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Research productivity and collaborative network analysis on Green Technology from Web of Science database in Scientometric review during 2014 to 2023

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ARTIGOS

Abstract
Objective: This study analysis research productivity and collaborative network analysis on green technology literature required plaintext data extracted from the Web of Science core collection database with the topic of the keywords “Green technology” “Environmental Technology” or “Clean technology”, or “Sustainable technology” was used to search with the objective of the study. **Methods:** The Scientometric method has been used in this research from 2014 to 2023. The bibliographic data was exported in plain text format for this research. Bibexcel, VoSviewer, and Microsoft Excel were employed for data analysis and visualization functions. **Results:** A total of 24325 bibliographic records were extracted from the study. The productivity of green technology publications has an upward from 2014 (944) at 3.88 % to 2023 (4737) at 19.47%, The highest publication in green technology written by English language 24136 (99.223%), Liu Y and Wang are most prolific authors in green technology published in 183 articles which a total citation was 6983 and h - index 43, The highest number of 1471 (6.04%) records was produced by the Journal of Cleaner Production, the highest used keyword were “Performance” 2488 (10.22%) times to search the other words Energy 1305 (5.36%).etc. **Conclusions:** Overall, the green technology publications are increased, and it shows the growth trends from 2014 to 2023. The results of the study will be useful for green technology-related studies scientists and researchers to find out the hotspots and collaboration networks in the green technology innovation domain.
Keywords: Green Technology. Environmental Technology. Scientometric. Web of Science.

Produtividade de pesquisa e análise de rede colaborativa sobre Tecnologia Verde do banco de dados Web of Science na revisão cienciométrica durante 2014 a 2023

Resumo
Objetivo: Este estudo analisa a produtividade da pesquisa e a análise de rede colaborativa na literatura de tecnologia verde, exigindo que os dados de texto simples tenham sido extraídos do banco de dados da coleção principal da web of science com o tópico das palavras-chave “Tecnologia verde” ou “Tecnologia ambiental” ou “Tecnologia limpa” ou “Tecnologia sustentável” foi utilizada para busca com o objetivo do

estudo. **Métodos:** O método cienciométrico foi utilizado nesta pesquisa de 2014 a 2023. Os dados bibliográficos foram exportados em formato de texto simples para esta pesquisa. Bibexcel, VoSviewer e Microsoft Excel foram empregados para análise de dados e funções de visualização. **Resultados:** No total foram extraídos 24.325 registros bibliográficos no estudo. A produtividade das publicações de tecnologia verde aumentou de 2014 (944) 3,88% para 2023 (4737) 19,47%, A maior publicação em tecnologia verde escrita em inglês 24136 (99,223%), Liu Y e Wang são os autores mais prolíficos em verde tecnologia publicada em 183 artigos cuja citação total foi de 6.983 e h - índice 43, O maior número de 1.471 (6,04%) registros foram produzidos pelo Journal of Cleaner Production, a palavra-chave mais utilizada foi "Desempenho" 2.488 (10,22%) vezes para pesquisar as demais palavras Energia 1.305 (5,36%).etc. **Conclusões:** No geral, as publicações sobre tecnologia verde aumentaram e mostram as tendências de crescimento de 2014 a 2023. Os resultados do estudo serão úteis para cientistas e pesquisadores de estudos relacionados à tecnologia verde para descobrir os pontos críticos e redes de colaboração na inovação em tecnologia verde.
Palavras-chave: Tecnologia Verde. Tecnologia Ambiental. Cienciométrico. Web of Science.

Productividad de la investigación y análisis de redes colaborativas sobre tecnología verde desde la base de datos de Web of Science en la revisión de Scientometric durante 2014 a 2023

Resúmen

Objectivo: Este estudio de análisis de la productividad de la investigación y el análisis de redes colaborativas sobre la literatura sobre tecnología verde requirió que los datos de texto sin formato se hayan extraído de la base de datos de la colección principal de la web de ciencia con el tema de las palabras clave "Tecnología verde" o "Tecnología ambiental" o "Tecnología limpia" o Se utilizó "tecnología sustentable" para la búsqueda con el objetivo del estudio. **Métodos:** En esta investigación se ha utilizado el método cienciométrico desde 2014 hasta 2023. Los datos bibliográficos se exportaron en formato de texto plano para esta investigación. Se utilizaron Bibexcel, VoSviewer y Microsoft Excel para las funciones de visualización y análisis de datos. **Resultados:** En el estudio se han extraído un total de 24325 registros bibliográficos. La productividad de las publicaciones sobre tecnología verde ha aumentado desde 2014 (944) 3,88% hasta 2023 (4737) 19,47%. La publicación más alta sobre tecnología verde escrita en inglés 24136 (99,223%), Liu Y y Wang son los autores más prolíficos en verde. tecnología publicada en 183 artículos cuya cita total fue 6983 y h - índice 43, el mayor número de 1471 (6,04%) registros fueron producidos por el Jornal of Cleaner Producción, la palabra clave más utilizada fue "Performance" 2488 (10,22%) veces para buscar las otras palabras Energía 1305 (5,36%) etc. **Conclusiones:** En general, el verde Las publicaciones sobre tecnología aumentan y muestran las tendencias de crecimiento de 2014 a 2023. Los resultados del estudio serán útiles para que los científicos e investigadores de estudios relacionados con la tecnología verde descubran el punto de acceso y redes de colaboración en el ámbito de la innovación en tecnologías verdes.
Palabras clave: Tecnología Verde. Tecnología Ambiental. Cienciométrico. Web of Science.

1 Introduction

The term Bibliometric has emerged from the words Biblio (Latin) and metrics (Greek). The most comprehensive definition was given by (Pritchard, 1969), bibliometric is the application of mathematical methods to books, journals, and other media of communication. Scientometrics is a quantitative method of research on the development of science as an informational process (Nalimov & Mulcjenko, 1971). This field concentrates specifically on science and social sciences and humanities. Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical mathematical methods. Green Technology (GT) is the study encompasses a wide area of scientific research, including energy, atmosphere,

science, agriculture, material science, and hydrology to reduce the harmful effects of the same, manufacturers altered the production processes to produce less waste by products. Green Technology can be broadly defined as technology that has the potential to significantly improve environmental performance relative to other technologies. It is related to the term “environmentally sound technology” are geared to protect the environment, are less polluting use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substituted other related terms for green technology include climate smart, climate friendly and low carbon technology. In the year 2022 report analyzed technological trends and practical solutions to combat climate change impact on agriculture and forestry, the water sector and cities.

Oxford English Language dictionary defines as environmentally beneficial technology, applied to mitigating or remediating effects of human activity on the environment. Green technology also called “Environmental Technology”, or “Clean Technology” is the application of one or more environmental science, green chemistry, environmental monitoring, and electronic devices to monitor, model and conserve the natural environmental factors and atmosphere, nature effect etc.,

World intellectual properties organization (WIPO) defined as a Green Technology (GT) includes both process and product technologies that generate low and no waste and increase resource and energy efficiency. They also cover “end-of - the pipe” technologies for treating pollution. Green technology does not only mean individual technologies but also systems, including know-how, procedures, goods and services and equipment, as well as organizational and managerial procedures. According to green technology books, they defined how healthy innovation ecosystems are generating a wealth of green technology solutions. Green technologies can help people adapt to the reality of climate change.

Since there is no specific study on the Scientometric analysis of green technology literature till today, as a result we have chosen it for analysis. Among the related studies about enquiry (Akbari, M., *et al*. 2022) by providing bibliometric analysis based on green innovation is recognized as one of the main factors affecting financial growth, environmental sustainability and quality of life. A total number of publications were 283 articles collected from the Web of Science (WoS) database to identify and define green innovation. The VoS viewer, citespace and CiteNet explorer bibliometric software have been used to build the Green Innovation network. The findings indicate that the Sustainability Journal has the greatest number of studies on green innovation followed by the journal of cleaner production, business strategy and the environment international journals of environmental research and public health. The co-citation

network of reference revealed three clusters of green innovation and performance, (Wang, X., & Gong, X. F., 2022) in the article discussed about mapping of research in the field of forest therapy-related issues: A bibliometric analysis for 2007–2021. A total number of publications, 2545 retrieved from web of science database analyzed the different scientometric parameter such as a journal and countries, citation, subject areas, and evolutionary stages, etc. (Adel, T.K., et al. 2021) in this article did green building construction is considered as an advancement towards sustainable development and providing a balance among health economics, and social problems. This study reviews a scientometric analysis of some published articles on the policies, incentives and barriers to GBC from 1990 to 2019. The data retrieved from the web of science database, and then analyzed using Hiscite, Citespace and VoSviewers' software. This study focuses on top journals, keywords co- occurrence networks, cluster analysis, the strongest citation burst, co citation articles, most citations per year and countries for the last three decades. (Farrukh, M., & Javed, S., 2021) aimed to analyze the publication structure of academic research on green innovation between 2000 and 2019. We used the Scopus database, and then they were analyzed through VOS viewer software. A total number of 653 publications were indexed during the period of 2000 - 2019. This study identifies the most productive countries, universities, authors, journals, and most prolific publications in green innovations. Besides, the study uses VoSviewer software to visualize the mapping based on co- citation bibliographic coupling and co-occurrence of keywords, (Bhardwaj, A.K., *et al.,* 2020) this studied the term of green products issued commonly to describe the products that seek to protect or enhance the environmental during production, use or disposal by conserving resources and minimizing the use of toxic agent's pollution and waste, we used Scopus database using different keywords to the green products. This study used bibliometric tools and various indicators to discern research progress in the field of green products over the period 1964- 2019 the VoSviewer software applied the map the main trends. A total of 1619 publications during the study period were extracted from the Scopus database using different keywords related to the green products. (Pang, R., & Zhang, X. 2019) studied bibliometric analysis of a basic review of the evolutionary progress of green manufacturing these study analyses 32 years of development a general cartography of existing research is now needed to reflect the major ideas and questions involved. We extract high-frequency keywords from the articles and calculate their co-occurrence. In the co-word matrix, six clusters are identified and visually presented by a strategic diagram and bi-dimensional multi-dimensional scaling diagrams. The six clusters cover the research subjects of green chemical materials and green manufacturing. etc. (Albort Morant, G., *et al.* 2017) the topic of green innovation has increasingly attained organizational relevance due to its contribution to the satisfaction of environmental needs. The study period of 1971 - 2015

Web of Science core collection database was used to analyze a total number of publications 618 retrieved on green innovation. This paper develops a bibliometric analysis with the aim of assessing the critical papers in the field and identifying the most substantive contributions to literature. This study presents the following findings the chronological development of the discipline the research trends and prevalent issues in this field, and the primary outcomes of green innovation.

2 Methodology

The present study has utilized the Clarivate web of science core collection database to obtain the required data for the study analysis. the search topic of the keywords “Green technology” or “Environmental Technology” or “Clean technology “or “Sustainable technology” has been used for collecting data from 2014 to 2023. The data was chosen on 05 January 2025. A total of 24,325 documents were found in this study. It has 19280 articles, Article; Book Chapter, 4006 and various description are data, in the documents search, authors exported bibliographic details in plain text format, in this study data analysis functions are employed by Bibexcel software (person et al., 2009).Moreover, visualization functions are employed by VoSviewer software (Van Eck; Waltman, 2007) and Microsoft excel were used for further mathematical and statistical analysis.

3 Results and discussion

Chronological – wise growth of publications

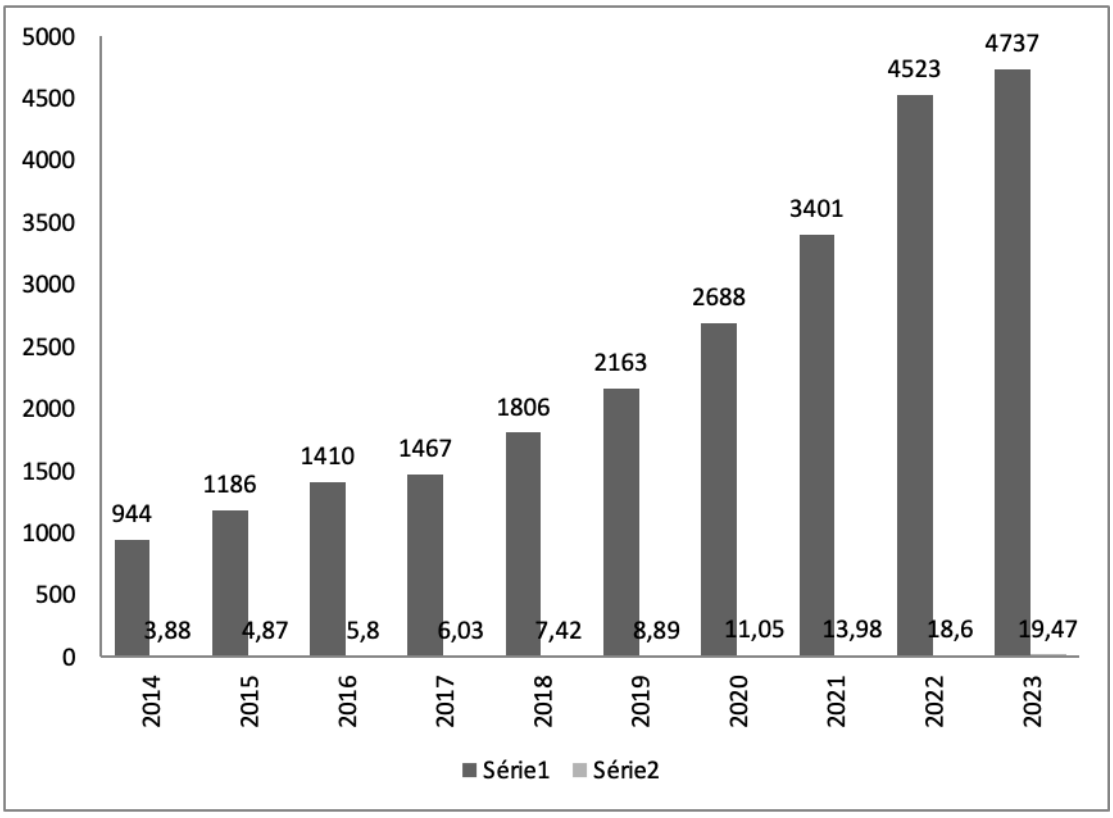
Table 1 - Chronological - wise growth of publication

Year	Publications Count	Publication percentage	Cumulative Publications	Cumulative Percentage
2014	944	3.88	944	3.88
2015	1186	4.87	2130	8.75
2016	1410	5.80	3540	14.55
2017	1467	6.03	5007	20.58
2018	1806	7.42	6813	28.00
2019	2163	8.89	8976	36.89
2020	2688	11.05	11664	47.94
2021	3401	13.98	15065	61.92

2022	4523	18.60	19588	80.52
2023	4737	19.47	24325	100
Total	24325	100		

Table 1 and figure 2 revealed that the year's wise growth of publication on Green technology research. It is employed that a total of 24,325 publications were published from 2014 to 2023 (Ten years), The maximum number of 4737, with (19.47%) was published in the year 2023, followed by 4523 publication with (18.60 %) that was published in the year 2022, and 3401 Publication with 13.98% that were published in the year 2021, The minimum number of 944 publications with (3.88 %) published in the year 2014, since 2014 onwards, the publication gradually increased from 944 to 4737. From the year 2014 to 2023, the growth of research output proved to be very effective, whereas in the beginning of 2014, research slowed down growth in the field of green technology research.

Figure 1. Chronological - wise publications



Language wise distribution of publications

Table 2 - Language wise distribution of publications

Sl. No	Language	Records	Cumulative	Percentage	Cumulative
1	English	24136	24136	99.223	99.223
2	Chinese	107	24243	0.439	99.662
3	German	24	24267	0.098	99.76
4	Spanish	18	24285	0.073	99.833
5	Polish	13	24298	0.053	99.886
6	Portuguese	8	24306	0.032	99.918
7	Italian	3	24309	0.012	99.93
8	Japanese	3	24312	0.012	99.942
9	Czech	2	24314	0.008	99.95
10	Korean	2	24316	0.008	99.958
11	Slovak	2	24318	0.008	99.966
12	Croatian	1	24319	0.004	99.97
13	English Estonian	1	24320	0.004	99.974
14	Estonian	1	24321	0.004	99.978
15	French	1	24322	0.004	99.982
16	Russian	1	24323	0.004	99.986
17	Turkish	1	24324	0.004	99.99
18	Unspecified	1	24325	0.004	100
	Total	24325		100	

The significance of language related to a specific field of knowledge changes from time to time. It is observed that total 18 languages were involved towards publications, Among the research publications on green technology research during 2014- 2023, out of that the English language plays a vital role towards dominating the whole publications of green technology worldwide. Out of 24,325 publications were published in English language were 24136 (99.223%) followed by Chinese language was 107 (0.439%), the third place occupied in German 24 (0.098%) records. Attempts were made to analyze the language of publication as shown in the table since English speaking countries and maximum journals covering the articles on the subject under the study are published in the English language. The English language dominates the other languages for the languages in article published in the journals.

Document type of Publications

Table 3 - Document type of Publications

SL. No	Document type	Records	Cumulative records	percentage	Cumulative records Percentage
1	Article	19280	19280	79.260	79.260
2	Article; Book Chapter	4006	23286	16.468	95.728
3	Article; Data Paper	402	23688	1.652	97.38
4	Editorial Material; Early Access	270	23958	1.109	98.489
5	Article; Early Access	194	24152	0.797	99.286
6	Review; Early Access	29	24181	0.119	99.405
7	Article; Retracted Publication	26	24207	0.106	99.511
8	Item Withdrawal	26	24233	0.106	99.617
9	Article; Proceedings Paper	23	24256	0.094	99.711
10	Biographical Item	15	24271	0.061	99.772
11	Editorial Material	12	24283	0.049	99.821
12	Correction	11	24294	0.045	99.866
13	Book Review	9	24303	0.036	99.902
14	Meeting Abstract	9	24312	0.036	99.938
15	Review	7	24319	0.028	99.966
16	News Item	2	24321	0.008	99.974
17	Reprint	1	24322	0.004	99.978
18	Review; Book Chapter	1	24323	0.004	99.982
19	Letter	1	24324	0.004	99.986
20	Review; Retracted Publication	1	24325	0.004	100
	Total	24325		100	

The above table 3 shows that the document type of distribution of green technology research was done. There are about 20 types of documents published in this study. The study is classified into broad groups articles, Article book Chapter, Review, etc. Most of the contributions 19280 (79.260 %) are articles, followed by article book chapter 4006 (16.468%). By and large it is found that the scholarly communication of green technology research output is found through articles and Article book chapter. The lowest of the contribution 1 (0.004%) Reprint, Review of Book Chapter, Letter, and Review Retracted publication.

Most Prolific Author based on h – Index

Table 4 - Most Prolific Author based on h-Index

Sl. No	H -index	Unit	Citation sum within h-core	All citations	All articles
1	43	Liu Y	5309	6983	183
2	40	Wang Y	4869	6608	179
3	37	Zhang Y	3113	4639	192
4	35	Li Y	4319	5666	171
5	34	Wang J	4146	5126	127
6	33	Li J	3965	5214	140
7	32	Wang L	2412	3533	140
8	31	Zhang L	2716	3484	103
9	31	Kumar A	2854	3638	105
10	30	Zhang J	2686	3418	104

The above table 4 shows that the Hirsch h-index score is a simple quantitative measure reflecting h papers at least h-citation each, with the respite of the publications having at a good number of h -citations. If the h - index score is equal, it measures the number of highly impactful articles published by authors, Bibexcel toolbox is used to identify the h – index of authors and their h index. It is seen from the table that Liu Y has published in 183 articles, a total citation was 6983 and h - index 43. Wang Y has published in 179 articles, 6608 citations and h-index 40, Followed by Zhang Y has published in 192 articles, 4639 citations and h index was 37.

Journal wise distribution of Publications

Table - 5 Journal wise publications

Sl. No.	Name of the Journals	Records	Percentage of Journals	Quartile	Impact Factor	SJR (2023)	Cite score
1	Journal of Cleaner Production	1471	6.04	Q1	9.8	2.06	20.4
2	Sustainability	755	3.10	Q1	3.3	0.67	6.8

3	Environmental Science and Pollution Research	591	2.42	Q1	-	1.01	-
4	Energies	515	2.11	Q1	3.0	0.65	6.2
5	Renewable & Sustainable Energy Reviews	462	1.89	Q1	16.3	3.6	31.2
6	International Journal of Hydrogen Energy	342	1.40	Q1	8.1	1.51	13.5
7	Energy	295	1.21	Q1	15.3	2.11	9.0
8	Applied Energy	263	1.08	Q1	10.1	2.82	21.2
9	Fuel	249	1.02	Q1	6.7	1.45	12.8
10	Science of The Total Environment	230	0.94	Q1	8.2	2	17.6

Above table 5 we found the highly productive journal on green technology research total was 3218 sources. The highest number of 1471 (6.04%) records were produced by the Journal of Cleaner Production followed by Sustainability was 755 (3.10%) and Environmental Science and Pollution Research 591(2.42%) and Energies was 515 (2.11%) records. The least number of 127(0.52%) records was produced by Journal of Environmental Chemical Engineering as well as International Journal of Environmental Research and Public Health, Journal of Membrane Science and Desalination and Water Treatment.

Keywords wise Publications

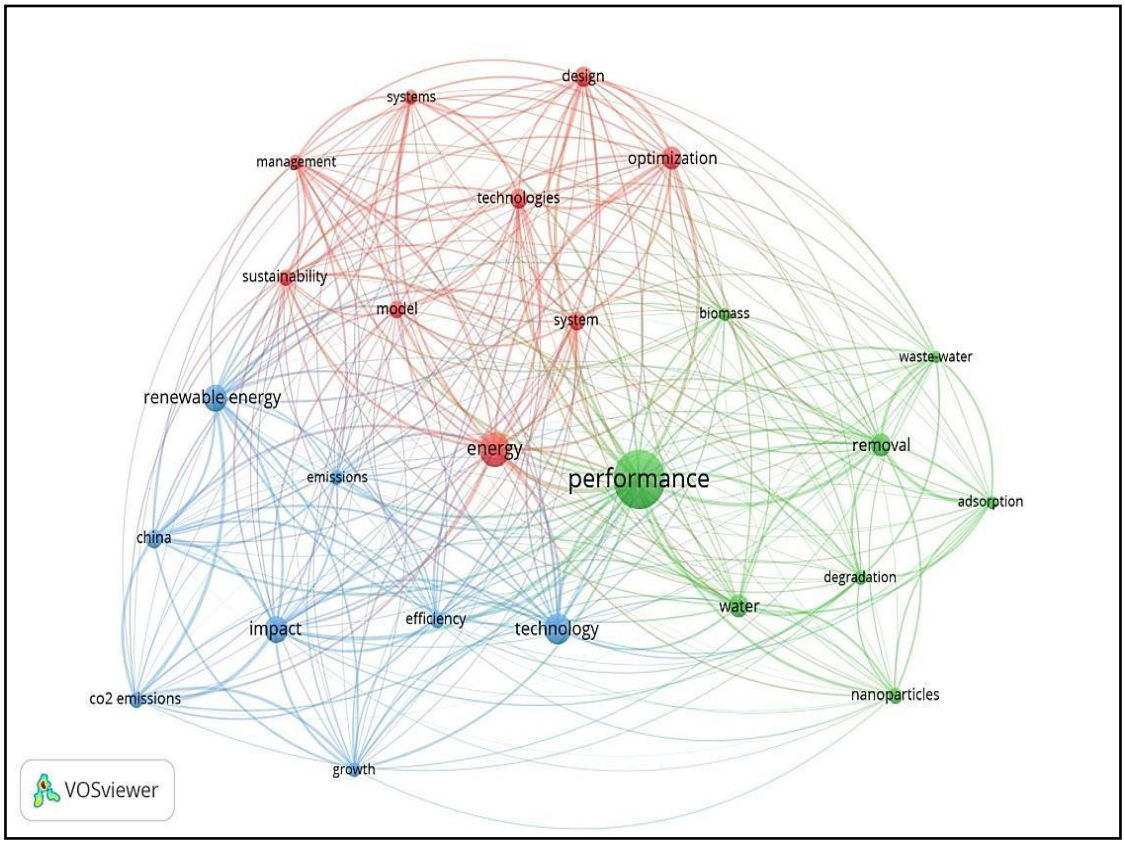
Table 6 - Keywords wise Publication

Sl. No.	Keyword wise	Records	Percentage
1	Performance	2488	10.22
2	Energy	1305	5.36
3	Technology	1236	5.08
4	Impact	1171	4.81
5	Removal	996	4.09
6	Water	937	3.85
7	Technologies	881	3.62
8	Design	866	3.56
9	Optimization	840	3.45

10	System	815	3.35

The above table 6 keyword wise distribution of green technology research has been examined in the top 25 keywords. This study is one of the most important aspects of Scientometric study. It is essential to focus on keywords production to evaluate the research input in green technology research, we found that the highest used keyword was Performance 2488 (10.22%) times to search the other words Energy 1305 (5.36%) and followed by Technology which was used to search about 1236 (5.08%) times. Keyword used impact1171 (4.81%) at the lowest keyword to search for Innovation 501(2.05%) times.

Figure 2. Keywords wise Publications



Publisher wise Publications

Table 7 - Publisher wise Publications

Sl. No	Name of the Publishers	Records	Percentage
1	Elsevier Science Ltd	3141	12.91

2	MDPI	2901	11.92
3	Elsevier	2868	11.79
4	Pergamon Elsevier Science Ltd	2428	9.98
5	Springer	1171	4.81
6	American Chemical Society	941	3.86
7	Wiley	898	3.69
8	Springer Heidelberg	875	3.59
9	Royal Society of Chemistry	648	2.66
10	Elsevier Science Bv	620	2.54

The above table 7 shows that the publisher's wise distribution of publications on green technology research, it is essential to focus on the greatest number of publications and productions to evaluate the research in green technology research. The publisher's wise distribution of publication in top 10 have been selected and tabulated. The majority of the records were published by Elsevier Science Ltd with 3141 (12.91%) followed by MDPI with 2901 (11.92%) publishers. The Elsevier with 2868 (11.79%), among the listed the Pergamon Elsevier Science Ltd with 2428 (9.98%) the lowest publisher was published Public Library Science with 124 (0.50%) the highest publisher compared to others the brief explains the below figure.

Subject wise distribution of publication

Table 8 - Subject wise publication

Sl. No	Name of the Subject	Records	Percentage
1	Environmental Sciences & Ecology	2053	8.43
2	Science & Technology other Topics; Engineering; Environmental Sciences & Ecology	1649	6.77
3	Engineering	1582	6.50
4	Chemistry	1135	4.66
5	Energy & Fuels	1066	4.38

6	Science & Technology Other Topics; Environmental Sciences & Ecology	934	3.83
7	Energy & Fuels; Engineering	825	3.39
8	Science & Technology Other Topics; Energy & Fuels	817	3.35
9	Science & Technology Other Topics	537	2.20
10	Business & Economics	496	2.03

This table 8 indicates the categories representing most of the subject covered under the study during 2014 - 2023. In this table 8 show that the subject field suing Scientometric technique the reason of analyzing the published subject wise green technology research was to identify the presence of the leaning of universal green technology has been classified under 756 major subject areas. Among the subject category wise distribution, highest contribution on green technology research was indexed with Environmental Sciences & Ecology with 2053 (8.43%) subjects, followed by Science and Technology other Topics; Engineering; Environmental Sciences & Ecology with 1649(6.77%) and third position of contributing subject category was Engineering with 1582 (6.50%) other subjects Food Science and Technology and Engineering; Water Resources with 317 (1.52%) respectively. The lowest number of contributing subjects with Physics 181 (0.74%).

Funding Agencies

Table 10 - Funding Agencies

Sl. No	**Name of the Funding Agency**	**Records**	**Percentage**
1	National Natural Science Foundation of China	142	0.58
2	Fundamental Research Funds for the Central Universities	115	0.47
3	Priority Academic Program Development of Jiangsu Higher Education Institutions	70	0.28
4	Natural Sciences and Engineering Research Council of Canada (NSERC)	59	0.24
5	Directorate For Engineering	52	0.21
6	China Scholarship Council	51	0.20

7	CNPQ	48	0.19
8	CAPES	47	0.19
9	China Scholarship Council (CSC)	42	0.17
10	Natural Sciences and Engineering Research Council of Canada	37	0.15

The above table 10 shows the status of financial support for green technology research from the top 25 funding agencies the “National Natural Science Foundation of China” has been identified as a highly funded organization that has funded the highest number of 142 (0.58%) papers in green technology research, followed by “Fundamental Research Funds for the Central Universities” funded by 115 (0.47%) papers, Priority Academic Program Development of Jiangsu Higher Education Institutions funded by 70 (0.28%) papers, and other funding agencies are funded less than 60 papers, which is considerably less.

Collaborative Countries of Publications

Table 11 - Collaborative Countries of Publications

Sl. No	Name of the Collaborative Country		Records	Percentage
1	Peoples R China	USA	744	3.726
2	Peoples R China	UK	394	1.973
3	Australia	Peoples R China	370	1.853
4	Pakistan	Peoples R China	323	1.617
5	UK	USA	213	1.066
6	Canada	Peoples R China	168	0.841
7	India	USA	166	0.831
8	India	South Korea	142	0.711
9	India	Peoples R China	139	0.696
10	Japan	Peoples R China	139	0.696

The majority of the records were published from the Peoples R China which collaborated with the USA with 744 (3.726%) records followed by Peoples R China which collaborated with the UK 394 (1.973%) publications. followed by Australia which collaborated with the Peoples R China 370 (1.853%), India which collaborated with Peoples R China and Japan which collaborated 139 (0.696%) is, respectively. Among the listed, Peoples R China was the highest collaborative country compared to other countries.

Highly Cited Reference

Table 12 - Highly Cited Reference

Sl. No	Highly Cited Reference	DOI	Records	% cited
1	Porter Me, 1995, V9, P97, J Econ Perspect,	10.1257/Jep.9.4.97	337	1.38
2	Shannon Ma, 2008, V452, P301, Nature,	10.1038/Nature06599	243	0.99
3	Elimelech M, 2011, V333, P712, Science,	10.1126/Science.1200488	234	0.96
4	Fujishima A, 1972, V238, P37, Nature,	10.1038/238037a0	214	0.87
5	Acemoglu D, 2012, V102, P131, Am Econ Rev,	10.1257/Aer.102.1.131	210	0.86
6	Pesaran Mh, 2007, V22, P265, J Appl Economet,	10.1002/Jae.951	186	0.76
7	[Anonymous], Thesis	-	168	0.69
8	Pardew Jp, 1996, V77, P3865, Phys Rev Lett,	10.1103/Physrevlett.77.3865	164	0.67
9	Seh Zw, 2017, V355, Science,	10.1126/Science.Aad4998	144	0.59
10	Grossman Gm, 1993, P13, Mexico-U.S. Free Trade Agreement	-	142	0.58

The above table 12 show that the top 25 highly cited reference of each scientific research output with records and the percentages, among them Porter Me, 1995, V9, P97, J Econ Perspect, has secured first place with 337(1.38%) cited records, followed by the second

place of the reference Shannon Ma, 2008, V452, P301, Nature, with 243 (0.99%) cited records, followed by the third place were Elimelech M, 2011, V333, P712, Science, with 234(0.96%) cited records, Grossman Gm, 1993, P13, Mexico-U.S. Free Trade Agreement and Grossman Gm, 1995, V110, P353, Q J Econ, with 142(0.58%) respectively, other reference also cited same records in Baron Rm, 1986, V51, P1173, J Pers Soc Psychol, and Baron Rm, 1986, V51, P1173, J Pers Soc Psychol, with 132 (0.54%) is respectively.

4. Conclusions

Research productivity and collaborative network analysis on green technology research have been examined through the web of science core collection database in a scientometric review from 2014 to 2023. From the study period results, the productivity of green technology publications has an upward from 2014 (944) 3.88 % to 2023 (4737) 19.47%, The highest publication in green technology written by English language 24136 (99.223%), Liu Y and Wang are most prolific authors in green technology published in 183 articles which a total citation was 6983 and h - index 43, The highest number of 1471 (6.04%) records was produced by the Journal of Cleaner Production, the highest used keyword was “Performance” 2488 (10.22%) times to search the other words Energy 1305 (5.36%).etc., Green technology research keyword was used to various publications in green technology it accounted for 24,325 records. This scientometric study will be helpful for green technology research growth, researchers, practitioners, policymakers, and governments for forecasting purposes, to find out the hotspots in green technology research and to make the right decision in the green technology discipline. In conclusion, the authors have suggested that this research can be expanded with the consideration of other databases like Scopus, PubMed, Dimensions, Open Alex, with different period limitations approaches and themes. These are the authenticated databases that provide the authenticated information to conduct further scientometric studies, this research can be expanded with the consideration of other databases like Scopus and PubMed, and these are the authenticated databases that provide the authenticated information to examine further scientometric studies.

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