institutes.

Figure 15-a Collaboration Network (countries)   **Figure 15-bCollaboration Network (Authors)**

Figure 15-eCollaboration Network (Institutes)

DISCUSSION

Bibliometric analysis of Green Finance has highlighted its key aspects with help of visual mapping and statistical tables. After final selection of the articles, descriptive statistics show that 450 articles have been published and became part of Scopus database from 2010 till July 29, 2022. However, concept of green finance emerged in academic studies since 2013 while significant academic contribution was started after 2015 with an annual growth rate of 54%. From the analysis of source mapping, it is identified that journal of Sustainability is the most popular for studies on Green Finance as out of 450 articles, 124 articles have been published in it. Among other prominent journals, we found the names of Environmental science and pollution research, Journal of Cleaner Production, Energies, Ecological Economics etc. Most prominent authors are Wang Z., Zhang y. Liu C. etc. among whom Liu C.' s publications have highest impact score of 5 on H-index. Liu C.'s work mainly focuses upon renewable energy sources and sustainable development backed by Green Finance. However, highest Global Citation score is of the article written by Taghizadeh-Hesary F, 2020. Some of the prominent institutes with their research work on green finance are China University of Mining and Technology, University College London, Jiangsu University, etc. China is on top of the list with the highest academics' contribution followed by UK, Italy, Pakistan, etc. Analysis of keywords not only highlights the prominent keywords frequently used in the study, but co-occurrence of keywords analysis provides insight into different prominent themes about the study in question. Thus, the analysis can be utilized as a guiding tool to get new ideas for future research in the field. Prominent keywords highlighted in the current study are green finance, sustainable development, green bonds, green technology innovation, CO_2 omission, etc. From this, we may conclude that green finance projects focus to achieve sustainable development by employing green technological innovations. Further, intellectual network analysis has provided the information about prominent co-cited documents and the sources whose articles were mostly co-cited. Among the prominent co-cited articles selected for analysis, Wang Y. 2016, Taghizadeh Hersary F. 2019 etc. are prominent in the cluster and thus show that their work is comparatively cited more as compared to other articles. In the end, social network clustering helped to identify the collaborations among authors and the institutes across different countries. China is forming the biggest cluster which depicts that recently China is working extensively on Green Finance.

CONCLUSION

Humans' activities have caused serious harms to earth over past few decades in form of deforestation, environment pollution, land pollution etc. Such serious threats to our land have gradually increased the need for expansion of green projects. For such projects that may provide solution of healthy environment and protect natural resources, green finance is becoming a center of interest since last decade. Research on green finance continues to nurture into several disciplines in several countries. This study is conducted on dataset of 450 articles extracted from Scopus by considering the period of 2010 till July 29, 2022. Through bibliometric analysis, we were able to take a deep insight into the evolution of green finance which has been witnessed so far. From the academic perspective, this study can serve as a roadmap to witness the underlying dynamics in the field of green finance in term of bibliometrix key indicators. Science mapping and statistical tables presented in the study help to get knowledge of the leading authors, influential journals, prominent institutes etc. that are significantly contributing in the field of green finance. World mapping

helped to distingue the prominent countries with their significant academic contribution in this field. For current study, rigorous analysis has been conducted by focusing single database. This provides the opportunity for future research to merge more than one database for bibliometric analysis. Thematic map and word cluster provide insight into emerging themes which provide the directions for future research. Some of such themes suggested by word mapping are green finance and green innovations to mitigate climate changes, green finance and its role in green economy and environmental substantiality, green finance and renewable energy sources, green finance and agricultural revolution, etc. Under the umbrella of bibliometric analysis, we now have comprehensive information of top-cited articles, emerging themes, prominent sources, key authors of the field, etc. Thus, the analysis provides a strong basis for literature which can aid the researchers to broaden their knowledge of the field

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