Asian Journal of Accounting and Governance 24(2025) ISSN2180-3838
e-ISSN2716-6060
(http://dx.doi.org/10.17576/AJAG-2025-24-14)

Greenwashing Unveiled: Insights from a Bibliometric Analysis

SUYA LI, ZAINI EMBONG, NORMAN MOHD SALEH & KAMARUL BARAINI KELIWON

ABSTRACT

As greenwashing is a hot topic in business, this bibliometric review aims to comprehensively analyze the greenwashing research, focusing on trends and knowledge gaps. It offers important insights for researchers and practitioners who understand the complex dynamics of corporate environmental deception. By reviewing the academic literature in the WOS database for last 25 years, this paper employs bibliometric methods to analyze publication trends in greenwashing research, notable authors, major countries contributing to the field, influential articles and noteworthy journals, and patterns of collaboration in greenwashing research. In addition, the abstracts were sentiment analyzed using Natural Language Processing to reveal the tendency of opinions in the field of greenwashing. The review identifies a growth in greenwashing research since 2021, with an upward trend in multi-authored publications, suggesting an increasing number of collaborative studies. Research on greenwashing needs to be increased in emerging economies. With a high percentage of authors publishing only one article in the field of greenwashing, there is a current need for more players to advance the field of greenwashing. This review presents the first sentiment analysis of the greenwashing literature, and although positive attitudes predominate, critical attitudes are gradually increasing. Despite the progress in greenwashing research, significant gaps remain, and this review offers possibilities for future research directions.

Keywords: Greenwashing; governance; sustainability; ESG; bibliometric

INTRODUCTION

Adaptation to climate change, characterized by warming due to natural factors and human activities, has become an important task for all countries and business. Companies increasingly need to find a balance between profit and growing social and environmental responsibility to meet the looming challenges of climate change (Sila & Cek 2017). Besides, driven by growing environmental and social concerns around the world, the need for sustainable development has put environmental, social and governance factors at the center of corporate development, with more and more companies demonstrating their environmental performance through public disclosure of environmental information. While people are now primarily committed to environmental protection in response to climate risk, the behavior of companies pretending to be green is becoming increasingly compelling.

In recent years, greenwashing has begun to become a 'fad' in the corporate world (Xia et al. 2023). American environmentalist Jay Westerveld coined the term "greenwashing" in 1986 to describe the practice of disguising dishonest environmental actions for one's own benefit (Guo et al. 2018). Greenwashing is the selective disclosure by firms of environmental information that is favorable to them, and it is centered on disclosing misleading environmental information to portray an environmentally friendly corporate image (Yu et al. 2020). This behavior has been scrutinized because it hides a company's environmental performance under a pretty veneer and prevents society from achieving true sustainability. By purposefully hiding negative environmental information, greenwashing corporations primarily focus on obfuscation and concealment. Many companies are keen to publicize their environmental actions, but few are able to provide clear, credible answers when it comes to actual pollution emissions data. The prevalence of greenwashing has become a prominent source of conflict, disrupting the effective allocation of resources, undermining the foundation of social trust, and impeding economic and social development and progress (Nygaard & Silkoset 2022). As ESG disclosure becomes more commonplace, there is an urgent need for academics and regulators to discern between real sustainable behavior and greenwashing. Therefore, it is of great significance to systematically sort out the literature on greenwashing research and clarify the research lineage and future direction. The aim of this review is to sort out the literature on greenwashing research through bibliometric analysis methods, identify its knowledge structure and themes, and propose future research directions that can be expanded.

Although the mechanisms and consequences of greenwashing have been discussed in the existing literature, the sentiment analysis to greenwashing behaviors and their effects have been less frequently addressed. By using sentiment analysis to uncover the sentimental features of greenwashing research for the first time, this review closes this gap. Sentiment analysis is a method of natural language processing that automatically recognizes, extracts, quantifies, and categorizes subjective information in texts to ascertain whether they are neutral, positive, or negative (Chaturvedi et al. 2018). Sentiment analysis reveals the emotional dynamics of public reactions behind events (Lo et al. 2017). In addition to helping to design more effective governance and communication methods, this offers fresh insights on the social acceptance of greenwashing behavior and the effects of shifting public trust. Meanwhile, this review in cleaned and harmonized the literature data, which led to a more accurate analysis relative to other bibliometrics.

This review's objectives are to examine the greenwashing literature included in the WOS database, reveal trends or patterns in the field's body of knowledge, check the knowledge's organizational structure, and present it in tabular and visual form. In particular, the objectives of this review are to (1) identify publication trends such as the distribution of literature and quantitative relationships on greenwashing; (2) identify the most productive and influential authors, journals, and countries in greenwashing research; (3) identify the authorship patterns of publications; (4) identify the patterns of collaborations on greenwashing; (5) identify research hotspots on greenwashing; (6) clarify the sentiment tone of the publication; (7) identify the historical evolution of greenwashing.

The following key research questions need to be addressed in this review. By revealing the evolution of the literature in the field of green cleaning in a comprehensive and organized manner, it will provide a basis for exploring the hotspots of subsequent research.

1. What are the publication trends in the field of greenwashing?
2. Which countries are most active in the field of greenwashing?
3. Which key authors in the field of greenwashing?
4. Which literature is most cited in the field of greenwashing?
5. What are the most productive journals in the field of greenwashing?
6. What are the authorship patterns of the publication?
7. What is the current state of collaboration?
8. Which topics are the most popular among scholars?
9. How is the sentimental tone distributed in the current literature?
10. How the topics of the publication has evolved?

In conclusion, in the face of the ever-increasing phenomenon of greenwashing, timely updating and sorting out the current state of literatures in this area will help to promote more effective regulatory measures and enhancements in company behavior, as well as the sustainable development of the economy. This is not only the responsibility of academia but also a necessary step towards achieving the goals of social responsibility and environmental protection. When analyzing this literature data through bibliometrics, this review can present insights into the structure of the field, social networks and topic interests.

PREVIOUS STUDIES ON BIBLIOMETRIC ANALYSIS OF GREENWASHING

The literature on greenwashing has grown and has significantly impacted both academia and practice. Also, bibliometrics is becoming a valuable technique for assessing research performance on a topic to examine the existing literature on that topic (Zupic & Čater 2015). Through the bibliometric review, it is possible to collate systematically, analyze existing research results, and identify research hotspots and weaknesses. As shown in Table 1, this review compiles a bibliometric review of the last 5 years on greenwashing, the latest literature can reflect current research hotspots, technological breakthroughs or theoretical updates. Although scholars have already conducted a bibliometric review of greenwashing (Gupta & Singh 2024; Wang et al. 2023; Pendse et al. 2023; Sundarasen et al. 2024; Montero-Navarro et al. 2021; Ramalho et al. 2024), but scholars have ignored data harmonization and sentiment analysis.

TABLE 1. Summary of previous bibliometric studies

Author	Domain/Search Strategy & Objective of the Study	Total Document, Data Source & Coverage	Attributes Examined
(Gupta & Singh 2024)	"Greenwashing" or "Green washing" or "Green Washed" or "Green sheen"	260 articles in journals ranked “A*”, “A”,” B” or “C” in the Australian Business Deans Council from Scopus, (1984- June 08,2023)	- Publications per year - Most influential journals (Total Publications) - Highly cited documents - Bibliographical coupling - Trend topic
(Wang et al. 2023)	“greenwashing” or “greenwash” or “green wash” or “green-washing” or “green-wash” or “brownwashing” or “bluewashing” or “green sheen”	594 Web of Science (SCI, SSCI and A&HCI) (2004-01-01 to 2022-05-31)	- Publications per year - Most productive countries (Total Publications, same below) - Collaboration by authors, institutions, countries - Highly cited documents - Citations metric - Co-citation analysis - Most local cited references - Co-occurrence networks - Word cloud analysis
(Pendse et al. 2023)	(“Greenwashing or Unsustainable practices”) And (“Greenwashing Behaviour”)	355 Scopus (1996-2021)	- Publications per year - Most productive authors, countries, journals - Most influential authors, countries, journals - Collaboration by authors, institutions, countries - Highly cited documents - Citations metrics - Co-citation analysis - Co-occurrence networks

			- Word cloud analysis - Tree map - Thematic evolution
(Sundarasen, Zyznarska-Dworczak & Goel 2024)	'greenwashing' And ('esg*' or 'environment, social and governance') And ('report*' or 'reporting' or 'disclosure')	87 Web of Science (2003-2022)	- Main information - Publication trend - Prominent documents & authors - Prominent sources - Most relevant affiliation - Country collaboration - Co-occurrence networks - Bibliographical coupling
(Montero-Navarro et al. 2021)	"greenwashing", "greenwash" and "greenhushing"	351 Web of Science (2003-2020)	- Publications per year - Most productive institutions, journals - Collaboration by countries - Highly cited documents - Bibliographical coupling - Co-occurrence networks
(Ramalho et al. 2024)	"Greenwashing", "Greenwash", "Green wash" and "Green washing"	638 Web of Science (2004 to 2023)	- Publications per year - Frequency of author, journals - Most influential articles - Productive journals - Co-authored network - co-occurrence of keywords

Moreover, due to the importance and complexity of data cleaning, it is widely recognized that data cleaning is a major challenge that requires a lot of time, but cleaned and harmonized data can be used more accurately and efficiently for data analysis and interpretation (Ahmi 2023). This bibliometric review of greenwashing is the first time to clean and harmonize data, prior articles usually cite metadata analysis directly. In the digital age, harmonizing and cleaning complex information has become particularly important due to the ever-increasing volume and complexity of academic data. Therefore, there is an urgent need for a systematic compilation of research in this area to update and improve the understanding and awareness of greenwashing in academia. This will help identify current literatures hotspots and theoretical developments and provide valuable references for policymakers and business managers.

Further, current bibliometrics for greenwashing ignore sentiment analysis. Sentiment analysis is a recent subject at the complex nexus of computer science and linguistics, which uses algorithms to automatically identify sentiment tendencies in texts (Taboada 2016). Sentiment analysis helps to reveal the overall tone and stance of research in the field (Chaturvedi et al. 2018). Sentiment analysis can significantly enhance the depth and breadth of a bibliometric review by providing insight into the emotional of the literature analyzed. This information is crucial in mapping the intellectual and emotional dynamics of the research field.

METHODS

This review applies bibliometric analysis to review the existing literature. It is mainly used to analyze literature output, citations and research trends, thus revealing the structure and dynamics of scientific activities (Lim et al. 2024). Bibliometric analyses can be applied to different disciplines to help researchers and policymakers understand the state of development, research hotspots, and important scholars and institutions in a particular field (Ellegaard & Wallin 2015). Bibliometric reviews are rarely employed in combination with a field's bibliography, instead concentrating on pertinent statistics (Donthu et al. 2021). This method contributes to a thorough grasp of research subjects, collaborations and trends, and publishing patterns, offering insights into the greenwashing development and knowledge gaps.

The data collection period for this study was from 2000- to June 30, 2024, which is beyond the time frame of previous reviews. The WOS database was used because it contains peer-reviewed content, extensive bibliometric metadata and strong support for citation and co-citation analysis. By analyzing the research findings in recent years, this review can have a more comprehensive view of the causes and manifestations of greenwashing and its impact on business and society.

DATA COLLECTION AND SEARCH STRATEGY

As shown in Figure 1, this review uses the Web of Science (WOS) database and develops the following search rules based on the purpose of the review:

(1) Title = ("Greenwashing" OR "green wash" OR "green washing" OR "greenwashed" OR "green-wash") OR (Abstract = "Greenwashing" OR "green wash" OR "green washing" OR "greenwashed" OR "green-wash") OR (Author keywords = "Greenwashing" OR "green wash" OR "green washing" OR "greenwashed" OR "green-wash")

(2) Version = Science Citation Index Expanded (SCIEXPANDED) or Social Sciences Citation Index (SSCI) or Arts and Humanities Citation Index (AHCI) or Emerging Sources Citation Index (ESCI) or Conference Proceedings Citation Index-Science (CPCI-S) or Conference Proceedings Citation Index - Social Sciences and Humanities (CPCI-SSH) or Book Citation Index - Science (BKCl-S) or Book Citation Index - Social Sciences and Humanities (BKCI-SSH) or Current Chemical Reactions (CCREXPANDED) or Index Chemicus.

(3) Document type = Article;
(4) Year of publication = 2000 to 2024.

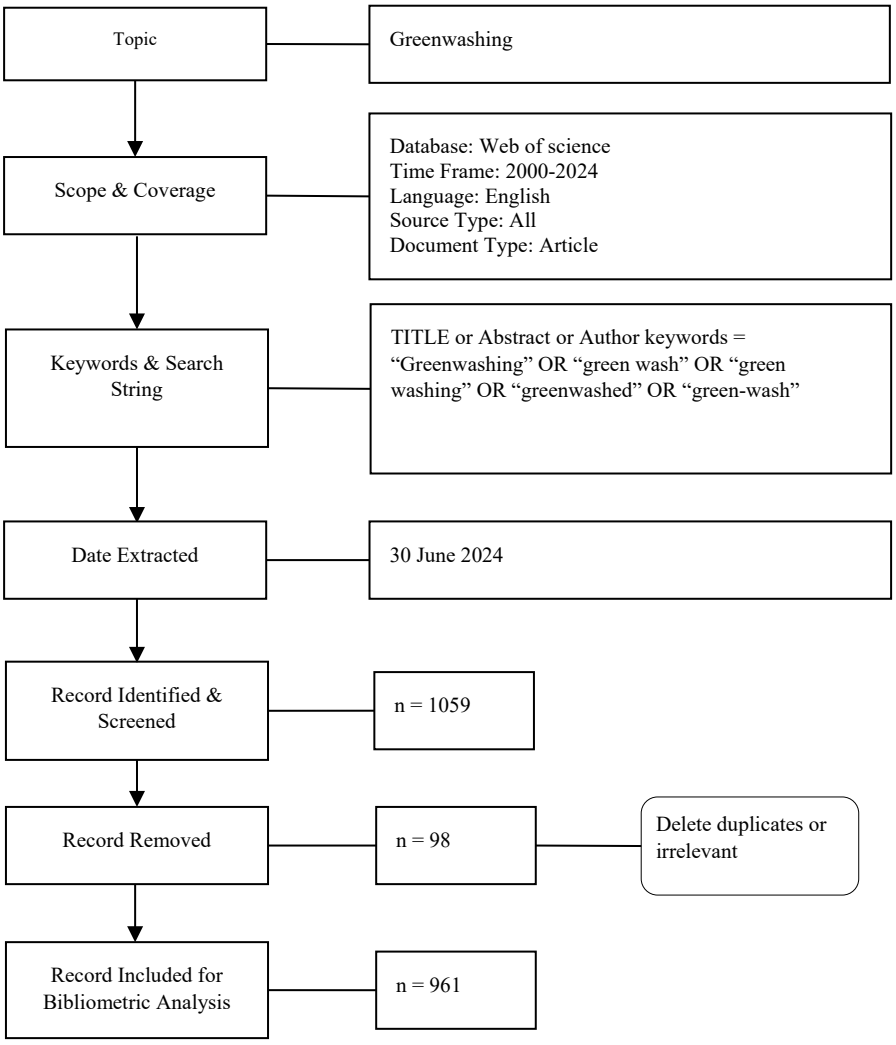


FIGURE 1. Flow diagram of the search strategy

Some metadata may have duplicate, irrelevant and messy metadata due to database archiving and other reasons. Instead, 98 items of metadata were deleted. 961 articles were found for the paper using the search strategy mentioned above.

TOOLS FOR ANALYSIS

The software used for inclusion in the review were biblioMagika® (Ahmi 2024a), Open Refine, and Biblioshiny. BiblioMagika® (Ahmi 2024a) was used for data cleaning, converting Web of Science metadata into various metrics and facilitating the collation of author, affiliation, and country/region data. Open Refine was then applied to refine further and align author names, affiliations and keywords. Cleaned and harmonized data can be used more accurately and efficiently for data analysis and interpretation (Ahmi 2024b). After data collation and adjustment, the data were subsequently analyzed using Biblioshiny, an application within the Bibliometrix R package and combine BiblioMagika®. In addition, the abstracts were sentiment analyzed using NLP (Natural Language Processing) to understand the tone of the greenwashing.

In addition, sentiment analysis was performed in Google Colab using the NLP (Natural Language Processing) package SpaCy and the sentiment computing package TextBlob to understand the emotional tone of the greenwashing. Incorporating sentiment analysis into a bibliometric review can uncover underlying sentiments, perspectives, and biases in the literature, enabling a deeper understanding of the field of knowledge, an appreciation of scholarly trends, and the identification of gaps or opportunities for further exploration (Mao et al. 2024; Kumar & Garg 2020). This review will incorporate sentiment analysis as a way to differentiate from current greenwashing bibliometric reviews, making it more insightful and impactful.

RESULTS AND DISCUSSIONS

This part shows the findings of the bibliometric analysis, which is structured to directly the research questions outlined in the introduction.

TIME DISTRIBUTION OF RESEARCH OF THE GREENWASHING

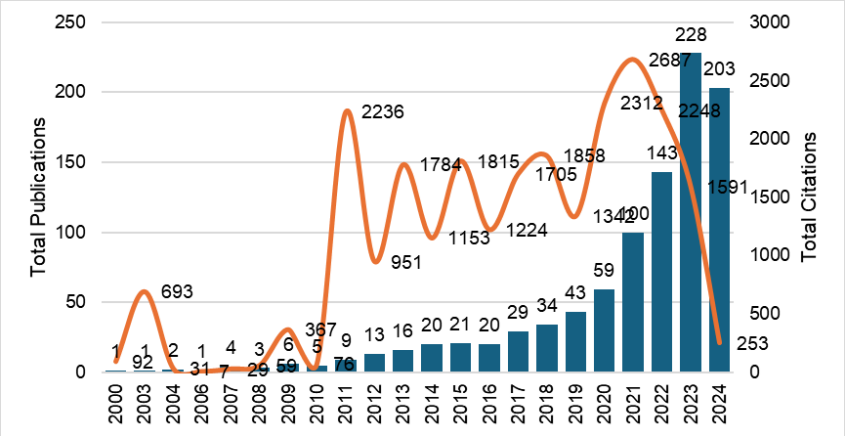


FIGURE 2. Time distribution of research
Source: Generated by the author using biblioMagika®

This review analysed 961 papers in the WOS database for publication trends in corporate greenwashing research. According to Figure 2, the histogram shows the number of published articles per year in the WOS database from 2000 to 2024, the orange line is the number of citations. Between 2000 and 2011, 32 articles were published, about 3.33% of all publications. The number of publications varied from at least 13 to as much as 100 between 2012 and 2021. 355 publications, or 37% of all publications, were issued during this period. From 2022 to 2024, there has been a significant increase in published articles, with 574 articles or about 59.67% of the total publications. More than half of all the publications registered during the past 25 years have been published in the last three years alone. Regarding literature publication, there has been a steady development of greenwashing research until 2020, and there has been an explosive growth of research from 2020 to the present. This demonstrates that there is a discernible upward trend in scholarly interest in the study of greenwashing, shows society is becoming more concerned about the of company environment activity as well as its growing demand for accurate, comprehensive information about these practices.

Meanwhile, figure 2 illustrates that citations to greenwashing literature surged beginning in 2011, coinciding with the release of the first special issue focused on examining the causes and effects of company greenwashing (Liu et al. 2023). The special issue focuses on the motivations, methods and implications of the greenwashing phenomenon, with a particular focus on how corporations can mislead consumers about their environmental claims and the impact of this behaviour on corporate reputation and market reaction.

GEOGRAPHIC DISTRIBUTION OF GREENWASHING RESEARCH

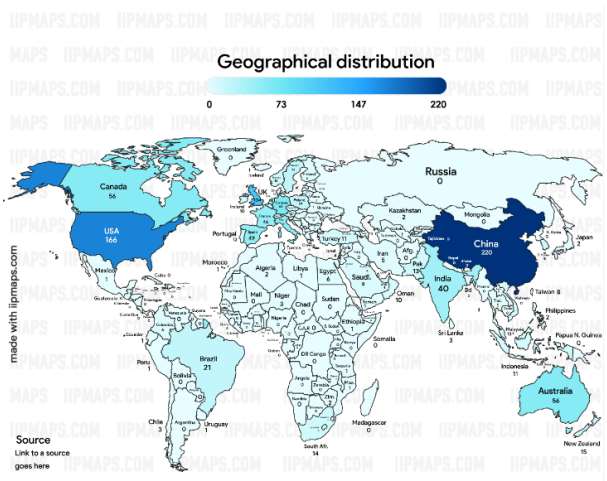


FIGURE 3. Geographical distribution
Source: Generated by the author using iipmaps.com/

Figure 3 shows the geographical distribution of greenwashing literature. From the figure 3, it can be seen that China (220 articles), and the United States (166 articles) lead the way in terms of literature. For China, this may be due to the enormous environmental challenges posed by China's rapid industrialisation and urbanisation (Cai et al. 2016). Also, since China has committed to achieving peak carbon and carbon neutral targets, it has incorporated ESG concepts and climate risk prevention into its overall management system to better adapt to and support the needs of economic and social transformation and development. Therefore, more and more Chinese scholars pay attention to corporate greenwashing.

In addition, Americans environmentalists Jay Westerveld coined the term greenwashing, the United States has a strong tradition of consumer activism and environmentalism advocacy, and there are numerous NGOs and oversight groups concerned with corporate responsibility and environmental sustainability. Meanwhile in 2021, the U.S. Securities and Exchange Commission (SEC) established a working group on ESG-related enforcement to collect potential ESG violations in the marketplace, and the issue of greenwashing was raised as a key issue (Karpoff et al. 2022). These reasons have led to a high number of greenwashing articles in the USA.

TABLE 2. Top 10 Most productive institutions

Country	TP	NCP	TC	*h*	*g*	*m*
CHINA	220	158	3764	32	61	2.667
USA	166	134	8180	39	90	1.560
ENGLAND	86	66	2265	24	47	1.143
GERMANY	60	47	1208	16	34	1.143
AUSTRALIA	56	46	1421	17	37	0.944
CANADA	56	47	2690	20	51	1.538
ITALY	51	46	1551	18	39	1.286
SPAIN	49	38	835	16	28	1.067
FRANCE	46	35	1537	16	39	1.143
INDIA	40	31	1111	9	33	0.563

Note: TP=total number of publications; NCP=number of cited publications; TC=total citations; h=h-index; g=g-index, m=m-index. Source: Generated by the author using biblioMagika®

Other countries also show strong research output, but there is a gap compared with China and the United States. As can be seen from Table 2, Web of Science (WOS) database articles also come from many countries, such as the UK (86), Germany (60), Australia (56), and Canada (56), and often research is conducted in developed economies. The increase in research on greenwashing in various countries may have been prompted by the fact that the interconnectedness of the global marketplace means that greenwashing in one country may have international implications, leading to extensive research. Secondly, the growing global awareness of climate change and environmental degradation drives the need for genuinely sustainable practices and research on greenwashing. Best of all, improved access to data and advances in research methods allow for more thorough investigation and exposure of greenwashing. Together, these factors have led to a high level of interest in greenwashing research in various countries. It is noteworthy, however, that few articles from developing countries.

HIGHEST NUMBER OF PRODUCTIVE OF AUTHORS WITHIN THE GREENWASHING

TABLE 3. Top 10 most productive authors

Full Name	Current Affiliation	Country	TP	TC	*h*	*g*	*m*
Dongyang Zhang	Capital Univ Econ & Business	China	11	437	10	11	3.333
Xavier Font	Uit Arctic Univ Norway	Norway	5	430	5	5	0.385
Xingqiang Du	Xiamen Univ	China	5	340	4	5	0.400
Joerg Matthes	Univ Vienna	Austria	5	220	3	5	0.429
Thomas P. P. Lyon	Univ Michigan	Usa	5	1668	5	5	0.357
Peter Seele	Univ Svizzera Italiana	Switzerland	5	376	5	5	0.625
Francesco Testa	St Anna Sch Adv Studies	Italy	5	475	4	5	0.286
Pengyu Chen	Inner Mongolia Univ	China	4	36	2	4	1.000
Fabio Iraldo	St Anna Sch Adv Studies	Italy	4	402	4	4	0.286
Helen Kopnina	Hague Univ Appl Sci	Netherlands	4	88	4	4	0.667

Note: TP=total number of publications; NCP=number of cited publications; TC=total citations; h=h-index; g=g-index, m=m-index. Source: Generated by the author using biblioMagika®

Table 3 demonstrates the top ten most productive authors, and it is worth noting that the first place is Dongyang Zhang, with a total output of 11 articles on greenwashing and a total number of citations of 437. It can also be seen that the H-index is 10, the G-index is 11, and the M-index is 3.33. This indicates that he not only produced a large number of scientific papers, but these papers also got a high number of citations, suggesting a high academic impact. It is also worth noting that total production (TP) is not necessarily exactly proportional to total citations (TC). For example, although Thomas P. P. Lyon has a relatively small number of papers (5), he has received an extremely high number of citations (1668), which indicates that his published research is of extremely high quality and has an important academic influence. This reflects the differentiated performance of current scholars in terms of their literature output and academic impact on greenwashing. Some scholars publish many papers, while others concentrate on high-quality research results, illustrating the diversity of research output and academic impact. From the perspective of high-yield authors, there are still fewer authoritative authors in the research field, and there is still more research space to be explored and explored in the future.

The H-index reflects both the quantity and quality of a scholar’s publications (van Eck & Waltman 2008). Most authors analyzed have an H-index between 4 and 5, indicating multiple well-cited, high-quality papers. The G-index, which

emphasizes the cumulative impact of highly cited work (Choudhri et al. 2015), highlights Dongyang Zhang (11) and Thomas P. P. Lyon (5) as leading contributors. The M-index, representing the growth rate of academic influence over time (Choudhri et al. 2015), is highest for Dongyang Zhang (3.33), suggesting his rapid rise as an emerging scholar. Pengyu Chen (1.00) also shows notable early-career impact. In contrast, Xavier Font (0.38) and Francesco (0.28) demonstrate slower yet potentially more sustained influence trajectories.

HIGHEST NUMBER OF CITATIONS OF DOCUMENTS WITHIN THE GREENWASHING

TABLE 4. Top 10 highly cited documents

No.	Author(s)	Title	Source Title	TC	C/Y	DOI
1	Delmas Ma;Burbano Vc (2011)	The Drivers of Greenwashing	California Management Review	943	67.36	10.1525/cmr.2011.54.1.64
2	Laufer Ws (2003)	Social Accountability and Corporate Greenwashing	Journal of Business Ethics	693	31.50	10.1023/A:1022962719299
3	Lyon Tp; Maxwell Jw (2011)	Greenwash: Corporate Environmental Disclosure Under Threat of Audit	Journal of Economics & Management Strategy	603	43.07	10.1111/j.1530-9134.2010.00282.x
4	Chen Ys;Chang Ch (2013)	Greenwash and Green Trust: The Mediation Effects of Green Consumer Confusion and Green Perceived Risk	Journal of Business Ethics	482	40.17	10.1007/s10551-012-1360-0
5	Lyon Tp;Montgomery Aw (2015)	The Means and End of Greenwash	Organization & Environment	423	42.30	10.1177/1086026615575332
6	Parguel B;Benoît-Moreau F;Larceneux F (2011)	How Sustainability Ratings Might Deter 'Greenwashing': A Closer Look at Ethical Corporate Communication	Journal of Business Ethics	421	30.07	10.1007/s10551-011-0901-2
7	Marquis C;Toffel Mw;Zhou Yh (2016)	Scrutiny, Norms, And Selective Disclosure: A Global Study of Greenwashing	Organization Science	407	45.22	10.1287/orsc.2015.1039
8	Walker K;Wan F (2012)	The Harm of Symbolic Actions and Green-Washing: Corporate Actions and Communications on Environmental Performance and Their Financial Implications	Journal of Business Ethics	394	30.31	10.1007/s10551-011-1122-4
9	Nyilasy G;Gangadharbatla H;Paladino A (2014)	Perceived Greenwashing: The Interactive Effects of Green Advertising and Corporate Environmental Performance on Consumer Reactions	Journal of Business Ethics	317	28.82	10.1007/s10551-013-1944-3
10	Mahoney Ls;Thorne L; Cecil L;Lagore W (2013)	A Research Note on Standalone Corporate Social Responsibility Reports: Signaling Or Greenwashing?	Critical Perspectives on Accounting	316	26.33	10.1016/j.cpa.2012.09.008

Source: Generated by the author using biblioMagika®

Citation analysis, which displays the most cited authors and documents to explain the literature's knowledge structure and, consequently, identify prominent scholars and documents, is a crucial component of bibliometric evaluations (Zaby 2019). Table 4 lists the 10 most cited articles on greenwashing from the WOS database. 9 papers belong to the period 2010-2020, and the remaining 1 paper is from 2000-2010. With 943 citations, the top-ranked article examines the causes of greenwashing and offers suggestions for managers, legislators, and NGO to lessen it. Alternatively, high citations may be due to their theoretical framework and ability to generalize findings across sectors.

In addition, C/Y represents the average number of times a document has been cited per year since its publication, which can help analyze the impact and importance of the document. C/Y focuses more on the citation rate of a document than the total number of citations, and is therefore more representative for assessing the timeliness and current influence of a document. As shown in Table 4, The Drivers of Greenwashing, Scrutiny, Norms, and Selective Disclosure: A Global Study of Greenwashing and Greenwash: Corporate Environmental Disclosure Under Threat of Audit have higher C/Y values of 67.36, 45.22 and 43.07 respectively, which also suggests that these articles may have had a greater influence on the academic.

Many studies on greenwashing have revealed key business and social challenges, pointing to the balance between genuine sustainability efforts and misleading green marketing. It has also attracted attention for its data-driven insights into how greenwashing affects stakeholder and business performance. This relevance makes the findings useful to policymakers, academics and practitioners, resulting in increased citations.

HIGHEST NUMBER OF JOURNALS WITHIN THE GREENWASHING

Table 5 highlights the top 10 journals regarding the number of articles published, which contain more articles on greenwashing literature. They are therefore especially significant in the study of greenwashing. With 69 articles about greenwashing, Sustainability is the most productive research journal. However, it is interesting to note that the Journal of Business Ethics has only 27 publications but 4807 citations and h-index of 26, has become an important source of discussion on greenwashing. Also, as can be seen from the Table 5, the Journal of Cleaner Production and Business Strategy

and the Environment are important sources of greenwashing research. Their high citation counts and g-index indicate that these journals have conducted influential and frequently cited research on greenwashing.

TABLE 5. Top 10 Most productive source titles

Source Title	TP	NCA	NCP	TC	C/P	*C/CP*	*h*	*g*	*m*
Sustainability	69	212	52	692	10.03	13.31	13	24	1.444
Journal of Cleaner Production	39	118	35	1732	44.41	49.49	17	39	2.125
Business Strategy and The Environment	38	120	33	1336	35.16	40.48	21	36	2.100
Environment Development and Sustainability	31	110	14	161	5.19	11.50	5	12	0.625
Journal of Business Ethics	27	71	27	4807	178.04	178.04	26	27	1.182
Corporate Social Responsibility and Environmental Management	26	92	22	789	30.35	35.86	12	26	1.200
Finance Research Letters	17	53	14	145	8.53	10.36	7	11	1.750
Energy Economics	15	38	12	277	18.47	23.08	8	15	2.667
Journal of Sustainable Finance & Investment	10	27	8	88	8.80	11.00	5	9	1.667
International Review of Financial Analysis	10	31	6	329	32.90	54.83	5	10	1.250

Note: TP=total number of publications; NCA=Number of contributing authors; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations Source: Generated by the author using biblioMagika®

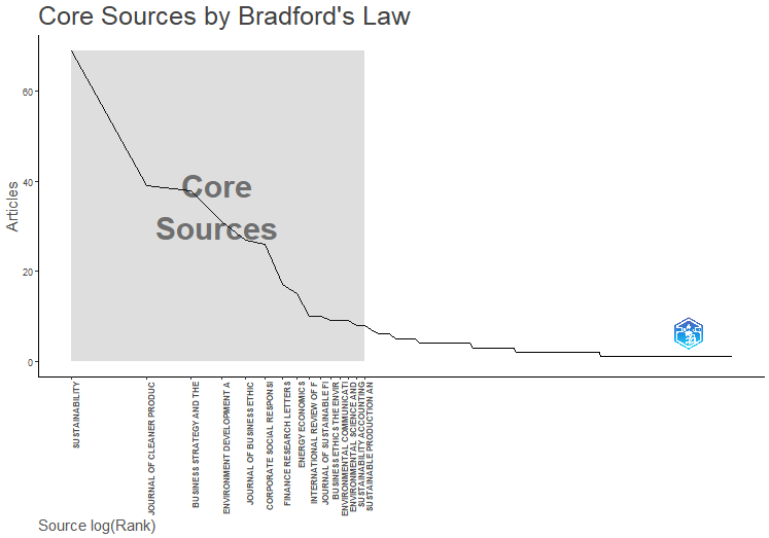


FIGURE 4. Core source by Bradford's Law
Source: Generated by the author using Biblioshiny

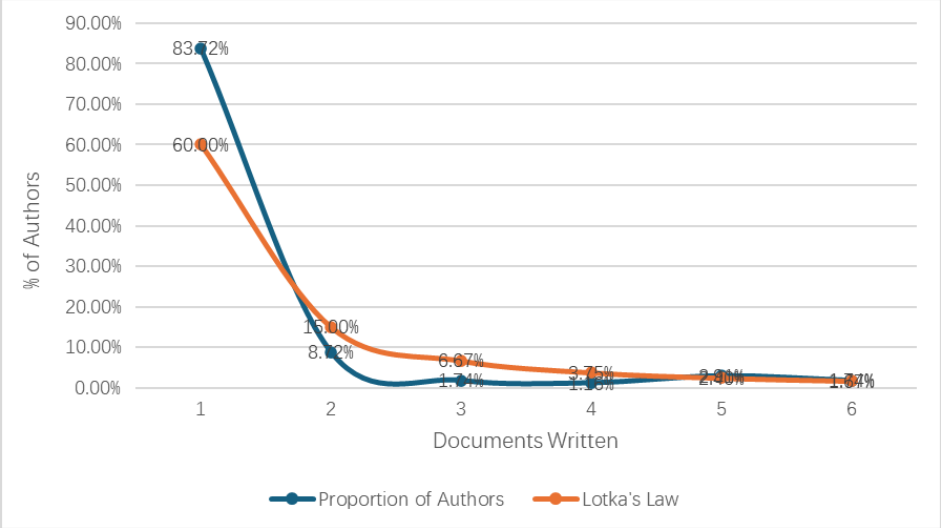
The figure 4 demonstrates the distribution of literatures among different sources, following Bradford's law. Samuel C. Bradford, a British librarian, developed Bradford's Law in 1934. Bradford's law suggests that relatively few journals will contain the most relevant articles on a given topic (Bradford 1934). The journals that publish the most papers on a certain topic are shown by the shaded region labeled core sources. These core sources are identified by a sharp drop in the curve, indicating a high concentration of articles in a few key journals.

The identified core sources in Table 5 and Figure 4 are central to the field and should be regarded as the main reference for a comprehensive literature review or study in the field. Researchers focusing on topics within these core sources will likely find the most relevant and influential articles. Meanwhile, authors looking to publish influential research may consider targeting these high-frequency journals to appeal to a broader, more active audience.

AUTHORSHIP PATTERNS OF THE PUBLICATION

In addition, this paper explains Lotka's Law, a law of bibliometrics first proposed by American demographer Alfred Lotka in the 1920s, which reveals the correlation between the number of authors and the number of papers and introduces the concept of scientific productivity. According to Lotka's law, there is a certain balance between the quality and quantity of scientists' output. The calculation of Lotka's law is discussed in Figure 4. Lotka's law generally describes how authors' production is distributed (Kushairi & Ahmi 2021), with the majority of authors being less productive and the minority being more productive. The majority of writers (83.72%) only produced one document, which shows a low level of involvement in the science production.

On the other hand, the percentage of authors who published two documents is 8.72% and becomes progressively smaller as the number of published documents increases. Figure 5 shows that 83.72% of authors have only published once, which is more than 20% higher than predictions based on Lotka's law, which suggest that roughly 60% of authors have only published once. Despite this inconsistency, the proximity to the essential concept of Lotka's law may still be proven. The high percentage of authors with only one greenwashing publication can be explained by the field's early stages of development. However, this is one of the obstacles to be overcome in the development of this field. Therefore, more participation and productivity are needed to advance knowledge in greenwashing.



Source: Generated by the author using biblioMagika®
FIGURE 5. Lotka's Law

CURRENT STATE OF COLLABORATION

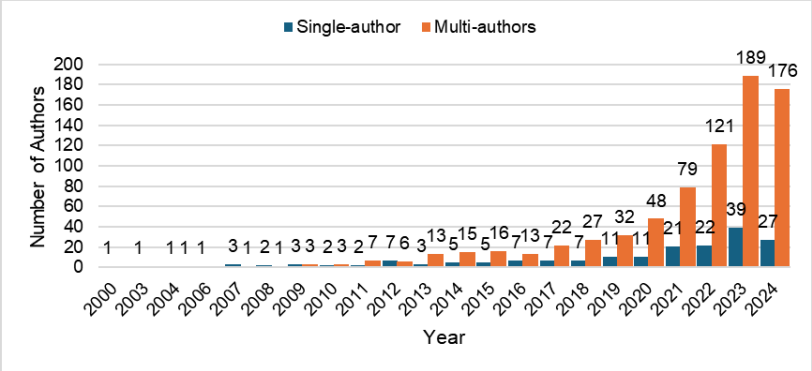


FIGURE 6. Single Author vs. Multi Authors
Source: Generated by the author using biblioMagika®

Co-authorship is a regular method of intellectual collaboration between researchers and analyses have examined how researchers in the research field interactions (Cisneros et al. 2018). Figure 6 illustrates the trend in the number of single-authored versus multi-authored publications between 2000 and 2024. Figure 6 shows that for most of the early part of the century, the number of single-author and multi-author works was low and varied little. However, the number of multi-authored works increased, especially from 2021 to 2024. By 2023, there are 189 multi-authored works, and in 2024, there are 176 multi-authored works. In contrast, the growth of single-author works is more modest, peaking at 39 authors in 2023. The overall trend shows that multi-author collaborative writing is gradually becoming mainstream, and the number of multi-authored articles has shown rapid growth, especially in recent years. Collaboration among scholars has become commonplace as the complexity of research methods and theories increases. Indeed, collaboration among scholars plays a crucial role in advancing research, as input from diverse contributors can lead to clearer understanding and deeper insights (Tahamtan et al. 2016). This collaborative state creates a network of researchers whose work supports development within the field.

The trend in greenwashing research from single to multiple collaborations is the result of a combination of multidisciplinary cooperation in academic research, social concerns and policy changes. The rise of green economy and sustainable development has made greenwashing an important topic, attracting more scholars to cut through the perspectives of economics, management and environmental science. Multidisciplinary author collaboration can bring more perspectives and promote the depth and breadth of research (Bu et al. 2018). Policy changes have also fueled related research, such as the Paris Agreement and the rise of environmental, social, and governance investments. In addition, modern data analysis techniques require researchers with more technical backgrounds to work collaboratively, which further promotes team-based research. As can be seen in Figure 6, greenwashing research is entering a more systematic and globalized phase, reflecting the academic preference for high-quality collaborative research.

MOST POPULAR TOPICS

Word cloud analysis is a popular data visualization technique that intuitively reflects the relative importance of keywords in the text by displaying them in different sizes, colors and positions in the text data (Mulay et al. 2020). With word cloud mapping, we can quickly identify key themes and important concepts in a text, so it has a wide range of applications in text analysis and information transfer. Word cloud shows key topics, such as “greenwashing”, “corporate social responsibility”, “sustainability”, “sustainable development”, “climate change”, “ESG” and “green bonds”. The frequency of these terms reveals the current topical issues of interest in academia and practice and suggests that in-depth research and discussion of these topics is on the rise.

FIGURE 7. Word cloud
Source: Generated by the author using Biblioshiny

Figure 7 reveals that greenwashing is closely associated with corporate social responsibility (CSR), often viewed as CSR failure when firms make unfulfilled sustainability claims. Frequent mentions of “sustainability” and “sustainable development” suggest researchers are examining how these concepts are used to reducing greenwashing (Kurpierz & Smith 2020). The appearance of terms like “environmental disclosure”, “sustainability reporting”, and “environmental performance” highlights the role of corporate transparency in preventing greenwashing. Meanwhile, “ESG” reflects growing concern over how misleading disclosures may distort investment decisions.

Keywords such as “green marketing”, “green advertising”, “green purchase intention”, and “consumer behavior” indicate interest in how greenwashing affects consumer trust and purchasing decisions. Scholars are investigating whether consumers can distinguish genuine sustainability efforts from deceptive claims (Timmons et al. 2024; Volschenk et al. 2022). The emergence of “sustainable finance”, “green bonds”, and the “circular economy” points to greenwashing concerns in the financial sector, suggesting a need for stronger regulation and verification of green financial instruments. And the prominence of “climate change “underscores its relevance to the greenwashing discourse, as companies may falsely claim climate responsibility, undermining global mitigation efforts.

The word cloud suggests that greenwashing is not just a stand-alone topic, but that it is intricately linked to broader topics such as corporate social responsibility, green marketing and sustainability reporting. Current trends in greenwashing seem to focus on understanding how corporations manipulate sustainability disclosures, the impact on consumer behavior, and the need for regulatory measures to ensure corporate accountability. This may require a critical examination of the integrity of corporate claims in the area of sustainability and how these claims affect trust, investment and real environmental progress.

SENTIMENT ANALYSIS

This review uses Natural Language Processing for sentiment analysis based on the abstract. Sentiments can be categorized as, positive, negative and neutral. According to Figure 8, neutral sentiment has the least number of articles and positive sentiment has the significantly highest distribution. Over time, the red dots have increased year by year, especially after 2015, with a significant increase in positive sentiment studies. The distribution is narrower, with most positive sentiment scores clustered between 0.0 and 0.4. Overall, the research field is more positive towards greenwashing, suggesting that academics still generally recognize the value of green concepts and environmental sustainability. There are several possible positive views on greenwashing, which has triggered increased policy and regulation and indirectly contributed to the green transition (Glavas et al. 2023). In addition, the greenwashing propaganda of companies, although flawed, had promoted awareness of the green environment.

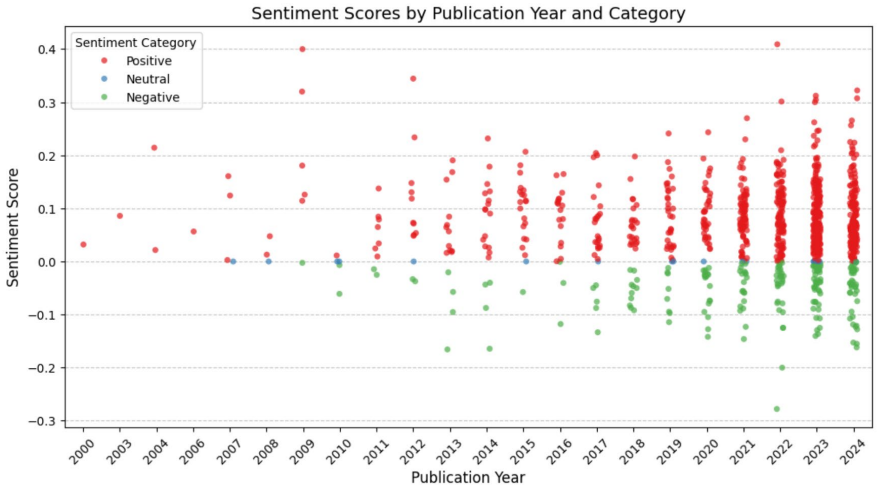


FIGURE 8. Sentiment scores
Source: Generated by the author using Google Colab

However, negative emotions are shown as green dots, mainly in the negative areas of the emotion scores. The distribution is more dispersed, with scores ranging from approximately -0.1 to -0.3. From 2010 onwards, the number of papers on negative sentiment gradually increases, especially after 2020 when more studies on negative sentiment appear. Negative attitudes towards greenwashing may be due to dishonest behavior of companies that mislead consumers through false green propaganda. Inadequate policies and regulations, existing laws or industry standards are not effective in stopping greenwashing behavior. Also, greenwashing may undermine public trust in truly sustainable development (Nygaard & Silkoset 2022). Academic attitudes towards greenwashing have gradually shifted from an initial focus on its positive potential to a deeper critique of its negative impacts. In recent years, in particular, the substantial increase in negative sentiment suggests that academics are more inclined to reveal and criticize corporate dishonesty, while calling for greater regulation and standardization. This distribution of sentiment reflects the diverse and controversial nature of greenwashing as a hot topic.

EVOLUTION OF PUBLICATION TOPICS

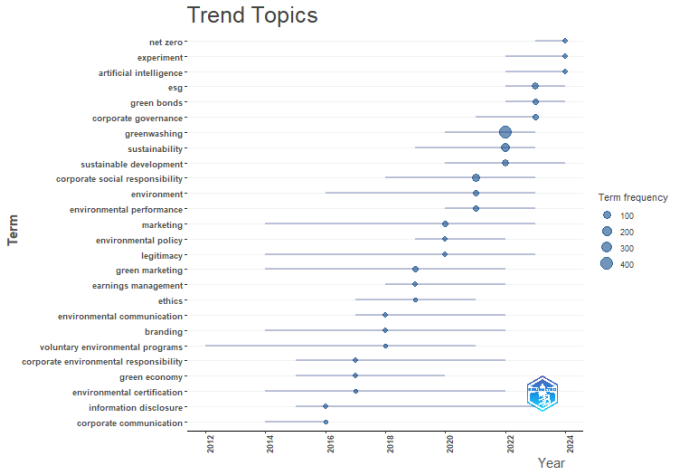


FIGURE 9. Trend topics
Source: Generated by the author using Biblioshiny

Figure 9 analyses the how topics related to greenwashing have evolved in recent years through term frequencies. The size of each bubble then represents the term frequency in the literature for a given year. Larger bubbles indicate higher frequencies.

In the early period, the topics of "voluntary environmental programs", "corporate environmental responsibility" and "information disclosure" suggest that research focused on measuring the environmental performance of companies and the measures of transparency. Next, the prominence of "green marketing", "marketing" and "branding" suggests that academic interest also lies in how companies utilize sustainability claims as part of their marketing strategies. This is closely related to the discussion on greenwashing, as companies often use green brands to appeal to environmentally conscious consumers, sometimes without backing up these claims with tangible actions. In addition, "legitimacy" and "ethics" are important in discussions about greenwashing, and both terms have received attention. Greenwashing can undermine the legitimacy of a

company and erode trust among stakeholders (Nyilasy et al. 2014). The discussion on ethics further explored the ethical implications of misleading sustainability claims.

From 2018 to 2023, “corporate social responsibility” is always at the forefront. It’s a foundational topic for understanding how companies develop environmental and social programs. Their continued importance suggests that greenwashing is often analysed through the lens of corporate social responsibility, questioning whether corporate claims are aligned with genuine sustainability efforts. Indeed, the fact that terms such as “sustainability”, “sustainable development”, and have been used frequently over the years suggests that these concepts have had a long-standing importance in environmental and business studies and continue to be at the centre of discussions of greenwashing.

Since 2022, the emergence of terms like “ESG” and “green bonds” highlights the rising prominence of sustainable finance and the pressure on firms to enhance ESG performance. However, such instruments may be misused to create a false picture of environmental responsibility, linking closely to greenwashing practices. Meanwhile, the appearance of “experiment” and “artificial intelligence” suggests growing interest in using technological innovations to monitor or prevent greenwashing. The increasing focus on “corporate governance” in recent 5 years reflects a shift toward exploring governance and transparency as key mechanisms for ensuring authentic sustainable practices. We can visualise a significant increase in the frequency of terms such as “net zero” form 2023. This trend reflects the rising public interest in achieving net-zero carbon emissions, which echoes the International Energy Agency’s net-zero emissions goal by 2050.

The trend topics analysis in Figure 9 shows the evolving trends and areas of focus in greenwashing research over time, with changes in topics moving from the macro to the micro in terms of specifics, highlighting enduring and emerging topics. The rise of “ESG”, “artificial intelligence” and “net zero” suggests that future greenwashing research is likely to explore how emerging technologies and sustainable financial mechanisms can facilitate or combat corporate deception in the context of sustainable development.

FUTURE RESEARCH DIRECTIONS

This review offers a bibliometric analysis of the articles on greenwashing, examining trends in greenwashing research from year 2000 to 2024 via the WOS database. For objective of this review, we mapped the knowledge base of greenwashing research, identifying the most influential works and authors in terms of authorship, citations, keywords, and geographic distribution of studies to understand as much as possible the current state of research on greenwashing. In addition, sentiment analyses show how attitudes towards greenwashing have changed in the academic community. Further, it was necessary to understand areas of future research interest.

As can be seen from the geographic distribution map, the relevant research has made great deal of work in analyse greenwashing, but not enough on emerging economies. In emerging economies, consumers may have less environmental knowledge and weaker enforcement mechanisms. Future research could focus on greenwashing in emerging economies, which could reveal the global dynamics of corporate environmental deception. Moreover, exploring whether emerging technologies can control the occurrence of greenwashing behaviour may also be a future research direction, such as through AI and big data analytics, machine learning, blockchain.

As an example, blockchain technology, with its decentralized and tamper-proof features, can be used to establish a transparent ESG data tracking and validation system. ESG performance indicators are automatically executed and recorded through smart contracts, reducing human intervention and data manipulation. This not only achieves the goal of reducing greenwashing and improving the transparency, but also provides regulators, managers with directions that can be explored.

It is clear from the word cloud analysis that much of the research on greenwashing has been conducted from a business or marketing perspective, with fewer findings from fields such as environmental science, psychology or ethics. Greenwashing is a multifaceted issue involving consumer behaviour, business ethics and environmental outcomes, but interdisciplinary research approaches still need to be developed. Future research directions could combine perspectives from multiple disciplines to explore the complexity of greenwashing and provide a more comprehensive understanding. This could include integrating insights from sustainability science, law and communication.

Moreover, despite increasing scrutiny of greenwashing behaviour, there is still a lack of a comprehensive legal framework to prevent and punish deceptive environmental claims. Regulation of greenwashing behaviour varies widely across countries and industries, and enforcement is often weak or inconsistent. Future research could explore questions about the effectiveness of different regulatory regimes. This could include assessing the role of third-party certification and green audits. Regulators are encouraged to formulate more binding disclosure policies and introduce mandatory independent verification mechanisms. It is recommended that an open and transparent corporate green credibility rating system be constructed, with a focus on verifying historical greenwashing records to provide investors and the public with a basis for reference, thereby incentivizing companies to improve their actual sustainability performance.

In addition, sentiment analysis, which can uncover implicit emotional attitudes and subjective evaluations within texts, has been relatively underutilized in existing bibliometric reviews. Future researchers can leverage this method to further investigate emotional dynamics related to green governance and greenwashing, revealing the emotional tendencies and attitudinal shifts of various stakeholders on sustainability issues. For instance, comparative studies can be conducted across industries or regions to analyse differences in sentiment toward greenwashing.

Closing these gaps will require the collaborative efforts of researchers, policymakers and industry practitioners to ensure that all types of greenwashing are understood and reduced. Future research should focus on better regulatory mechanisms, cross-sectoral analysis, and consumer behaviour studies. Due to the considerable influence of greenwashing on society and company, future research should focus on gathering new evidence to better understand the reasons behind greenwashing behaviours and how to mitigate their harmful effects.

REFERENCES

Aerts, W. & Cormier, D. 2009. Media legitimacy and corporate environmental communication. Accounting, Organizations and Society 34(1): 1–27.

Ahmi, A. 2023. OpenRefine: An approachable tool for cleaning and harmonizing bibliographical data. In AIP Conference Proceedings (Vol. 2827, No. 1). AIP Publishing.

Ahmi, A. 2024a. biblioMagika. https://bibliomagika.com.

Ahmi, A. 2024b. Bibliometric Analysis using biblioMagika®

Bradford, S.C. 1934. Sources of information on specific subjects. *Engineering* 137(3550): 85-86.

Bu, Y., Ding, Y., Xu, J., Liang, X., Gao, G. & Zhao, Y. 2018. Understanding success through the diversity of collaborators and the milestone of career. *Journal of the Association for Information Science and Technology* 69(1): 87–97.

Cai, X., Lu, Y., Wu, M. & Yu, L. 2016. Does environmental regulation drive away inbound foreign direct investment? Evidence from a quasi-natural experiment in China. *Journal of Development Economics* 123: 73–85.

Chaturvedi, I., Cambria, E., Welsch, R.E. & Herrera, F. 2018. Distinguishing between facts and opinions for sentiment analysis: Survey and challenges. *Information Fusion* 44: 65–77.

Choudhri, A.F., Siddiqui, A., Khan, N.R. & Cohen, H.L. 2015. Understanding bibliometric parameters and analysis. *RadioGraphics* 35(3): 736–746.

Cisneros, L., Ibanescu, M., Keen, C., Lobato-Calleros, O. & Niebla-Zatarain, J. 2018. Bibliometric study of family business succession between 1939 and 2017: Mapping and analyzing authors' networks. *Scientometrics* 117(2): 919–951.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N. & Lim, W.M. 2021. How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research* 133: 285–296.

van Eck, N.J. & Waltman, L. 2008. Generalizing the h- and g-indices. *Journal of Informetrics* 2(4): 263–271.

Ellegaard, O. & Wallin, J.A. 2015. The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics* 105(3): 1809–1831.

Glavas, D., Grolleau, G. & Mzoughi, N. 2023. Greening the greenwashers – How to push greenwashers towards more sustainable trajectories. *Journal of Cleaner Production* 382.

Guo, R., Zhang, W., Wang, T., Li, C.B. & Tao, L. 2018. Timely or considered? Brand trust repair strategies and mechanism after greenwashing in China—from a legitimacy perspective. *Industrial Marketing Management* 72: 127–137.

Gupta, K. & Singh, N. 2024. Visualization of global research trends and future research directions of greenwashing by using bibliometric analysis. *Environment, Development and Sustainability* 27(9): 21493-21513.

Karpoff, J.M., Litan, R., Schrand, C. & Weil, R.L. 2022. What ESG-related disclosures should the SEC mandate? *Financial Analysts Journal* 78(2): 9–18.

Kumar, A. & Garg, G. 2020. Systematic literature review on context-based sentiment analysis in social multimedia. *Multimedia Tools and Applications* 79(21–22): 15349–15380.

Kurpierz, J.R. & Smith, K. 2020. The greenwashing triangle: Adapting tools from fraud to improve CSR reporting. *Sustainability Accounting, Management and Policy Journal* 11(6): 1075–1093.

Kushairi, N. & Ahmi, A. 2021. Flipped classroom in the second decade of the Millenia: A bibliometrics analysis with Lotka's law. *Education and Information Technologies* 26(4): 4401–4431.

Lim, R.G., Voon, S.P., Yahya, F., Mohamad, F.S. & Ahmi, A. 2024. Global and LMIC insights into Acceptance and Commitment Therapy (ACT): A bibliometric study from 1998 to 2023. *Journal of Contextual Behavioral Science* 33.

Liu, Y., Li, W., Wang, L. & Meng, Q. 2023. Why greenwashing occurs and what happens afterwards? A systematic literature review and future research agenda. *Environmental Science and Pollution Research* 30(56): 118102–118116.

Lo, S.L., Cambria, E., Chiong, R. & Cornforth, D. 2017. Multilingual sentiment analysis: From formal to informal and scarce resource languages. *Artificial Intelligence Review* 48(4): 499–527.

Mao, Y., Liu, Q. & Zhang, Y. 2024. Sentiment analysis methods, applications, and challenges: A systematic literature review. *Journal of King Saud University - Computer and Information Sciences* 36(4).

Montero-Navarro, A., González-Torres, T., Rodríguez-Sánchez, J.-L. & Gallego-Losada, R. 2021. A bibliometric analysis of greenwashing research: a closer look at agriculture, food industry and food retail. *British Food Journal* 123(13): 547–560.

Mulay, P., Joshi, R. & Chaudhari, A. 2020. Distributed incremental clustering algorithms: a bibliometric and word-cloud review analysis. *Science & Technology Libraries* 39(3): 289–306.

Nygaard, A. & Silkoset, R. 2022. Sustainable development and greenwashing: How blockchain technology information can empower green consumers. *Business Strategy and the Environment* 32(6): 3801-3813.

Nyilasy, G., Gangadharbatla, H. & Paladino, A. 2014. Perceived greenwashing: The interactive effects of green advertising and corporate environmental performance on consumer reactions. *Journal of Business Ethics* 125(4): 693–707.
Pendse, M.K., Nerlekar, V.S. & Darda, P. 2023. A comprehensive look at Greenwashing from 1996 to 2021: A bibliometric analysis. *Journal of Indian Business Research* 15(1): 157–186.
Ramalho, A.L. de O.S., Oliveira, F.M., Cabral, A.C. de A., Santos, S.M. dos, Costa Holanda, T. & Ricarte, T.L. 2024. Bibliometric study of scientific production on greenwashing. *Revista de Gestão Social e Ambiental* 18(5).
Sila, I. & Cek, K. 2017. The impact of environmental, social and governance dimensions of corporate social responsibility on economic performance. *Australian Evidence. Procedia Computer Science* 120: 797–804.
Sundarasen, S., Zyznarska-Dworczak, B. & Goel, S. 2024. Sustainability reporting and greenwashing: A bibliometrics assessment in G7 and non-G7 nations. *Cogent Business & Management* 11(1).
Taboada, M. 2016. Sentiment analysis: An overview from linguistics. *Annual Review of Linguistics* 2(1): 325–347.
Tahamtan, I., Safipour Afshar, A. & Ahamdzadeh, K. 2016. Factors affecting number of citations: A comprehensive review of the literature. *Scientometrics* 107(3): 1195–1225.
Timmons, S., Whelan, A. & Kelly, C. (2024). Consumers struggle to distinguish genuine and 'greenwashed' environmental claims in advertisements. *Sustainable Production and Consumption* 47: 318–328.
J., Gerber, C. & Santos, B.A. 2022. The (in)ability of consumers to perceive greenwashing and its influence on purchase intent and willingness to pay. *South African Journal of Economic and Management Sciences* 25(1).
Wang, W., Ma, D., Wu, F., Sun, M., Xu, S., Hua, Q. & Sun, Z. 2023. Exploring the knowledge structure and hotspot evolution of greenwashing: A visual analysis based on bibliometrics. Sustainability 15(3): 1-35.
Xia, F., Chen, J., Yang, X., Li, X. & Zhang, B. 2023. Financial constraints and corporate greenwashing strategies in China. *Corporate Social Responsibility and Environmental Management* 30(4): 1770-1781.
Yu, E.P., Luu, B.V. & Chen, C.H. 2020. Greenwashing in environmental, social and governance disclosures. *Research in International Business and Finance* 52.
Zaby, S. 2019. Science mapping of the global knowledge base on microfinance: Influential authors and documents 1989–2019. *Sustainabilit*y 11(14): 1-21.
Zupic, I. & Čater, T. 2015. Bibliometric methods in management and organization. *Organizational Research Methods* 18(3): 429–472.

Suya Li*
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA
E-mail: p120114@siswa.ukm.edu.my

Zaini Embong
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA
E-mail: zainiembong@ukm.edu.my

Norman Mohd Saleh
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA
E-mail: norman@ukm.edu.my

Kamarul Baraini Keliwon
Faculty of Economics and Management
Universiti Kebangsaan Malaysia
43600 UKM Bangi, Selangor, MALAYSIA
E-mail: baraini@ukm.edu.my

*Corresponding author