Greenwashing in Sustainability Reporting: A Bibliometric Review and Direction for Future Research

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Abstract
This article presents a bibliometric analysis of greenwashing in sustainability reporting studies from 2003 to 2023 via five indicators: trend of annual publications, major contributors, current citation pattern, current pattern of cross-country collaboration, and popular themes within the research field. The Scopus database was queried using keywords and search strings associated with greenwashing in sustainability reporting. Biblioshiny and VOSviewer were utilized for our various analyses. We found 332 researchers from 245 different institutions in 45 other countries published 137 papers across 92 sources. Furthermore, this research field is growing as the number of related publications has steadily increased, especially from 2019 to 2023. The top three cited authors in the field are Simone Pizzi, Alfonso Siano, and Wei Wang, while the major contributing authors and affiliations in this research field are in the USA, China, the UK, and Italy.
Keywords: Greenwashing, Sustainability Reporting, Bibliometric, Biblioshiny, VOSviewer

Introduction
As much emphasis has been placed on environmental, social, and sustainability issues by the public in recent years, there is a growing need for companies to conform to societal expectations by practicing greater corporate social responsibility and sustainability and providing products and services that are environmentally friendly, among others. Yet, there are mounting concerns that all may not be as claimed by companies. Hence, the difference between what a company says it does in terms of commitment to sustainability and what the company does as evaluated by external parties is termed greenwashing (Ruiz-Blanco et al., 2021, p.1). There are many forms of greenwashing, such as providing misleading claims about the environmental performance of a company's products. One area that is of growing concern to investors is greenwashing in sustainability reporting because it undermines their confidence in such reports. Therefore, it is important to examine the current state of research in the field.

The first study on greenwashing sustainability reporting was published in 2003 by Laufer (2003), and the number of studies on this topic has increased, especially since 2019. As a result, it is vital to assess current patterns in greenwashing in sustainability reporting academic efforts utilizing a reliable research database.

Bibliometric analysis is regarded as an adequate and possibly unbiased instrument for quantifying the contribution of the publication to knowledge advancement among the various literature review techniques that are currently used (Yang et al., 2013; Yi and Xi, 2008). Bibliometric analysis, which combines the qualitative and quantitative analyses of papers identified by databases employing statistical methods and computational technologies, is a valuable technique for analyzing research trends, key contributors, citation analysis, co-authorship, and co-occurrence of a given academic field (Aleixandre-Benavent et al., 2017; Liu et al., 2019).

Several articles review the literature on greenwashing using bibliometric analysis. For example, Montero-Navarro et al. (2023) focused on greenwashing practices in the food retail, agricultural, and food industry sectors after conducting a bibliometric analysis of 351 publications concerning this practice that were taken from the Web of Science (WoS) database between 2003 and 2020.

Employing the Scopus database, Pendse et al. (2023) examined 355 publications retrieved from the Scopus database between 1996 and 2021 to conduct a bibliometric analysis on greenwashing practices. Additionally, Wang et al. (2023) bibliometrically analyzed 594 papers on greenwashing published between 2004 and 2022 using the WoS database. It is observed that previous bibliometric analyses concentrated on the topic of greenwashing in general. In contrast to the above analyses, the current analysis focuses on a specific area of greenwashing, namely in sustainability reporting disclosures.

Owing to the scarcity of bibliometric reviews on the topic of greenwashing in sustainability reporting, the objective of this study is to conduct a bibliometric analysis of the literature within this research field from its origin to October 2023. This review of research seeks not only to assess the current trend of publication in this scientific field but also to address other important aspects, including the contribution of major players, the citation pattern of publications, and the most popular themes within the research field. Therefore, this study concentrates on the bibliometric analysis of greenwashing in sustainability reporting-related academic papers seeking to address the following questions:

1. What are the current state and trends of publications on greenwashing in the sustainability reporting literature?
2. Who are the most productive contributors in greenwashing in sustainability reporting research?
3. What are the current citation patterns of publications on greenwashing in sustainability reporting?
4. What is the current collaboration pattern among countries in greenwashing in sustainability reporting research?
5. What are the themes involving greenwashing in sustainability reporting that are the most popular among scholars?

To answer the above questions, we analyzed the bibliographic data of 137 documents related to greenwashing in sustainability reporting retrieved from the Scopus database. Specifically, the type of documents; growth patterns of publications; author, country, affiliation, and source contribution; citation analysis; co-authorship analysis of author-affiliated countries; and author keyword co-occurrence analysis within this research field were examined.

This paper adds to the literature on greenwashing in sustainability reporting in different ways. Firstly, it provides an overview of the history of greenwashing in sustainability reporting. It highlights early ground-breaking publications in the field and provides insight into research development. Additionally, it tracks the dramatic growth of publications throughout the past 20 years. Secondly, it outlines the most productive authors, countries, affiliations, and sources for future studies. Determining the leading countries and affiliations, for instance, might function as an indicator of geographical patterns in greenwashing in sustainability reporting studies.

Thirdly, it outlines the citation pattern of greenwashing in sustainability reporting research and identifies the most cited publications within this research field. Research issues on greenwashing in sustainability reporting that are deemed crucial by academia can be recognized by quantitative examinations of the most-cited publications and citation trends, which also provide an overview of greenwashing in the sustainability reporting research environment. Finally, this paper identifies the most occurred keywords used by authors of greenwashing in sustainability reporting research. Understanding the prevailing themes in this field of study will be especially helpful to novice scholars.

Four sections constitute the remaining portion of the paper: methodology, findings, discussion of findings, and conclusions.

Methodology

Faithorne originally used the term "bibliometric" in December 1969 to describe the statistical data regarding the papers that had been published in a particular field or area by revealing and highlighting specific studies, patterns, keywords, citations, and sources of research literature (Broadus, 1987). This implies that bibliometric analysis uses bibliographic data to quantify the features of a body of publications.

This method has two primary purposes: performance analysis and science mapping. The performance of publications is assessed on an individual and institutional basis through performance analysis. The structure and dynamism of scientific areas are revealed through science mapping. The ability of bibliometric analysis to review large numbers of research quantitatively and effectively is one of its key advantages. It directs the scholar to the most relevant publications and provides a systematic, clear, and reliable review of the literature (Aria and Cuccurullo, 2017).

Bibliometric analysis is becoming increasingly common as a technique for identifying studies' trends and patterns (Ahmi and Mohamad, 2019). The categorization of publications by year, author, affiliation, country, or source title allows researchers to gain insight into study patterns. A publication's performance can also be evaluated via matrices, including the count of citations and the average rate of citations per year. Additionally, the publications' state-of-

the-art can be mapped and visualized using a variety of indices, including collaboration and keyword co-occurrence analyses.

The simplicity of downloading data from academic databases (like Scopus, Web of Science, and Dimensions) facilitates the gathering of an extensive collection of relevant documents, as well as the capability for searching throughout a broad range of bibliographic fields (Hassan and Ahmi, 2022). Additionally, the instruments for this type of analysis (like VOSviewer and Biblioshiny) have become more affordable. All these factors contribute to the growing number of investigations that have used bibliometric analysis.

The processes utilized to identify the research for the bibliometric analysis and methods of conducting such a type of data analysis are explained in the following subsection.

Data collection
We accessed bibliographic data for this study from the Scopus database, the largest multi-disciplinary database of peer-reviewed literature in social science research (Bartol et al., 2014; Norris and Oppenheim, 2007). Scopus is widely recognized and frequently accessed for quantitative analyses (Durán-Sánchez et al., 2019; Guerrero-Baena et al., 2014).

Search strategy
Identifying keywords is the first step in the research process. When searching the Scopus database for data on article titles, abstracts, and keywords, we employed the following term: ("greenwashing" AND "sustainability" OR "esg" OR "csr" OR "environmental" OR "nonfinancial" AND "reporting" OR "report" OR "disclosure"). The Scopus database was thoroughly searched from its launch until October 15, 2023. No constraints were placed on the type of document; however, the analysis was limited to documents in the English language and the subject area of "business, management, and accounting". The search protocol is summarized in Figure 1.
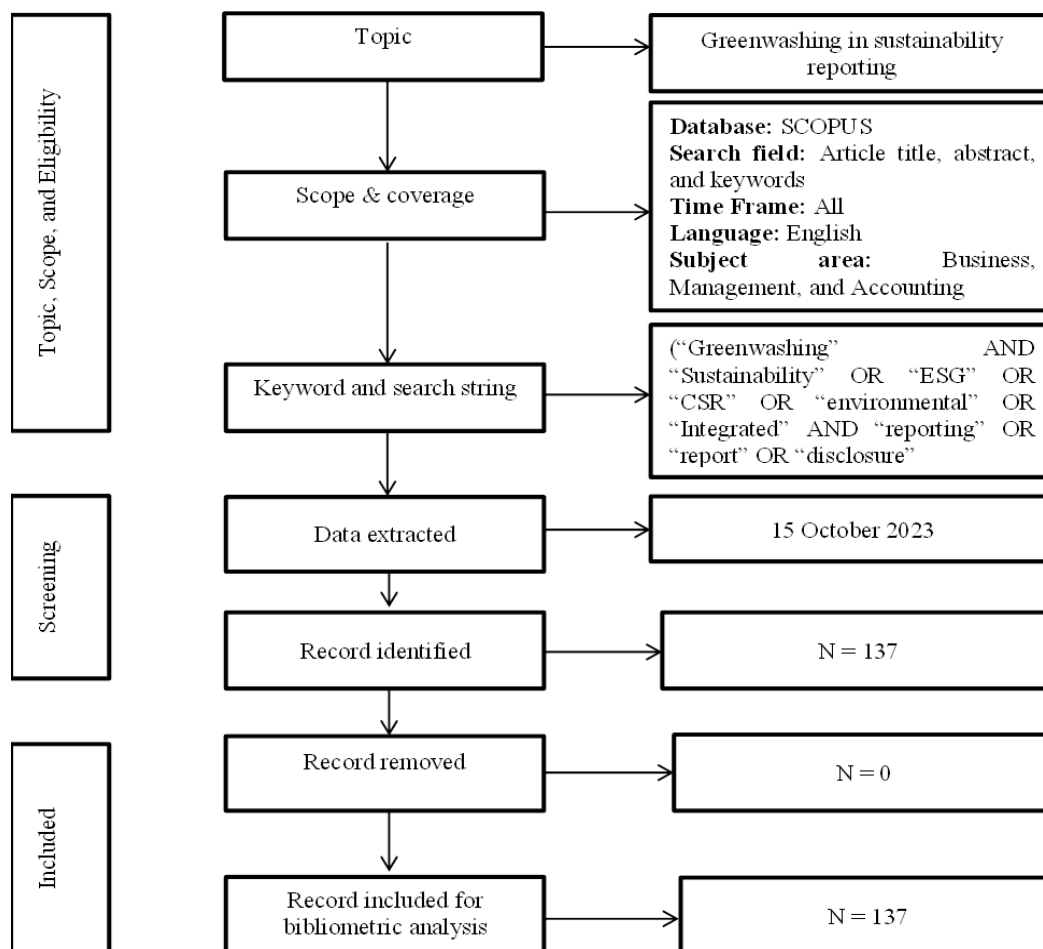
Figure 1: Search protocol

The database provides publication-specific information about the retrieved documents, including their year, type, subject area, language, keywords, title of the source, abstract, affiliation, country, citations, and authorship. All the data collected from the Scopus database was exported into files in the research information systems (.ris) and comma-separated values (.csv) formats.

Data Analysis

To provide insight into the answers to our study questions, we conducted a variety of analyses on the data exported from the database. The first analysis addressed the first research question by analyzing publications according to the year and type of document. To tackle the second research question, the papers were analyzed by author, country, affiliation, and source title in the second analysis. The third research question was answered by identifying the citation metrics and revealing the 10 most frequently cited publications. Most of these analyses were directly obtained through the analyze search results function of the Scopus database. Other analyses were retrieved from data exported to Biblioshiny software that analyzes the bibliographic data in mathematical formats such as percentages. The phases and analyses carried out in this study using Biblioshiny are displayed in Figure 2.

Stage 1: Open RStudio, load 'Bibliometrix' library and run 'Biblioshiny'

Stage 2: Uploading dataset (in .bib format) and conversion to R data frame

Stage 3: Descriptive Analysis

Descriptive Analysis
1. Main Information
2. Annual publication trends
3. Most cited papers
4. Most productive authors
5. Most productive countries
6. Most productive institutions
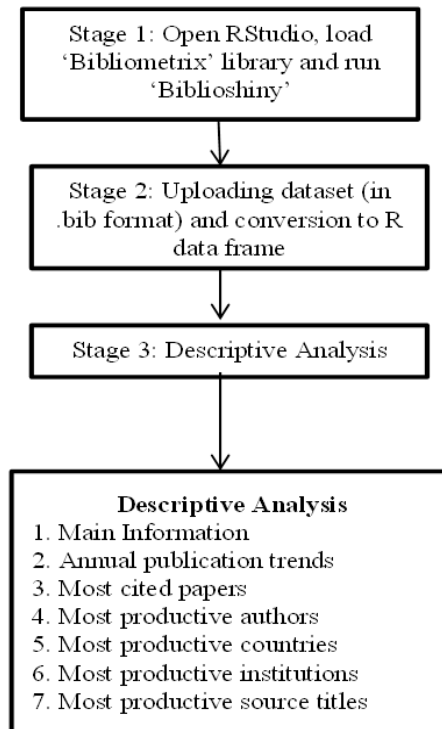7. Most productive source titles

Figure 2: Detail steps for bibliometric analysis using Biblioshiny

Additionally, we mapped and visualized the bibliometric networks using VOSviewer. The fourth research question is addressed by conducting co-authorship analysis among countries. Co-occurrence analysis of the author's keywords was accomplished to answer the final research question. The steps and analyses carried out in this research employing VOSviewer are presented in Figure 3.

Stage 1: Open VOSviewer

Stage 2: Uploading dataset (in .CSV format)

Stage 3: Network Analysis

Co-occurrence analysis
Co-occurrence of author keywords

Collaboration analysis
Co-authorship analysis of countries

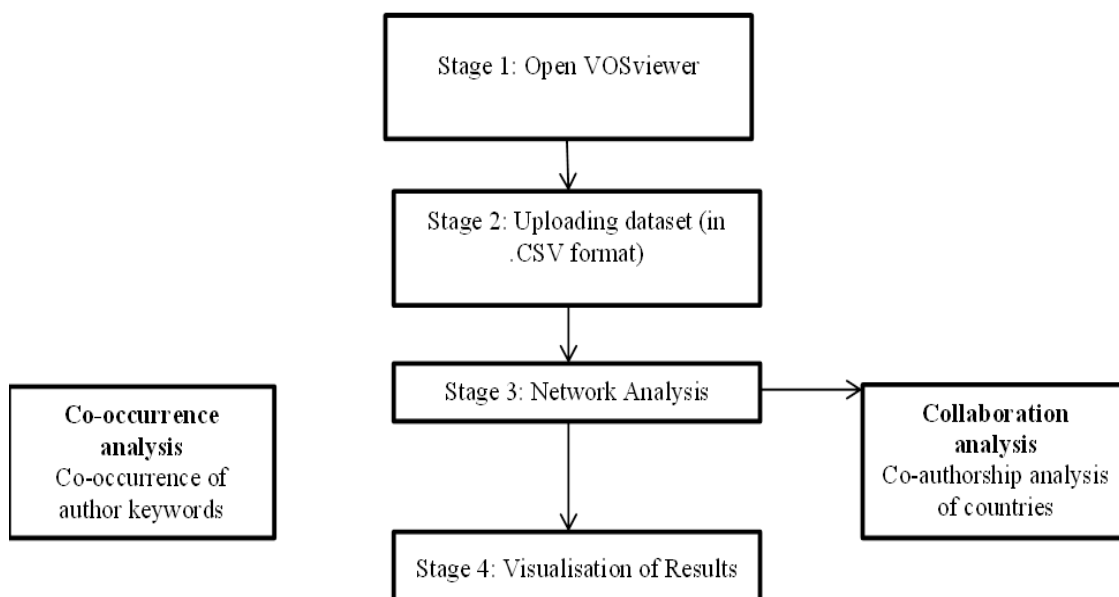Stage 4: Visualisation of Results

Figure 2: Detail steps for bibliometric analysis using Biblioshiny

After identifying, analyzing, and synthesizing the bibliographic data of the retrieved publications, the results are presented in the following section.

Results

To accomplish the research goal and address the research questions established in the present research, the following bibliometric indicators were employed for analyzing publications associated with the greenwashing in sustainability reporting over a period of 20 years: main information, annual publication growth, type of document, productivity of authors, countries, affiliations, source titles, citation metrics, articles with the highest number of citations, collaboration of countries, and co-occurrence analysis of author keywords.

The number of published documents, the average rate of publication by year, the total number of citations, the average rate of citations per document, the average rate of citations per year are displayed in proportion and frequency form. Countries' collaboration and co-occurrence analysis of author keywords are presented through network visualization maps. We employed Biblioshiny, an application for the Bibliometrix R package, to compute the citation metrics, proportions, and frequencies of the publications, and VOSviewer to generate and display the bibliometric networks.

Our bibliometric overview is presented into the formats of descriptive and network analyses. The first analysis discusses the greenwashing in sustainability reporting research profile, including all information on the current trend of publications, most contributing authors, countries, affiliations, source titles, and highly cited papers. Co-occurrence and collaboration analyses in greenwashing in sustainability reporting are included in the second analysis.

Descriptive Analysis

Here we present the main information about publications included in our bibliometric analysis such as number of sources, number of documents, annual growth rate, average citations per document, number of keywords, number of authors, and authors' collaboration.

Main Information

Table 1 provides an overview of every paper that was published on greenwashing in sustainability reporting during the period from 2003 to 2023. It includes details on the number of sources and documents, the average number of citations per document, the contents of documents, and the details and collaboration of authors. This study examines 137 publications on greenwashing in sustainability reporting across 92 sources. The first article addressing greenwashing in sustainability reporting initially arose in the Scopus database in 2003. With a 16.3% yearly growth rate, the number of publications is increasing significantly. At an average citation rate of 33.9 per document, 332 authors produced 137 studies. Merely 16% (n = 22) of the publications were single-authored, with the majority (84%, n = 115) being multi-author studies.

Table 1
Main Information

Timespan	2003 – 2023
Sources (Journals, Books, etc.)	92
Documents	137
Annual Growth Rate %	16.3
Document Average Age	3.34
DOCUMENT CONTENTS	
Keywords Plus (ID)	194
Author's Keywords (DE)	448
AUTHORS	
Authors	332
Authors of single-authored docs	21
AUTHORS COLLABORATION	
Single-authored docs	22
Co-Authors per Doc	2.62
International co-authorships %	30.15

We used the type of document and number of publications and citations per year to analyze the trend of publication in greenwashing in sustainability reporting to respond to the first research question. To compute the data for that analysis, we utilized bibliographic data gathered from the Scopus database. The source type, which demonstrates the kinds of research that are now being conducted in the area of greenwashing in sustainability reporting, is the primary aspect of recognizing the current trend.

Types of Documents
The data is also analyzed in this study according to document type, which can be characterized into several categories, including conference papers, articles, book chapters, reviews, editorials, and notes. As summarized in Table 2, the documents discussing greenwashing in sustainability reporting have been classified into seven categories. As the most used document format, accounting for approximately three-quarters of all publications, journal articles (102) are acknowledged to be the main source of greenwashing on sustainability reporting papers. They were followed by book chapters (13; 9.5%), reviews (9; 6.6%), books (6; 4.4%), and conference papers (5; 3.6%). Less than 1% of the publications comprised other document types, which included notes and editorials.

Table 2
Types of Retrieved Documents (2003 – 2023)

Type of document	Frequency	%
Article	102	74.5
Book Chapter	13	9.5
Review	9	6.6
Book	6	4.4
Conference Paper	5	3.6
Editorial	1	0.7
Note	1	0.7
Total	137	100

The second aspect illustrating the present trend of greenwashing in sustainability reporting is yearly growth. Data on annual growth up to October 2023 are displayed in proportional and frequency form.

Annual Publication Trend
The trend of the growth of the publication throughout time is evaluated by analyzing the papers according to the year of publication (Ahmi and Mohammad, 2019). Table 3 displays annual publishing patterns from 2003 to 2023 along with information on total publications, total citations, and citations per year.

2003 was the initial year in which papers on greenwashing in sustainability reporting were published and included in the Scopus database. About 45 papers on this topic were listed in the Scopus database between 2003 and 2019. It is interesting to note that the number of documents produced on this topic dramatically increased in 2020, with 12 documents being published. From 2020 to 2023, the number grew progressively, indicating increasing attention paid to greenwashing in sustainability reporting.

Table 3
Annual Publication Trend

Year	Total publication	%
2003	2	1.46
2007	1	0.73
2008	1	0.73
2010	2	1.46
2011	1	0.73
2012	3	2.19
2013	2	1.46
2014	2	1.46
2015	8	5.84
2016	4	2.92
2017	6	4.38
2018	7	5.11
2019	6	4.38
2020	12	8.76
2021	16	11.68
2022	20	14.60
2023	44	32.12
Total	137	100

As shown in Figure 4, there was a fluctuation in the number of documents published each year during the period from 2003 to 2019, and there were not more than nine documents released annually during this period. Meanwhile, there was a sharp growth in the number of documents published per year after 2019. More than half (66.4%) of the retrieved documents were published during the period from 2020 to 2023. The growing body of research suggests that the field of study on greenwashing in sustainability reporting is expanding and has further room for development.
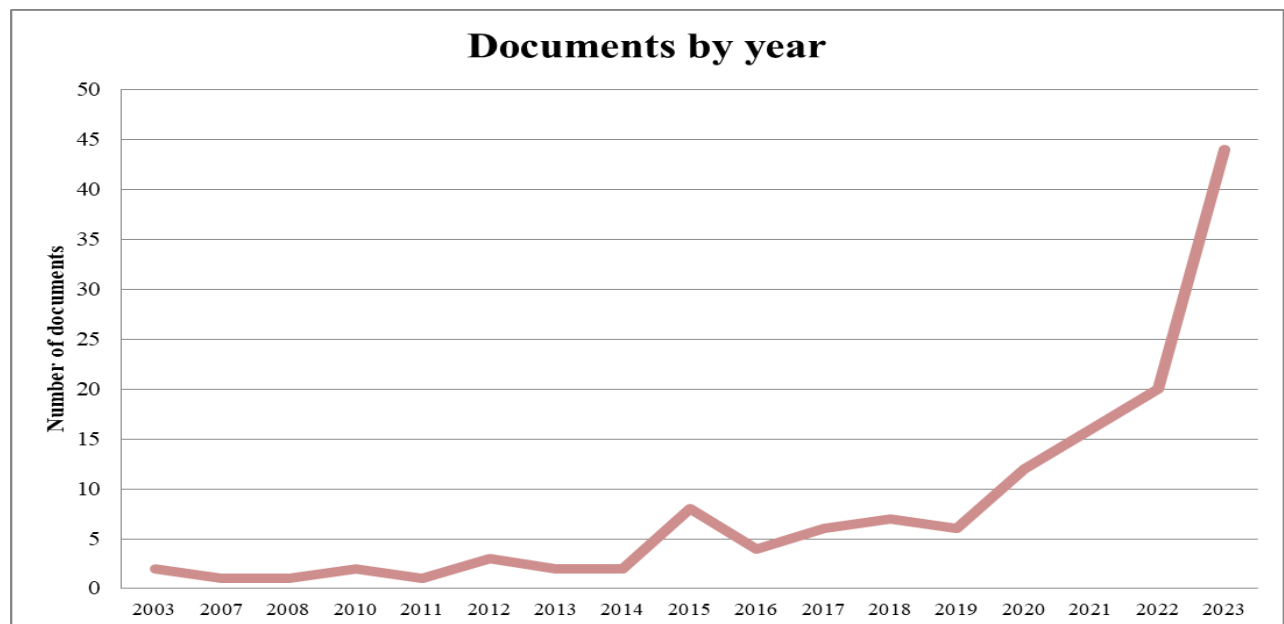
Figure 4: Number of documents by year

We recognize the influential authors, countries, affiliations, and sources with the most publications on greenwashing in sustainability reporting until 2023 to identify the top contributors to the study issue.

Most Productive Authors
Expertise in a certain topic can be inferred from an author's publication frequency (Omoregbe et al., 2020). According to our database, 332 scholars in total contributed to the publications on the topic of greenwashing in sustainability reporting between 2003 and 2023. The most influential authors in this subject, with a minimum number of three published documents, are listed in Table 4. With three papers each, Simone Pizzi, Alfonso Siano, and Wei Wang were the authors with the greatest number of publications on greenwashing in sustainability reporting.

Table 4
The authors with Minimum Productivity of 3 Documents in the Field of Greenwashing in Sustainability Reporting (2003 - 2023)

Author	Articles
Pizzi, S.	3
Siano, A.	3
Wang, W.	3

Most Productive Countries
Based on our findings, 45 different countries contributed to publishing at least one document on greenwashing in sustainability reporting research field during the period from 2003 to 2023. Among these nations, only 13 have a minimum of 5 published documents related to this research field, as shown in Table 5. The USA had the first highest number of documents (69 documents), total citations (2,049 citations), and average citation rate per document (97.6). While China had the second largest number of documents (218 articles), UK has the second highest number of total citations, and Germany had the second highest average rate

of citation per document (73.6). Notably, the USA contributed to approximately half of the retrieved documents.

Table 5
Countries with a Minimum Productivity of 5 Documents in the Field of Greenwashing in Sustainability Reporting (2003- 2023)

Rank	Country	Documents	%	Total citation	Average article citation
1	USA	69	50.4	2,049	97.6
2	China	31	22.6	103	8.6
3	UK	28	20.4	472	59
4	Italy	22	16.1	282	25.6
5	Australia	14	10.2	48	12
6	France	13	9.5	82	82
7	Spain	10	7.3	63	12.6
8	Canada	8	5.8	42	8.4
9	Netherlands	8	5.8	21	7
10	Germany	6	4.4	368	73.6
11	India	6	4.4	1	0.3
12	Poland	6	4.4	0	0
13	Sweden	5	3.6	21	10.5

Most Productive Affiliations
Similarly, we utilized Biblioshiny to identify the most active institutions. Greenwashing in sustainability reporting research was found to have been actively undertaken by 245 institutions in total, but only four of these institutions had at least three publications on research associated with greenwashing in sustainability reporting. The most active institutions are displayed in Table 6, along with the number of publications that each one has issued. For simplicity, this table includes only the institutions with a minimum of three publications in the field of greenwashing in sustainability reporting from 2003 to 2023. The University of Salerno, with a total of six publications, is the most active institution in publishing papers associated with greenwashing in sustainability reporting, followed by Deakin University (three documents), Stockholm Environment Institute (3 documents), and Zhongnan University of Economics and Law (three documents).

Table 6
Institutions with Minimum Productivity of three Documents in Greenwashing in Sustainability Reporting (2003 – 2023)

Rank	Affiliation	Documents	%
1	University of Salerno	6	4.4
2	Deakin University	3	2.2
3	Stockholm Environment Institute	3	2.2
4	Zhongnan University of Economics and Law	3	2.2

Most Productive Source Titles

It is shown by the source analysis that the 173 chosen publications on greenwashing in sustainability reporting examined in this study were published in 92 sources. According to the total number of papers published on the topic between 2003 and 2023, Table 7 lists the most productive sources with a minimum publication number of five documents. Of the 173 documents, 27% were published by these sources. In terms of overall publications, Corporate Social Responsibility and Environmental Management (12, 8.8%) is obviously the most productive source, followed by Business Strategy and the Environment (7, 5.1%), the Journal of Cleaner Production (7, 5.1%), and the Journal of Business Ethics (6, 4.4%).

Table 7
Journal names with Minimum Productivity of Five Publications in Greenwashing in Sustainability Reporting (2003 – 2023)

Rank	Journal name	Articles	%
1	Corporate Social Responsibility and Environmental Management	12	8.8
2	Business Strategy and the Environment	7	5.1
3	Journal of Cleaner Production	7	5.1
4	Journal of Business Ethics	6	4.4
5	Sustainability Accounting, Management and Policy Journal	5	3.6

As it is vital to show the number of publications issued by each source, it is also important to show the number of times that publications from each source are cited. In terms of the number of citations, Table 8 shows the titles of journals with a minimum of 100 citations. Although the number of articles published in the Journal of Business Ethics is half that published in Corporate Social Responsibility and Environmental Management in the field of greenwashing in sustainability reporting, the articles published in the former journal of this research field are cited more than documents published in other journals. This shows that researchers on the topic of greenwashing in sustainability reporting pay more attention to the articles published in the Journal of Business Ethics.

Table 8
Journal names with a Minimum of 100 Citations in Greenwashing in Sustainability Reporting (2003 – 2023)

Rank	Journal name	Citations
1	Journal of Business Ethics	1,321
2	Organization Science	614
3	Journal of Economics and Management Strategy	578
4	Critical Perspectives on Accounting	323
5	Journal of Cleaner Production	242
6	Corporate Social Responsibility and Environmental Management	237
7	Journal of Business Research	231
8	Tourism Management	219
9	Research In International Business and Finance	170
10	Business Strategy and the Environment	164

We presented the citation trend of 137 documents and identifying the 10 most referenced documents on the subject of greenwashing in sustainability reporting, enabling us to address the third question, which is concerned with the citation pattern of the study issue.

Citation Trend

By utilizing the number of citations from other publications, we used citation analysis to determine the influence of greenwashing in sustainability reporting publications (Baker et al. 2020). Table 9 presents the citation trend for the papers retrieved on October 15, 2023. It is demonstrated that 2003 was the most productive year in terms of citations. A total of 746 citations have been assigned to the papers published during that year. Documents produced in 2011 had the highest average rate of citations per document, as these documents were cited no fewer than 578 times. Based on citations per year, 2020 (154.67) and 2022 (225) were the most impactful years.

Throughout the whole study period, there were 5154 recorded citations, with an average of 258 citations annually and an average of 37.62 per document for the 137 publications retrieved.

Table 9
Citation Trend

Year	Citations	%	Per document	Per year
2003	746	14.47	373	37.3
2007	13	0.25	13	0.81
2008	13	0.25	13	0.87
2010	176	3.41	88	13.54
2011	578	11.21	578	48.17
2012	250	4.85	83.33	22.73
2013	327	6.34	163.5	32.7
2014	277	5.37	138.5	30.78
2015	600	11.64	75	75
2016	471	9.14	117.75	67.29
2017	322	6.25	53.67	53.67
2018	268	5.20	38.29	53.6
2019	52	1.01	8.67	13
2020	464	9.00	38.67	154.67
2021	255	4.95	15.94	127.5
2022	225	4.37	11.25	225
2023	117	2.27	2.66	117
Total	5154	100	257.7	37.62

Top Cited Documents

Citation frequency, which indicates the level of recognition a publication receives in a particular study field and may represent the scholarly contribution of the paper, can be utilized to assess the significance of an article (Yoshikane, 2013). It also establishes the article's level of popularity (Guo et al., 2021). Table 10 displays the overall number of citations and the average rate of citations on a yearly basis for the ten most cited retrieved publications

based on Scopus. All ten most cited publications are research articles. The article that can be considered the foundation for the major body of research on greenwashing in sustainability reporting is "*Social Accountability and Corporate Greenwashing,*" published by Laufer in the Journal of Business Ethics in 2003. This article garnered the most citations, with a total of 720. Meanwhile, the article entitled "*Greenwash: Corporate environmental disclosure under threat of audit*", with 43.5 citations per year, published by Lyon and Maxwell in the Journal of Economics and Management Strategy in 2011, was the most influential based on the average rate of citations per year. Three of the ten most cited articles of the research field of the greenwashing in sustainability reporting have been published in the Journal of Business Ethics.

Table 10

Top 10 Cited Documents in Greenwashing Literature (2003 – 2024)

Rank	Title	Publication year	Author(s)	Journal name	Total citations	Average citations per year
1	Social Accountability and Corporate Greenwashing	2003	Laufer W.S.	Journal of Business Ethics	720	34.3
2	Greenwash: Corporate environmental disclosure under threat of audit	2011	Lyon T.P., Maxwell J.W.	Journal of Economics and Management Strategy	565	43.5
3	Scrutiny, norms, and selective disclosure: A global study of greenwashing	2016	Marquis C., Toffel M.W., Zhou Y.	Organization Science	346	28.8
4	A research note on standalone corporate social responsibility reports: Signaling or greenwashing?	2013	Mahoney L.S., Thorne L., Cecil L., LaGore W.	Critical Perspectives on Accounting	317	27.1
5	Legitimizing Negative Aspects in GRI-Oriented Sustainability Reporting: A Qualitative Analysis of Corporate	2014	Hahn R., Lulfs R.	Journal of Business Ethics	271	27.4

	Disclosure Strategies					
6	Greenwash vs. Brownwash: Exaggeration and undue modesty in corporate sustainability disclosure	2015	Kim E.-H., Lyon T.P.	Organization Science	247	31.4
7	"More than words": Expanding the taxonomy of greenwashing after the Volkswagen scandal	2017	Siano A., Vollero A., Conte F., Amabile S.	Journal of Business Research	220	18
8	Corporate social responsibility: The disclosure-performance gap	2012	Font X., Walmsley A., Cogotti S., McCombes L., Hausler N.	Tourism Management	216	19.6
9	How the Market Values Greenwashing? Evidence from China	2015	Du X.	Journal of Business Ethics	176	26.5
10	CSR Performance and the Readability of CSR Reports: Too Good to be True?	2018	Wang Z., Hsieh T.-S., Sarkis J.	Corporate Social Responsibility and Environmental Management	159	39.3

Network Analysis

VOSviewer is used to visualize bibliometric networks since it is simple to use and provides a wide range of visualization alternatives. This software generates a network visualization map where units that belong to a single cluster, the amount of contribution or citations, and their respective linkage (collaboration) strength are represented, respectively, by color, size of the circle, and line thickness. In this study, VOSviewer is employed to generate maps displaying the network of collaboration between countries and the co-occurrence of author keywords.

Collaboration of Countries
A network map of the cooperation among countries is presented in Figure 6. Irrespective of the number of citations retrieved, we included all nations with at least five publications in our selection. Based on the fractional counting technique, a network visualization map is created. There are 13 countries with a minimum of five publications, but there are two countries with zero link strength; therefore, only 11 countries are displayed on the map and arranged into five distinct clusters, each of which is colored differently. For instance, the UK, Canada, and the Netherlands are within a cluster of red-colored nations. China and Australia are clustered in green, while France and Spain are clustered in blue. The yellow cluster contains the USA and Germany, whereas the purple cluster includes Italy and Poland.

A country's node size in a network visualization map represents the number of published documents; larger nodes imply a greater number of publications (Li et al., 2019). The lines that connect the nodes depict the collaboration between nations, and the degree of thickness of these lines indicates how frequently each nation cooperates on co-authorship projects (van Eck and Waltman, 2017). The distance of the connecting lines determines how similar two countries' research interests are to one another. The less distance that exists between the two nations, the more comparable they are (van Eck and Waltman, 2010).

Despite not being the country with the highest number of publications and citations, Figure 5 illustrates how UK scholars are fostering collaboration, preceded by the USA and Canada. These three dominant nations collaborate closely with each other as well as with others like China and the Netherlands. It is important to point out that France and Italy are not ranked at the first positions in the collaboration network visualized map of countries, even though their authors contribute significantly to the context of the number of papers and citations.
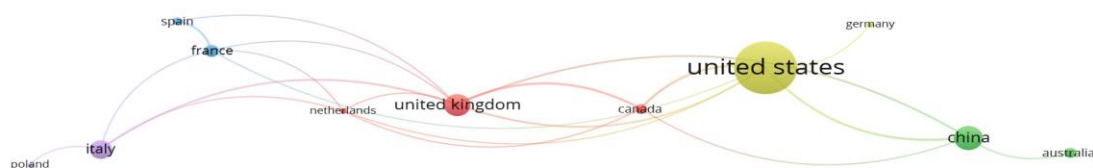

Figure 4: Number of documents by year

Finding the most common themes among academics studying greenwashing in sustainability reporting is the focus of the final research question. We employed author keyword co-occurrence analysis in VOSviewer to answer this question.

4.2.2- Co-occurrence of author keywords: A paper's keywords reflect its main ideas (Comerio and Strozzi, 2019). When both keywords appear in a document simultaneously, they are regarded as co-occurring, suggesting a connection between the two viewpoints. Consequently, the co-occurrence analysis of keywords is essential for examining current issues and advancements in a particular field (Wang et al., 2018).

The fourth research question concentrates on determining the common themes among academics studying greenwashing in sustainability reporting. We employed keyword co-occurrence analysis in the VOSviewer software, which is a tool for generating and visualizing bibliometric networks that show the strength of the association between keywords in terms of color, font, circle size, and line thickness, to answer this research question. Large circles and text fonts are used to indicate keywords that are used more frequently (Vošner et al., 2016). The degree of association between keywords is indicated by the colour of the lines linking them (Danvila-del-Valle et al., 2019).

Our analysis yielded a full set of 447 keywords with 718 co-occurrences. The visualization map created by VOSviewer of the authors' keywords, each of which had at least ten occurrences, is shown in Figure 6. It can be observed that greenwashing, which is illustrated in the map with the largest circle, is the most frequent word in this research field. It can also be indicated that greenwashing, sustainable development, sustainability reporting, disclosure, and ESG, which are all depicted in the diagram in green, are all closely related and commonly occurring together.
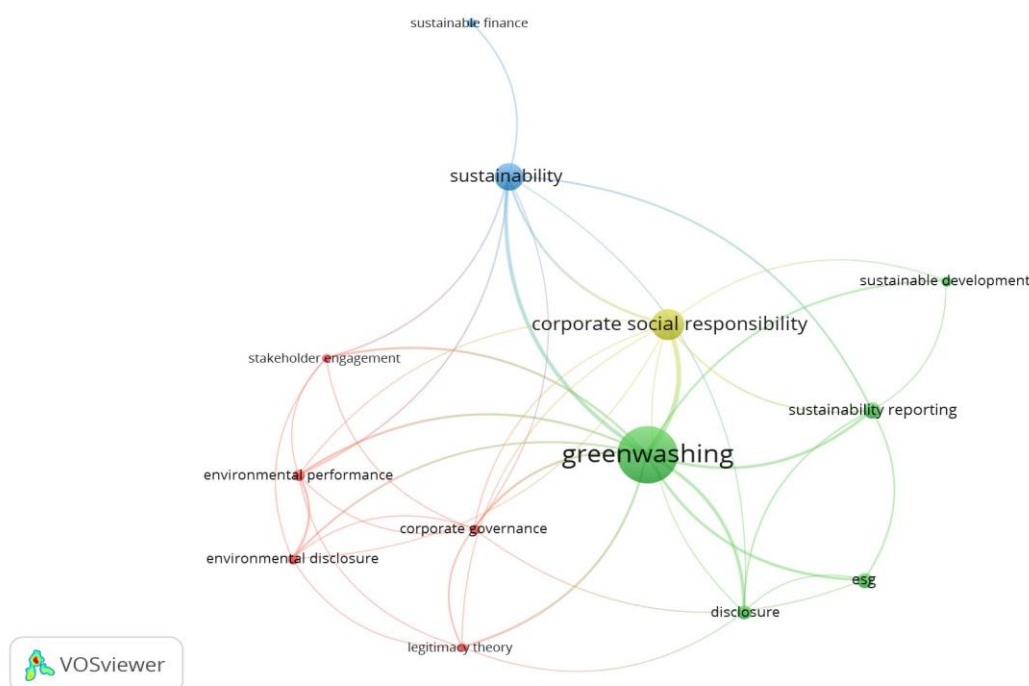

Figure 6: Network visualization map of author keywords co-occurrence with at least 5 occurrences created by VOSviewer.

Discussion

Using bibliometric analysis, this study reviewed the published research on greenwashing in sustainability reporting during the previous 20 years. A small body of literature pertaining to the greenwashing in sustainability reporting was found through this bibliometric review, which included 137 Scopus-indexed papers published throughout the period from 2003 to 2023. We discuss the review's results in this section.

The paper's first question focuses on analyzing the current trends in the field of greenwashing in sustainability reporting. This question is addressed by analyzing the type of document, annual publication growth, and annual citation trend. In contrast to other forms of documents, roughly three-quarters of the documents are articles.

The descriptive analysis sheds light on the present research trend regarding greenwashing in sustainability reporting. Throughout the study period, there was a steady rise in the amount of literature on greenwashing in sustainability reporting. The research on greenwashing in sustainability reporting has shown an upward trend, as evidenced by the growing number of publications each year, starting in 2003 with Laufer's (2003) article entitled "Social Accountability and Corporate Greenwashing". This trend stabilized until 2019, after which there was a proliferation of academic papers published in the subsequent years. This supports the finding that more academics are likely to focus on investigating greenwashing in sustainability reporting in the future.

Regarding research on greenwashing in sustainability reporting, the current analysis found that documents published in 2003 are the most cited, with an overall number of citations higher than that of more recent publications. As evidenced by the large number of citations that some articles published following 2019 have received, these publications might ultimately be recognized as "scientific classics".

The second research question is concerned with recognizing the most productive contributors in greenwashing in sustainability reporting. Based upon analyzing bibliographic data extracted from the Scopus database, it was found that Simone Pizzi, Alfonso Siano, and Wei Wang are the most productive authors, with each of them contributing three publications. Of the papers on the subject of greenwashing in sustainability reporting published between 2003 and 2023, half of them originated from authors in the USA. A wide range of funding sources and a sizable network of active scholars play a great role in this significant contribution from the USA (Shadgan et al., 2010).

It has also been demonstrated that there is a global interest in investigating greenwashing in sustainability reporting that goes beyond the United States and some European countries. Countries like China, Australia, Canada, and India have also generated research on this subject. Despite this, it is observed that a relatively small number of studies emerged from developing countries in the Middle East, Africa, and South America. Promoting and carrying out research on this subject in emerging nations is necessary.

It is also implied that the University of Salerno in Italy is affiliated with the greatest contribution in the field of greenwashing in sustainability reporting. Regarding the source analysis, it is shown that Corporate Social Responsibility and Environmental Management,

which had the highest number of publications (12), is the most common source for publications that address greenwashing in sustainability reporting. Meanwhile, the journal with the greatest number of citations (1,321) was the Journal of Business Ethics, which also issued three of the 10 most cited articles within this research field.

Recognizing the current citation patterns of publications on greenwashing in sustainability reporting is the main emphasis of the third research question. This can be illuminated by the citation metrics that are discussed in this study and by identifying the most cited publications within this research field. As of this writing, there were 5,154 citations for the 137 documents that were retrieved from the Scopus database. They are generally cited 257.7 times annually, with an average of 37.62 citations per publication. For the most cited publications within the greenwashing in sustainability reporting, Laufer's (2003) paper, which was published in the Journal of Business Ethics in 2003, has received the most citations to date, followed by Lyon and Maxwell (2011) and Marquis et al. (2016).

The fourth research question relates to the current collaboration pattern among countries in greenwashing in sustainability reporting research. The co-authorship analysis of countries generated by VOSviewer revealed that, despite the majority of publications in this field of study being generated by American academic institutions, scholars from the UK were the primary contributors to international collaboration. Finally, to address the final question regarding identifying the most popular themes among scholars of the research field of greenwashing in sustainability reporting, the keyword co-occurrence analysis through VOSviewer was conducted. Five fundamental themes emerged from this analysis: "greenwashing", "sustainable development", "sustainable reporting", "disclosure," and "ESG".

Conclusion

Scholars and the public have become increasingly aware of the detrimental impact that greenwashing in sustainability reporting has had on the capital market. Given the growing number of articles about greenwashing sustainability reporting, bibliometric analysis helps analyze research trends in this topic by analyzing the current status of publishing, the pattern of citation, and the popular keywords within this research field. The bibliometric profile on the growth and advancement of greenwashing in sustainability reporting studies was presented in this paper by conveying the quantity (for example, types of documents and the number of publications by year, author, country, affiliation, and source title), quality (for instance, citation indicators and number of citations), and network maps (e.g., co-authorship analysis of author-affiliated countries and co-occurrence analysis of author keywords) based on 137 papers retrieved from the Scopus database.

Generally, there has been significant growth in the number of documents on greenwashing in sustainability reporting from two documents at the beginning of the period in 2003 to 44 articles in 2023 by 332 authors in 45 different countries, 245 affiliations and 92 sources. The findings showed a significant rise in the production of researchers throughout the previous four years. In other words, there is growing interest in this research subject, with an upward trajectory in the coming years.

Based on the quantity of publications, Simone Pizzi, Alfonso Siano, and Wei Wang were the most prolific scholars. The USA was at the forefront of the contributing countries. The University of Salerno in Italy was the most contributing affiliation. The journal with the highest productivity was *Corporate Social Responsibility and Environmental Management*.

In terms of the number of citations, the *Journal of Business Ethics* was the most cited journal, and one of the articles published in this journal, by Laufer (2003), was the most cited article within the research field.

The co-authorship analysis of author-affiliated countries has revealed that the UK has played a key role in generating collaborative research in this research field. The co-occurrence analysis of author keywords has indicated that themes including greenwashing, sustainable development, sustainable reporting, disclosure, and ESG are popular in this research field.

Although bibliometric analysis yields valuable insights, its results may be limited by various factors, including the database utilized, the search keywords and strings chosen, the names of authors or institutions, the document language, and the bibliometric metrics applied to the chosen publications.

Though Scopus is one of the biggest research databases, it should be noted that some journals are still not indexed, which means that articles published in these journals may have been unrecognized. Additionally, journal articles are covered more thoroughly by Scopus than books and conference proceedings. Future studies may take advantage of more databases, such as Web of Science, Google Scholar, Dimensions, and others. Combining all these databases can lead to valuable and interesting outcomes.

Furthermore, no search keyword or string is perfect and capable of capturing every single article on a subject. However, we have sought to make our search string as comprehensive as possible. Also, authors or affiliations might have several names or a distinct spelling of their names. This could lead to inaccuracies in these authors' or affiliations' productivity, although we have endeavored to minimize this by manually crosschecking authors and affiliations.

Studies on greenwashing in sustainability reporting that are published in languages other than English are not analyzed in this study. Applying the citation count in evaluating the research effect may not accurately reflect the quality of each study because of the changing dynamics of this index, which provides older publications an edge over more recent ones.

Regardless of these shortcomings, this investigation advances our knowledge of the patterns of greenwashing in sustainability reporting research and publications. It broadens and extends earlier findings on the greenwashing in sustainability reporting literature by employing bibliometric techniques, which allowed us to recognize the dynamics of this topic throughout the years. This paper yields various intriguing findings that demonstrate the growing interest that academics worldwide have in the topic of greenwashing in sustainability reporting, as well as crucial insights for academicians and scholars in this research field.

References

Ahmi, A., and Mohamad, R. (2019), "Bibliometric analysis of global scientific literature on web accessibility", *International Journal of Recent Technology and Engineering*, Vol. 7 No. 6, pp.250–258.

Aleixandre-Benavent, R., Aleixandre-Tudó, J. L., Castelló-Cogollos, L., and Aleixandre, J. L. (2017). "Trends in scientific research on climate change in agriculture and forestry subject areas (2005–2014)", *Journal of Cleaner Production*, Vol. 147, pp. 406-418.

Aria, M., and Cuccurullo, C. (2017), "Bibliometrix: An R-tool for comprehensive science mapping analysis", *Journal of Informetrics*, Vol. 11, No. 4, pp.959-975.

Baker, H. K., Pandey, N., Kumar, S., and Haldar, A. (2020), "A bibliometric analysis of board diversity: Current status, development, and future research directions", *Journal of Business Research*, Vol. 108, pp.232-246.

Bartol, T., Budimir, G., Dekleva-Smrekar, D., Pusnik, M., and Juznic, P. (2014), "Assessment of research fields in Scopus and Web of Science in the view of national research evaluation in Slovenia", *Scientometrics*, Vol. 98 No. 2, pp.1491-1504.

Broadus, R. N. (1987), "Toward a definition of "bibliometrics". *Scientometrics*, Vol. 12 No. 5, pp.373-379.

Comerio, N., and Strozzi, F. (2019), "Tourism and its economic impact: A literature review using bibliometric tools", *Tourism Economics*, Vol. 25, No. 1, pp.109-131.

Du, X. (2015), "How the market values greenwashing? Evidence from China", *Journal of Business Ethics*, Vol. 128, pp. 547-574.

Durán-Sánchez, A., Del Río, M. D. L. C., Álvarez-García, J., and García-Vélez, D. F. (2019), "Mapping of scientific coverage on education for Entrepreneurship in Higher Education", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 13, No.1/2, pp. 84-104.

Font, X., Walmsley, A., Cogotti, S., McCombes, L., and Häusler, N. (2012), "Corporate social responsibility: The disclosure–performance gap", *Tourism Management*, Vol. 33, No. 6, pp.1544-1553.

Guerrero-Baena, M. D., Gómez-Limón, J. A., and Fruet Cardozo, J. V. (2014), "Are multi-criteria decision making techniques useful for solving corporate finance problems? A bibliometric analysis", *Revista de Metodos Cuantitativos para la Economia y la Empresa*, No. 17, pp.60-79.

Guo, Y. M., Huang, Z. L., Guo, J., Guo, X. R., Li, H., Liu, M. Y., Ezzeddine, S. and Nkeli, M. J. (2021), "A bibliometric analysis and visualization of blockchain", *Future Generation Computer Systems*, Vol. 116, pp.316-332.

Hahn, R., and Lülfs, R. (2014), "Legitimizing negative aspects in GRI-oriented sustainability reporting: A qualitative analysis of corporate disclosure strategies", *Journal of Business Ethics*, Vol. 123, pp.401-420.

Hassan, S., and Ahmi, A. (2022), "Mapping the state of the art of scientific production on requirements engineering research: A bibliometric analysis", *International Journal of Information Technologies and Systems Approach (IJITSA)*, Vol. 15, No. 1, pp.1-23.

Kim, E. H., and Lyon, T. P. (2015), "Greenwash vs. brownwash: Exaggeration and undue modesty in corporate sustainability disclosure", *Organization Science*, Vol. 26, No. 3, pp.705-723.

Laufer, W. S. (2003), "Social accountability and corporate greenwashing", *Journal of Business Ethics*, Vol. 43, pp.253-261.

Li, H., Jiang, H. D., Yang, B., and Liao, H. (2019), "An analysis of research hotspots and modeling techniques on carbon capture and storage", *Science of the Total Environment*, Vol. 687, pp.687-701.

Liu, W., Wang, J., Li, C., Chen, B., and Sun, Y. (2019), "Using bibliometric analysis to understand the recent progress in agroecosystem services research", *Ecological Economics*, Vol. 156, pp.293-305.

Lyon, T. P., and Maxwell, J. W. (2011), "Greenwash: Corporate environmental disclosure under threat of audit", *Journal of Economics & Management Strategy*, Vol. 20, No. 1, pp. 3-41.

Mahoney, L. S., Thorne, L., Cecil, L., and LaGore, W. (2013), "A research note on standalone corporate social responsibility reports: Signaling or greenwashing?" *Critical Perspectives on Accounting*, Vol. 24, No. 4-5, pp.350-359.

Marquis, C., Toffel, M. W., and Zhou, Y. (2016), "Scrutiny, norms, and selective disclosure: A global study of greenwashing", *Organization Science*, Vol. 27, No. 2, pp.483-504.

Montero-Navarro, A., González-Torres, T., Rodríguez-Sánchez, J. L., and Gallego-Losada, R. (2021), "A bibliometric analysis of greenwashing research: A closer look at agriculture, food industry and food retail", *British Food Journal*, Vol. 123, No. 13, pp.547-560.

Norris, M., and Oppenheim, C. (2007), "Comparing alternatives to the Web of Science for coverage of the social sciences' literature", *Journal of Informetrics*, Vol. 1, No. 2, pp.161-169.

Pendse, M. K., Nerlekar, V. S., and Darda, P. (2023), "A comprehensive look at Greenwashing from 1996 to 2021: a bibliometric analysis", *Journal of Indian Business Research*, Vol. 15, No. 1, pp.157-186.

Pritchard, A. (1969), "Statistical bibliography or bibliometrics", *Journal of Documentation*, Vol. 25, No. 4, pp.348- 349.

Ruiz-Blanco, S., Romero, S., Fernandez-Feijoo, B. (2022), "Green, blue or black, but washing – what company characteristics determine greenwashing?" *Environment, Development and Sustainability,* Vol. 24, pp.4024-4055.

Shadgan, B., Roig, M., HajGhanbari, B., and Reid, W. D. (2010), "Top-cited articles in rehabilitation", *Archives of Physical Medicine and Rehabilitation*, Vol. 91, No. 5, pp.806-815.

Siano, A., Vollero, A., Conte, F., and Amabile, S. (2017), "More than words": Expanding the taxonomy of greenwashing after the Volkswagen scandal", *Journal of Business Research*, Vol. 71, pp.27-37.

Van Eck, N. J., and Waltman, L. (2010), "Software survey: VOSviewer, a computer program for bibliometric mapping", *Scientometrics*, Vol. 84, No. 2, pp.523-538.

Van Eck, N. J., and Waltman, L. (2017), "Citation-based clustering of publications using CitNetExplorer and VOSviewer", *Scientometrics*, Vol. 111, pp.1053-1070.

Vošner, H. B., Kokol, P., Bobek, S., Železnik, D., and Završnik, J. (2016), "A bibliometric retrospective of the Journal Computers in Human Behavior (1991–2015)", *Computers in Human Behavior*, Vol. 65, pp.46-58.

Wang, W., Ma, D., Wu, F., Sun, M., Xu, S., Hua, Q., and Sun, Z. (2023), "Exploring the Knowledge Structure and Hotspot Evolution of Greenwashing: A Visual Analysis Based on Bibliometrics", *Sustainability*, Vol. 15, No. 3, p.2290.

Wang, Z., Hsieh, T. S., and Sarkis, J. (2018), "CSR performance and the readability of CSR reports: too good to be true?" *Corporate Social Responsibility and Environmental Management*, Vol. 25, No. 1, pp.66-79.

Wang, Z., Zhao, Y., and Wang, B. (2018), "A bibliometric analysis of climate change adaptation based on massive research literature data", *Journal of Cleaner Production*, Vol. 199, pp.1072-1082.

Yang, L., Chen, Z., Liu, T., Gong, Z., Yu, Y., and Wang, J. (2013), "Global trends of solid waste research from 1997 to 2011 by using bibliometric analysis", *Scientometrics*, Vol. 96, No. 1, pp.133-146.

Yi, H., and Xi, Z. (2008), "Trends of DDT research during the period of 1991 to 2005", *Scientometrics*, Vol. 75, No. 1, pp.111-122.

Yoshikane, F. (2013), "Multiple regression analysis of a patent's citation frequency and quantitative characteristics: the case of Japanese patents", *Scientometrics*, Vol. 96, pp.365-379.

Zhao, L., Deng, J., Sun, P., Liu, J., Ji, Y., Nakada, N., and Yang, Y. (2018), "Nanomaterials for treating emerging contaminants in water by adsorption and photocatalysis: Systematic review and bibliometric analysis", *Science of the Total Environment*, Vol. 627, pp.1253-1263.