Global Trends In Greenwashing Research Within Sustainability Reporting: A Bibliometric Analysis (2008–2026)

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Abstract
This study aims to uncover the intellectual evolution and global dynamics of greenwashing practices in sustainability reporting and to identify shifts toward more technical detection mechanisms. The methodology used is a quantitative descriptive bibliometric approach to 174 Scopus-indexed journal articles from 2008 to 2026 through analysis of trends, citation networks, and conceptual structures. The results show that greenwashing has transformed from a marginal issue to a strategic topic with exponential growth since 2023, accompanied by a shift in focus from symbolic legitimacy to Environmental, Social, and Governance (ESG) based transparency and disclosure. Furthermore, the integration of technologies such as Artificial Intelligence and Natural Language Processing is beginning to be utilized to detect discrepancies between claims and actual performance. The study's conclusion confirms that greenwashing has developed into a systemic risk that impacts the credibility of sustainability reporting and financial market performance. The limitations of this study lie in the use of a single database and the lack of cross-sector empirical validation. The contribution of this study is to provide a comprehensive mapping of the trends, structure, and future directions of greenwashing research and provide a basis for the development of more adaptive policies and detection instruments.

Keywords: *Bibliometric Analysis, Greenwashing, Sustainability Reporting*

1. INTRODUCTION

The global corporate landscape is currently witnessing a surge in the adoption of sustainability reporting and Environmental, Social, and Governance (ESG) frameworks, transforming environmental issues into a strategic pillar of corporate communications. However, regulatory pressure and strong market demand for a green appearance often push companies to focus more on image than on substantial environmental performance improvements. Greenwashing is broadly defined as the practice of making false, exaggerated, or misleading claims regarding the environmental benefits of a company's products, services, or practices. This often involves a significant gap between communicated environmental claims and actual company actions, leading to consumer distrust and skepticism (Srisathan & Naruetharadhol, 2025). The urgency of this issue is further heightened by global data showing that the majority of companies in the Global Fortune 500 have not implemented credible impact measurement methodologies, such as Life Cycle Assessment (LCA).

This situation creates a paradox in which companies in environmentally sensitive sectors tend to score higher on sustainability indices, yet their reporting practices are still heavily influenced by regional differences. For example, companies in the Americas show a weak correlation between earnings and sustainability reporting, while companies in Asia and Europe show no such correlation, further highlighting the differences in global reporting standards (Chang & Cheng, 2025). Greenwashing distorts the effectiveness of green finance mechanisms, such as green bonds and loans, by misrepresenting sustainability credentials. This leads to the misallocation of capital and undermines the credibility of sustainable finance frameworks (Poiriazi, Zournatzidou, Konteos, & Sariannidis, 2025).

Several studies have highlighted that companies engage in greenwashing practices to maintain or enhance their legitimacy among stakeholders. This is often achieved through symbolic actions, such as sustainability reporting, which create a positive public image without substantial operational changes (Leonhardt & Guertler, 2025). This study highlights the use of signaling theory in environmental disclosures during IPOs, showing that a positive tone in disclosures can reduce underpricing, but only if the disclosures are authentic. This suggests that authenticity is crucial and that investors are wary of inauthentic signals (Markowitz, Kouchaki, Gino, Hancock, & Boyd,

2023). This creates a moral hazard risk in the market, where signals sent through sustainability reports no longer reflect the reality of performance, thus undermining data-driven decision-making mechanisms for both investors and consumers.

Although the discourse on greenwashing has evolved considerably, current research indicates significant fragmentation. Greenwashing, or misleading environmental claims, can lead to green confusion, significantly increasing the likelihood of boycotts. For example, a study of Green Arm in Vietnam showed that misleading claims create uncertainty, prompting consumers to boycott businesses (Nguyen & Duong, 2025). These findings highlight the importance of a deeper understanding of this phenomenon; however, a research gap remains regarding comprehensive intellectual property mapping that integrates research trends from various disciplines. Greenwashing is prevalent in emerging markets because of lax law enforcement and regulatory loopholes. For example, greenwashing can sometimes benefit both established companies and customers if the sustainability gap in the market is small; however, it generally undermines sustainable progress. Multinational Corporations (MNCs) entering emerging markets often exploit these regulatory weaknesses by engaging in greenwashing to capitalize on market opportunities (Mahomed & Mohamad, 2025).

As these practices increase, Artificial Intelligence (AI) technology is being utilized to detect them through various methods, such as web scraping, Natural Language Processing (NLP), and life cycle analysis. This technology can be used to analyze environmental claims in company reports to identify potentially misleading practices (Boedijanto & Delina, 2024). Based on this gap, this study mapped the evolution of the global literature on greenwashing to uncover dominant themes and areas for future research that remain unexplored. This article discusses the application of Biblioshiny in R Studio for network analysis, thematic mapping, and trend analysis, which directly supports the claims of its superior capabilities in citation network analysis and thematic mapping (Narayanan & Pradhan, 2023). By analyzing bibliometric data, this study aims to test the hypothesis that the current global research trend is shifting from mere conceptualization to the development of digital technology-based detection instruments to reduce information asymmetries.

The novelty of this study lies in its specific focus on mapping the intellectual structure of greenwashing in the context of sustainability reporting, a topic that has not been widely addressed by previous bibliometric studies, which tend to focus on Corporate Social Responsibility (CSR) or ESG themes. Through this approach, the study uncovers a shift in orientation from a research group focused on legitimacy to one emphasizing the development of Artificial Intelligence (AI) based detection mechanisms. This study not only provides theoretical contributions to strengthening the scientific structure of sustainability management but also provides empirical justification for regulators and practitioners to design more transparent and accountable supervisory policies and research directions in the future. The objectives of this study are formulated in the form of research questions.

RQ_1: What are the trends in scientific research on greenwashing?
RQ_2: What are the key studies on this topic, and what are the main trends developing in these studies?
RQ_3: Who are the main contributors to the scientific research on greenwashing?
RQ_4: What concepts, forms, and levels of greenwashing are explored in the journal?
RQ_5: What factors influence the occurrence of greenwashing?
RQ_6: What methods are used to identify greenwashing practices at different levels?
RQ_7: What instruments or tools are used to prevent greenwashing?
RQ_8: Based on the findings from existing research, what direction of research development is recommended for the future.
RQ_9: How does research mapping reveal thematic clusters that comprehensively analyze the greenwashing ecosystem?

This study contributes to the current discourse on the variety, extent, complexity, and measurement methods of greenwashing in ESG reporting, including prevention efforts. First, this study presents a systematic methodological review of the literature that can serve as a foundation for future empirical research on greenwashing prevention. Second, this study compiles various

definitions, types, and levels of greenwashing, measurement instruments in ESG reports, and measures implemented to prevent the practice at the international, national, financial institution, organizational, and consumer levels. Third, this study reveals differences in perspectives on understanding greenwashing between academics and practitioners.

2. LITERATURE REVIEW

A literature review shows that greenwashing in sustainability reporting is common across various industrial sectors. Previous studies have developed methods to detect this practice, ranging from textual analysis to technology-based approaches such as machine learning, and have found that greenwashing negatively impacts stakeholder trust and loyalty. Furthermore, the existence of disease reporting standards and regulations has been shown to play a significant role in curbing this practice, although their effectiveness varies, particularly in developing countries (Putri, Mutia, & Kartasari, 2026).

To strengthen the conceptualization, this phenomenon can be explained through legitimacy theory, which states that companies strive to gain and maintain legitimacy from society through social expectations (Sharma & MP, 2026). In this context, sustainability reporting serves not only as a means of transparency but also as a strategic tool for building a positive corporate image. When there is a gap between actual environmental performance and public expectations, companies tend to use symbolic disclosure to maintain their legitimacy. This practice gives rise to greenwashing, a company's attempt to present itself as more sustainable than it actually is. Furthermore, the bibliometric analysis approach makes a significant contribution to systematically and comprehensively mapping the development of greenwashing research (Damanik, Prasetyo, Alie, & Oktaria, 2025; Nhorito, 2025). Through bibliometric analysis, researchers can identify publication trends, collaborations between authors, and interrelationships between topics such as sustainability, ESG, and corporate governance. This approach also enables the uncovering of previously obscured conceptual relationships, thereby broadening our understanding of variables related to greenwashing. Thus, bibliometrics serves not only as a literature mapping tool but also as a basis for identifying new research directions and integrating diverse perspectives into a more coherent framework (Yulianto, Setiadi, Miswanto, & Ismail, 2025).

However, several research gaps remain that require attention. Research on greenwashing is still dominated by developed countries, leaving studies in developing countries limited. Furthermore, sectoral analyses comparing greenwashing practices across industries are scarce. Methodologically, developing comprehensive and integrated automated detection tools remains a challenge. Therefore, this study aims to address this gap by examining greenwashing empirically and by strengthening its theoretical approach through Legitimacy Theory and utilizing bibliometric analysis to uncover interrelationships and potential variable development opportunities for further research. A summary of the key findings and research gaps is presented in Table 1.

Table 1. Literature synthesis and research gaps on greenwashing

Aspects	Main Findings	Research Gap
Prevalence	Greenwashing practices are widely found across various industrial sectors, indicating that greenwashing is a systemic and cross-sectoral phenomenon (Choudhury, Islam, & Sujauddin, 2024; Dempere, Alamash, & Mattos, 2024; Henao-Rodríguez, Lis-Gutiérrez, & Angulo-Bustinza, 2024; Raman, Das, Nedungadi, & Dávid, 2025; Vollero, 2024).	Research on greenwashing is still dominated by studies in developed countries; therefore, more empirical research focusing on developing countries is needed.
Greenwashing Detection	Textual analysis, the impression management gap, and the Greenwashing Triangle Score (GTS) have proven	Research with larger sample sizes and the use of cross-country and cross-sector datasets is

Aspects	Main Findings	Research Gap
	effective in identifying greenwashing practices in sustainability reports (Janik & Ryszko, 2025; Kılınç, İnce, & Badem, 2026; Motz, Uzun, Hariharan, & Weinhardt, 2025; Sneideriene & Legenzova, 2025).	needed to increase the validity and generalizability of these results.
Impact on Trust	Greenwashing negatively impacts stakeholder trust, particularly among consumers and investors, by reducing the perception of the transparency and authenticity of a company's sustainability commitments (AlQahtani, 2025; Alsaggaf, 2025; Salem, Elbaz, Hassan, Elsaqqa, & Magdy, 2026).	However, research examining the impact of greenwashing on specific industrial sectors is limited.
Standards and Regulations	The implementation of sustainability reporting guidelines such as the Global Reporting Initiative (GRI) can reduce greenwashing practices by increasing transparency and consistency of disclosure (Azizah, Mandasari, & Adi, 2026; Zhang, Khurram, Moussa, & Jiang, 2025).	Further studies are needed to examine the effectiveness of national and international regulatory frameworks in minimizing greenwashing practices.
Technological Developments	The use of Natural Language Processing (NLP) and Large Language Models (LLMs) improves the accuracy and efficiency of the automatic detection of greenwashing in sustainability reports (Anaraki, Croce, & Basili, 2025; Davidescu, Manta, Bîrlan, Miler, & Niță, 2026; Liu, Yuan, & Zhu, 2026).	Future research should focus on developing and refining automated detection tools to enhance their accuracy, transparency, and applicability.

3. METHODOLOGY

This research is designed as a bibliometric study with a quantitative descriptive approach that aims to systematically map the intellectual structure, citation networks, and evolutionary trends of scientific literature on the practice of manipulating environmental information in the domain of sustainability reporting (Ellili, 2024). The population in this study covers the entire scope of global scientific documents discussing the phenomenon of greenwashing from their initial publication in 2008 to April 2026. The sampling technique was carried out through a purposive sampling method by determining the Scopus database as the sole primary data source because of its reputation for providing standardized metadata and curating reputable international journals with high impact factors.

In the initial identification stage, a specific search query instrument entered through the string command title abs key greenwashing and sustainability reporting successfully captured an initial population of 272 documents in diverse formats, consisting of 175 articles, 46 book chapters, 26 reviews, 16 conference papers, 7 books, and 2 notes. To ensure the quality, validity, and homogeneity of the analyzed data, this study applied strict inclusion and exclusion criteria through document screening, limiting the results to source types such as scientific journals (source type: journal) and research articles (document type: article). During this screening process, one document was identified that, although categorized as an article, did not originate from a scientific journal source and was, therefore, excluded from the sample. Through this systematic filtration procedure, a final sample of 174 relevant journal articles was obtained, which were then extracted into a

complete metadata format that included author identity, publication year, number of citations, and keyword associations, the primary and secondary data types.

All stages of the data analysis techniques were carried out by integrating the R Bibliometric Package (bibliometrix 4.0.0 software, biblioshiny application web interface for bibliometrix) has been used to perform performance analysis and bibliometric mapping automatically, which includes publication performance analysis, author co-citation, and intellectual network visualization to identify the most influential scientific contributions. This comprehensive methodological approach ensures that every stage of the work, from the initial identification of 272 documents to visual analysis techniques on 174 selected articles, accurately, objectively, and responsibly represents the current state of scientific discourse on greenwashing in international journal publication standards.

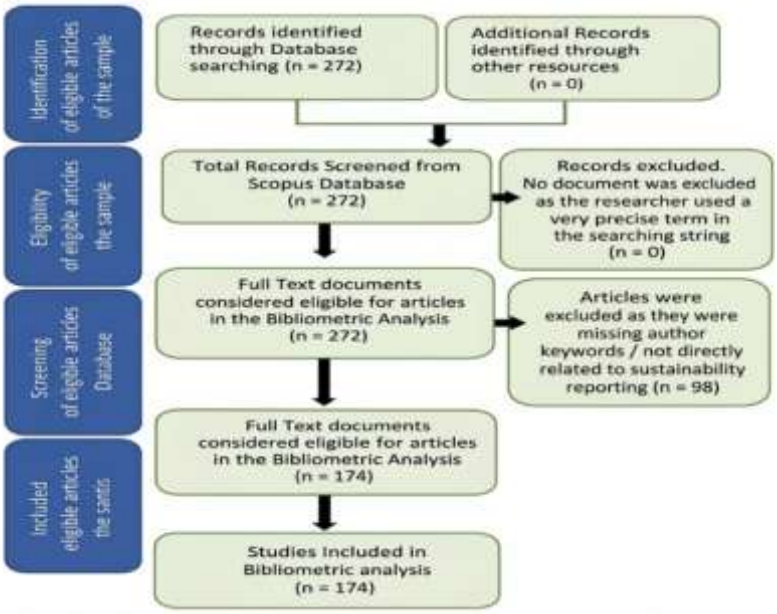

Figure 1. Data collection

The selection process, as shown in Figure 1, refers to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework for this study. PRISMA is a widely recognized framework designed to guide systematic reviewers in transparently reporting the rationale, methodology, and findings of systematic reviews and meta-analyses. It includes tools such as the PRISMA 2020 27 item checklist and flow diagrams to ensure comprehensive and transparent reporting of the selection process (Page et al., 2024). During the identification stage, 272 articles were obtained through a search of the Scopus database without additional information from other sources, as shown in Table 2. Subsequently, during the screening stage, all 272 identified articles were reviewed, and none were eliminated. Given the use of specific and targeted keywords, all documents were initially considered to be relevant.

During the eligibility stage, a thorough review of the full-text articles was performed. Of the 272 articles, 98 were excluded because they lacked author keywords or were not directly related to sustainability reporting. In the final stage, 174 articles met the criteria and were included in the bibliometric analysis. This was done with the focus of the research, thus increasing the validity and reliability of the results. After the filtering process, the following table presents the keywords used as the sample in this study. The number of keywords used was filtered, with a pre-filtering count of 1,190 words, followed by 764 after filtering, which were then used as the sample for this study. This procedure ensured that the articles analyzed were highly relevant and aligned with the study objectives. Exceptions, such as book, book series, conference proceeding, book chapter, review, conference paper, note (166). Duplicate Papers were removed. After merging the data from both databases, 464 duplicate papers were removed, resulting in a final sample of 174 papers, as shown in Table 3.

Table 2. Research protocol

Aspect	Description
Database	Scopus
Search Phrase	TITLE-ABS-KEY ("Greenwashing" And "Sustainability Reporting")
Publication Period	2008 - April 2026
Document Type	Article
Publication Source	Scientific Journal

Table 2 shows, the literature search was conducted using the Scopus database with the search phrase “Greenwashing” and “Sustainability Reporting” in the title, abstract, and keywords. The search covered articles published in scientific journals from 2008 to April 2026.

Table 3. Keyword sample

No.	Keyword	Number Of Papers	Number Of New Papers	No.	Keyword	Number Of Papers	Number Of New Papers
1	Accountability	11	9	99	Europe	5	5
2	Advertising	2	2	100	European Green Deal	3	2
3	Accounting	2	0	101	European Union	0	2
4	Agriculture	3	0	102	Finance	6	4
5	Alignment	2	0	103	Financial Performance	5	3
6	Article	6	6	104	Financial Materiality	0	2
7	Artificial Intelligence	7	4	105	Global Reporting Initiative	7	3
8	Assurance	6	4	106	Ghg Emissions	0	2
9	Auditing	2	0	107	Governance	13	8
10	Australia	3	2	108	Governance Approach	7	6
11	Aviation Industry	2	0	109	Goverment	0	2
12	Benchmarking	5	5	110	Green	3	0
13	Bibliometric Analysis	6	3	111	Green Accounting	0	2
14	Bibliometrics	2	2	112	Green Development	7	2
15	Big Data	4	2	113	Green Economy	12	10
16	Big Data Analytics	3	2	114	Green Finance	0	2
17	Biodiveristy	3	3	115	Green Innovation	0	2
18	Blockchain	12	4	116	Green Washing	3	3
19	Brown Washing	2	2	117	Greenhouse Gas	3	3
20	Business	3	2	118	Greenhouse Gases	3	0

No.	Keyword	Number Of Papers	Number Of New Papers	No.	Keyword	Number Of Papers	Number Of New Papers
21	Business Development	2	2	119	Greenwashing	140	88
22	Business Practices	2	0	120	Greenhouse Gas Emission	0	2
23	Carbon Emissions	5	4	121	Human	6	6
24	Carbon	3	0	122	Greenhushing	0	2
25	Carbon Dioxide	2	0	123	Greenwashing Prevention	0	2
26	Carbon Economy	4	0	124	Gri	0	2
27	Carbon Footprint	7	3	125	Impression Management	0	2
28	Carbonwashing	2	0	126	India	0	2
29	Case-Studies	4	0	127	Industrial Enterprise	0	2
30	Certification	2	2	128	Industrial Performance	0	2
31	Chain Management	2	0	129	Industry	0	2
32	China	5	5	130	Information Asymmetry	0	2
33	Circular Economy	8	5	131	Information Disclosure	0	2
34	Circularity Indicator	2	2	132	Information Management	0	2
35	Civil Society	2	2	133	Innovation	3	3
36	Civil Aviation	2	0	134	Institutional Theory	3	2
37	Climate Change	15	12	135	Intergrade Reporting	3	0
38	Climate Governance	0	2	136	Interpersonal Communication	0	2
39	Climate Risk	0	2	137	Investing	3	2
40	Commerce	9	3	138	Invesment	3	3
41	Commercial Phenomena	3	3	139	Invesments	15	2
42	Communication	3	3	140	Italy	4	4
43	Competition	4	0	141	Legitimacy	3	2
44	Competitiveness	0	2	142	Life Cycle	4	2
45	Compliance	3	2	143	Literature Review	4	0
46	Content Analysis	4	3	145	Machine Learning	3	0
47	Conceptual Framework	0	2	146	Management Practice	0	2
48	Corporate Governance	14	8	147	Manufacturing	0	2

No.	Keyword	Number Of Papers	Number Of New Papers	No.	Keyword	Number Of Papers	Number Of New Papers
49	Corporate Communication	0	2	148	Mining Industry	3	2
50	Corporate Financial Performance	0	2	149	Marketing	5	0
51	Corporate Social Responsibility (CSR)	45	29	150	Multinational Corporation	0	2
52	Corporate Strategy	5	5	151	Natural Language Processing	7	5
53	Corporate Sustainability	9	5	152	Net Zero	3	2
54	Corporate Sustainability Reporting	3	2	153	Non-Financial Reporting	3	0
55	Corporate Transparency	3	2	154	Organization	0	2
56	Corporates-Sustainability	8	0	155	Performance	8	4
57	Corporate	11	3	156	Performance Assessment	3	2
58	Csr	7	3	157	Policy Making	4	3
59	Csrd	5	7	158	Private Sector	0	2
60	Data Envelopment Analysis	0	2	159	Public Policy	6	0
61	Data Quality	0	2	160	Readability	3	2
62	Due Diligence	0	2	161	Regulatory Approach	0	2
63	Decentralized Finance	4	0	162	Reporting	5	4
64	Decision Making	7	4	163	Reporting Standards	4	0
65	Disclosure	11	0	164	Risk Management	5	2
66	Double Materiality	3	3	165	Sdg Washing	0	2
67	Economic And Social Effect	8	2	166	Sdgs	6	5
68	Economics	8	5	167	Small-And Medium-Sized Enterprises	0	2
69	Emission Control	3	3	168	Social Aspects	11	0
70	Energy Sector	0	2	169	Social Responsibility	3	2
71	Environmental	8	3	170	Socioeconomics	0	2

No.	Keyword	Number Of Papers	Number Of New Papers	No.	Keyword	Number Of Papers	Number Of New Papers
72	Environmental Conditions	0	2	171	Spatiotemporal Analysis	3	3
73	Environmental Disclosure	3	2	172	Stakeholder	16	9
74	Environmental Economics	8	8	173	Stakeholder Engagement	13	7
75	Environmental Factor	3	2	174	Stakeholder Theory	4	4
76	Environmental Impact	10	4	175	Standardization	3	0
77	Environmental Impact Assessment	0	2	176	Supply Chains	7	0
78	Environmental Management	11	7	177	Supply Chain Management	10	5
79	Environmental Monitoring	3	2	178	Sustainability	83	57
80	Environmental Performance	7	5	179	Sustainability Accounting	3	3
81	Environmental Policy	3	3	180	Sustainability Assurance	3	0
82	Environmental Responsibility	0	2	181	Sustainability Communication	3	0
83	Environmental Regulations	4	0	182	Sustainability Practices	3	0
84	Environmental Sustainability	7	5	183	Sustainability Reporting	72	45
85	Environmental, Social, And Governance	3	3	184	Sustainable Development	50	19
86	Environmental, Social, And Governance (ESG)	3	2	185	Sustainable Development Goal	5	3
87	ESG	39	29	186	Sustainable Development Goals (Sdgs)	13	6
88	Esg Disclosure	13	10	187	Sustainable Finance	15	11
89	Esg Assurance	0	2	188	Sustainable Investing	4	4
90	Esg Performance	7	7	189	Sustainable Supply Chains	3	0
91	Esg Rating	3	2	190	Systematic Literature Review	6	0
92	Esg Communication	0	2	191	Systematic Review	3	0

No.	Keyword	Number Of Papers	Number Of New Papers	No.	Keyword	Number Of Papers	Number Of New Papers
93	Esg Controversies	0	2	192	Textile Industry	3	0
94	Esg Reporting	7	3	193	Textiles	3	0
95	Esg Investing	0	2	194	Transparency	15	9
96	Ethical Technology	3	0	195	United States	4	4
97	Ethics	4	3	196	United Nations	3	0
98	Eu Taxonomy	3	3	197	Value Creation	3	0
Total Number of Words Before Filter		**1190**	Total Word Count After Filter			**764**	
Exclusions: Book, Book Series, Conference Proceeding, Book Chapter, Review, Conference Paper, Note			(166)				
Duplicate Papers Removed After Merging Data From Both Databases			(424)				
Final Sample for Bibliometric Analysis			**174**				

4. RESULT AND DISCUSSION

4.1 Research Results

The analysis of scientific research on greenwashing against the publication timeline shows a very dynamic transformation of literature to answer RQ_1, where this research topic evolved from a marginal issue to a crucial academic discourse. As shown in Figure 2, in the initial phase spanning from 2008 to 2019, the literature was still in an embryonic stage, marked by the sporadic emergence of documents, starting with only one document in 2008 and fluctuating low until reaching three documents in 2013, before finally closing the decade with only two publications in 2019. Crucial momentum began to form when entering 2020, which served as a turning point in growth with the publication of four documents, which then consistently accelerated to ten documents in 2022 and continued to increase sharply to reach 19 papers in 2023.

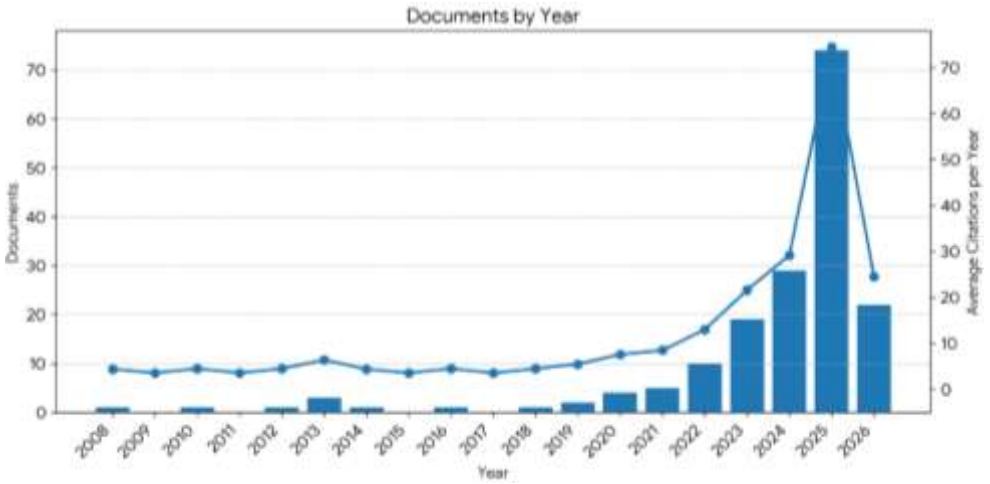

Figure 2. Greenwashing research development graph

Figure 2 shows, the surge in scientific interest has transformed into exponential growth in the current period, with the research volume increasing dramatically to 29 papers in 2024 and reaching a phenomenal peak of 74 publications in 2025. This massive productivity trend in 2025 reflects the global urgency driving researchers to explore this issue in depth and across multiple disciplines, making it the gold standard in sustainability discourse. Although data for 2026 recorded as of April, this figure does not indicate a decline in interest but rather represents an active year. Considering that this achievement surpassed the total publications for 2023 in just one quarter, it can be interpreted that academic attention to ESG disclosure and preventing greenwashing continues to strengthen and is predicted to dominate the scientific literature in the future.

The annual citation analysis presented in Table 4 regarding the development of the literature since 2008 shows a significant paradigm shift that has addressed the objectives of RQ_2 in terms of document productivity and scientific impact. During the initial period, which lasted from 2008 to 2019, this research field was in an inertial phase with a very limited number of publications (N) and an average citation value (Mean) that stagnated at a low figure, namely, below 6.00. This indicates that during this period, research on ESG disclosure and greenwashing had not become a primary reference in the global academic community. The peak was observed in 2016, where the average citation per article (MeanTCperArt) reached its highest figure of 939. This indicates that during that period, the literature produced was fundamental and became the main foundation for theory development in the following years.

Table 4. Citation analysis per year

Year	MeanTCperArt	N	MeanTCperYear	CitableYears
2008	19	1	1	19
2010	65	1	3.82	17
2012	295	1	19.67	15
2013	12.33	3	0.88	14
2014	419	1	32.23	13
2016	939	1	85.36	11
2018	23	1	2.56	9
2019	21.5	2	2.69	8
2020	75.25	4	10.75	7
2021	42.8	5	7.13	6
2022	55.2	10	11.04	5
2023	30.16	19	7.54	4
2024	16.14	29	5.38	3
2025	8.55	74	4.28	2
2026	0.41	22	0.41	1

Table 4 shows, the fundamental transformations began to be detected after 2020. Unlike the previous period, this era was marked by exponential growth in publication volume (N). Although only four documents were published in 2020, this figure is expected to jump dramatically to 74 in 2025. This massive surge in quantity demonstrates that this research topic has shifted from a niche issue to a "hot" topic, attracting the attention of the global scientific community. The decline in the average citation rate in the most recent period (2025-2026) does not indicate a decline in quality but rather represents a common bibliometric phenomenon known as citation time lag. Documents published in 2025 and 2026 require time to be absorbed and cited by other researchers; therefore, the impact metric has not yet reached the saturation point. Nevertheless, the dominant number of documents (N=74) in 2025 reflects the urgency and relevance of this topic in meeting current industry and regulatory needs. Overall, these trends confirm that this research field is in a phase of intellectual expansion, where scientific discourse is no longer focused solely on theoretical depth by

a handful of researchers but has expanded into massive collaborations that dominate the academic scene today.

The map of scientific contributions to answer *RQ3* by country in Figure 3 shows that Italy holds the most dominant role as a major contributor, with 16 articles. Italy's superiority is particularly striking because almost all of its publications are independent research or Single-Country Publications (SCPs), reflecting the independence of a very strong domestic research infrastructure. India follows in second place with 12 articles, of which a third of the total work was produced through international collaborations (Multiple Country Publications), indicating a higher openness to global cooperation. The group of medium-productivity countries is led by the United Kingdom and Australia with nine articles each, followed by Germany and Malaysia with eight articles. Malaysia is noteworthy for its very high level of international collaboration, reaching 50%, a figure significantly higher than that of its neighboring European countries.

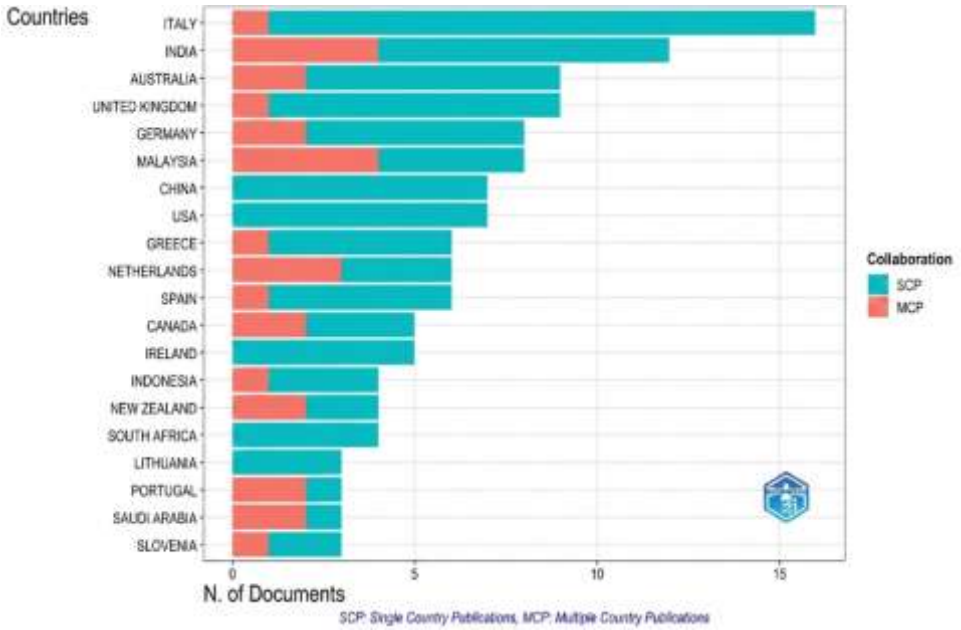

Figure 3. Map of greenwashing contributions by countries

Figure 3 shows, Indonesia maintains a stable position in the middle of the table with four articles, equal to New Zealand and South Africa. In terms of strategic research, Indonesia demonstrates a stronger tendency towards domestic research development, with 75% (3 articles) of its work produced independently (SCP), while the remaining 1 article emerged from cross-border collaboration. Compared to neighboring countries like Malaysia, Indonesia appears to still prioritize strengthening its internal research base but is actively opening up to global partnerships, with a collaboration rate of 25%. A unique phenomenon has emerged in the United States and China. Despite being in the top 10, these two countries recorded all of their articles (seven articles each) as independent research with no international collaboration whatsoever (0% MCP). In contrast, countries with low publication volumes, such as Singapore and Belgium, recorded a perfect collaboration rate of 100%.

The dynamics of author contributions in Table 5 to answer *RQ4* show a shift from the dominance of pioneering authors to the emergence of highly productive new figures in 2025 and 2026. Legenzova R. and Sneideriene A. emerged as the most progressive contributors with a total of 4 articles, they recorded an extraordinary surge in activity in 2025 by releasing three works at once, including research on greenwashing which immediately received 61 citations. Their consistency was maintained until 2026, positioning both as rising stars or key experts for the most up-to-date references.

Table 5. Scientific contribution of greenwashing based on author

Authors	Year	TI	SO	TC	Tcpy
Legenzova R	2026	A Framework for Mitigating Greenwashing in Sustainability Reporting	Sustainability (Switzerland)	0	0
Legenzova R	2025	Greenwashing Prevention in Environmental, Social, And Governance (Esg) Disclosures: A Bibliometric Analysis	Research In International Business and Finance	61	30.5
Legenzova R	2025	Uncovering Greenwashing: Investigating Impression Management Gap In Corporate Reporting	Sustainability (Switzerland)	3	1.5
Legenzova R	2025	Early Evidence on Auditor's Intentions and Readiness to Provide Mandatory Sustainability Reporting Assurance Services in The European Union: A Study of Regulatory Effect in Lithuania	Journal Of Governance and Regulation	4	2
Sneideriene A	2026	A Framework for Mitigating Greenwashing in Sustainability Reporting	Sustainability (Switzerland)	0	0
Sneideriene A	2025	Greenwashing Prevention in Environmental, Social, And Governance (Esg) Disclosures: A Bibliometric Analysis	Research In International Business and Finance	61	30.5
Sneideriene A	2025	Uncovering Greenwashing: Investigating Impression Management Gap in Corporate Reporting	Sustainability (Switzerland)	3	1.5
Matakanye Rm	2025	How Effective Are Regulations in Preventing Greenwashing? Lessons From the Mining Sector in an Emerging Market	Journal Of Governance and Regulation	1	0.5
Van Der Poll Hm	2025	How Effective Are Regulations in Preventing Greenwashing? Lessons From the Mining Sector in an Emerging Market	Journal Of Governance and Regulation	1	0.5
Sariannidis N	2025	Public Funding, Esg Strategies, And the Risk of Greenwashing: Evidence from Greek Financial and Public Institutions	Risks	1	0.5
Sariannidis N	2025	Green Accounting and Esg-Driven Eco-Efficiency in European Financial Institutions: A Two-Stage Dea–Critic-Topsis Evaluation	Plos One	3	1.5
Sariannidis N	2025	Unmasking Greenwashing in Finance: A Promethee Ii-Based Evaluation of Esg Disclosure and Green Accounting Alignment	Risks	3	1.5

Authors	Year	TI	SO	TC	Tcpy
Matakanye Rm	2021	Linking Sustainability Reporting to Sustainability Performance Through Regulation	Journal For Global Business Advancement	8	1.3
Van Der Poll Hm	2021	Linking Sustainability Reporting to Sustainability Performance Through Regulation	Journal For Global Business Advancement	8	1.3
Matakanye Rm	2021	Do Companies in Different Industries Respond Differently to Stakeholders' Pressures When Prioritizing Environmental, Social, and Governance Sustainability Performance?	Sustainability (Switzerland)	39	6.5
Van Der Poll Hm	2021	Do Companies in Different Industries Respond Differently to Stakeholders' Pressures When Prioritizing Environmental, Social, and Governance Sustainability Performance?	Sustainability (Switzerland)	39	6.5
De Villiers C Rm	2025	Determinants, Mechanisms and Consequences of Un Sdgs Reporting by Universities: Conceptual Framework and Avenues for Future Research	Journal Of Public Budgeting, Accounting and Financial Management	15	7.5
Dimes R Hm	2025	Determinants, Mechanisms and Consequences of Un Sdgs Reporting by Universities: Conceptual Framework and Avenues for Future Research	Journal Of Public Budgeting, Accounting and Financial Management	15	7.5
Billedeau Db	2025	Misalignment In the Automotive Supply Chain: Sustainability Commitments of Automotive Manufacturing Firms and Their Suppliers	Journal Of Cleaner Production	1	0.5
Billedeau Db	2024	Assessing The Impact of The Sustainable Development Goals on Corporate Philanthropy: A Study of Canada's Leading Private Sector Companies	Business Strategy and Development	9	3
De Villiers C	2024	How Will Ai Text Generation and Processing Impact Sustainability Reporting, Critical Analysis, A Conceptual Framework and Avenues for Future Research	Sustainability Accounting, Management and Policy Journal	110	36.7
Dimes R	2024	How Will AI Text Generation and Processing Impact Sustainability Reporting? Critical Analysis, A Conceptual	Sustainability Accounting, Management and Policy Journal	110	36.7

Authors	Year	TI	SO	TC	Tcpy
		Framework and Avenues for Future Research			
Caeiro S	2023	Towards A Framework for Corporate Disclosure of Circular Economy: Company Perspectives and Recommendations	Corporate Social Responsibility and Environmental Management	30	7.5
Antoncic M	2022	Opinion Piece Is Esg Investing Contributing to Transitioning to A Sustainable Economy or to The Greatest Misallocations of Capital and A Missed Opportunity	Journal Of Risk Management in Financial Institutions	9	1.8
Caeiro S	2022	Circular Economy Disclosure in Corporate Sustainability Reports: The Case of European Companies in Sustainability Rankings	Sustainable Production and Consumption	70	14
Antoncic M	2020	Uncovering Hidden Signals for Sustainable Investing Using Big Data: Artificial Intelligence, Machine Learning and Natural Language Processing	Journal Of Risk Management in Financial Institutions	37	5.9

Although Legenzova leads in quantity, the highest scientific authority was held by De Villiers and Dimes. Although only two articles have been published, their work has had a massive impact, garnering 125 citations. Their key article, published in 2024, is a leading reference in the field, with an annual citation rate of 36.67, the highest among all authors on this list. This indicates that, despite their lower publication volume, the quality and influence of their research are far more influential in shaping academic discussions than that of other authors.

Furthermore, there is a group of authors who have demonstrated long-term consistency, such as Matakanye R.M. and Van Der Poll H.M., who were active from 2021 to 2025. Caeiro S., on the other hand, remains a significant contributor thanks to the consistent influence of her work from 2022, garnering 70 citations, an average of 14 citations per year. Overall, this contributor map illustrates close collaboration, often in pairs, where research success on this topic is heavily influenced by synergy between established authors, combining a volume of new publications with a strong theoretical foundation from previous years. According to Figure 4, the structure of author contributions demonstrates a contrasting research strategy between output volume and scholarly authority. Legenzova R. and Sneideriene A. emerged as the most progressive contributors quantitatively, with a total of four articles. They demonstrated strong research acceleration in 2025, publishing three papers simultaneously, including a study titled "Greenwash Research," which received 61 citations. This trend continued into 2026, positioning them as rising stars and dominating the current discourse in this field.

However, when measured by impact metrics, De Villiers and Dimes held the highest intellectual authority. Although they have produced only two articles in volume, one of their key works, published in 2024, received 110 citations. With an average annualized citation (TCpY) of 36.67, their influence surpasses that of other authors in the dataset, indicating that their research serves as a key theoretical foundation widely referenced by the academic community. Based on the activity timeline, the research baton has shifted from pioneers to contemporary researchers. Antoncic M. is identified as one of the early pioneers, active since 2020, laying the foundation for the development of this topic at the beginning of the decade. Over time, the research focus has shifted

to authors like Legenzova R., who remained active until 2026. This combination of rising stars' activity and senior experts' authority has shaped the greenwashing knowledge ecosystem, which is highly competitive and continues to thrive today.

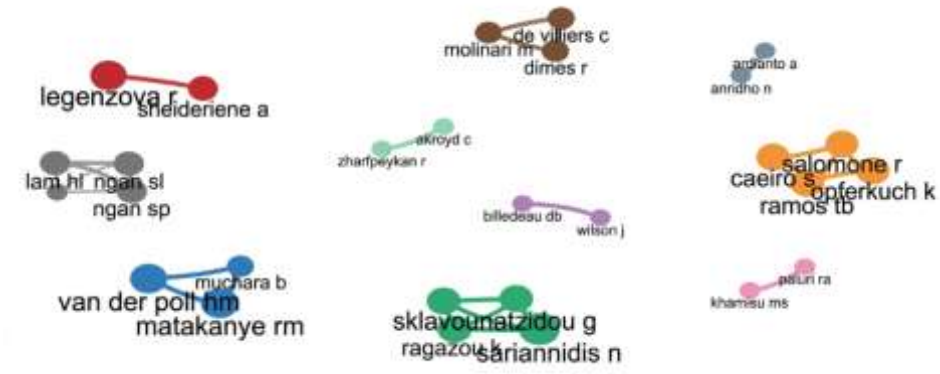

Figure 4. Co-authorship network

The data presented in Figure 4 confirm that publication distribution is still dominated by small groups (clusters) working independently, with no significant cross-cluster connections. The cluster with the highest collaboration density. This group has formed a strong internal network, indicating consistent and in-depth research within the team. A similar trend is also seen in the cluster led, which emerged as a major contributor to the recent literature, according to data trends from 2020 to 2026. Furthermore, Sneideriene and Legenzova (2025) stands out as a significant research axis, reinforcing the findings in Table 5 regarding authors with high citation or publication frequency. However, overall, this map shows that there are no bridge researchers connecting large clusters, clustered with other research groups. This fragmentation indicates that academic discourse on this topic is still developing within institutionally and geographically separated silos. This situation presents a strategic opportunity for further research to conduct integrative or comparative studies to bring together various perspectives from these independent clusters (De Villiers et al., 2024).

In terms of keyword frequency to answer RQ_5, greenwashing stands at the core of the entire intellectual discourse with 88 occurrences. This absolute dominance indicates that the current literature focuses heavily on criticizing companies' dishonest environmental claims, which are mechanically linked directly to sustainability reporting practices (45) and sustainability (57). The presence of ESG (29) as the next dominant keyword confirms that research has shifted to using the Environmental, Social, and Governance framework as the primary metric for distinguishing between genuine commitment and information manipulation.

Word Frequency over Time data reveals that these topics experienced exponential growth, particularly starting in 2023 and peaking in 2026. During this period, deeper topic specializations emerged, such as climate change (12) and sustainable finance (11). This indicates that research is no longer solely discussing corporate image in general but has also entered the realm of financial risk and its impact on global capital markets. This shift is reinforced by the emergence of the term ESG disclosure (10), which demonstrates the urgency of standardizing data disclosure to prevent companies from manipulating information selectively.

Furthermore, the integration of technology in sustainability monitoring is beginning to emerge as an emerging trend. Although still infrequent, the emergence of the terms Artificial Intelligence (4) and blockchain (4) signals the beginning of the digital era in detecting greenwashing practices. AI technology is being explored to automate report analysis, while blockchain is being proposed as a solution to ensure supply chain transparency that cannot be manipulated by any party. The convergence of macro issues, such as the green economy (10), with digital technology indicates that future research will focus more on creating technical early detection instruments to ensure more substantial corporate accountability amid the global climate crisis.

Table 6. Keyword evolution analysis

Term	Frequency	Year (Q_1)	Year (Median)	Year (Q_3)
Stakeholder	9	2020	2021	2023
Governance approach	6	2021	2022	2024
Disclosure	7	2021	2023	2024
Environmental management	7	2020	2023	2024
Circular economy	5	2023	2023	2025
Sustainability	57	2023	2024	2025
Sustainability reporting	45	2022	2024	2025
Corporate social responsibility	23	2022	2024	2025
Greenwashing	88	2023	2025	2025
Esg	29	2023	2025	2025
Esg disclosure	10	2024	2025	2026

Table 6 shows a clear intellectual evolution from managerial awareness to technical and regulatory standardization. In the early phase (2020–2021), research focused on stakeholders and environmental management, reflecting the development of foundational theory. From 2023 to 2025, there was a sharp increase in publications, peaking in 2025, with attention shifting toward critical evaluation of sustainability reporting and ESG as key tools for detecting information manipulation. Keyword trends show that sustainability reporting (45) and ESG (29) dominate the discourse, while the emergence of circular economy topics indicates an expanding research scope. By 2025–2026, the field becomes more specialized, emphasizing ESG disclosure, digital auditing, and regulatory compliance, signaling a move toward technical solutions for greenwashing detection.

Three main forms of greenwashing are identified: disclosure manipulation in accounting, symbolic legitimacy strategies in corporate behavior, and regulatory greenwashing related to frameworks such as CSRD. Overall, the field progresses from macro-level stakeholder theory to micro-level empirical analysis, and finally to advanced technological and regulatory approaches involving AI, blockchain, and data-driven auditing. This reflects the transformation of greenwashing research into a multidisciplinary, system-oriented field focused on ensuring corporate transparency and accountability.

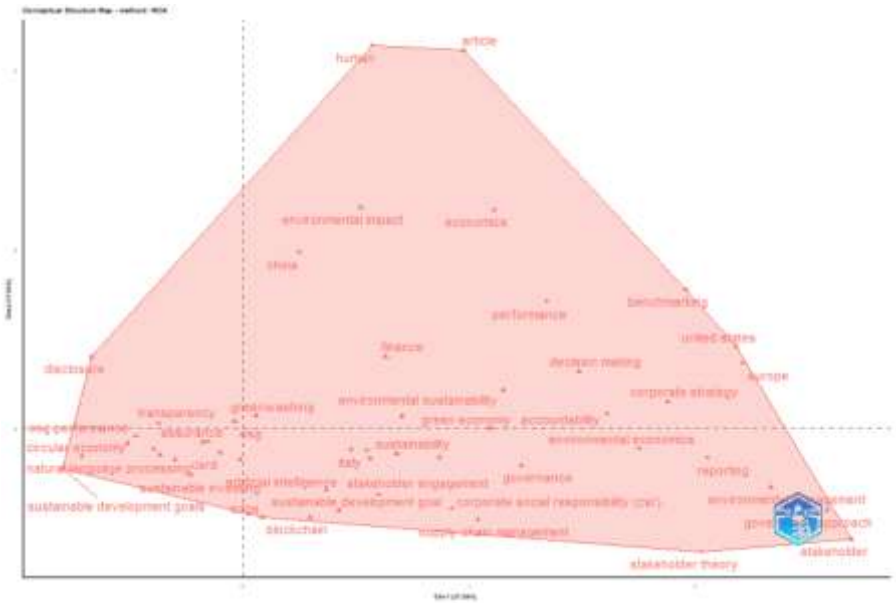

Figure 5. Keyword co-occurrence network

Greenwashing has evolved from a discussion on marketing ethics into a measurable accountability failure within the ESG ecosystem. The literature identifies three main dimensions: manipulation of disclosure quality in accounting research (Michelon), symbolic legitimacy strategies in corporate behavior (Delmas), and regulatory avoidance through practices such as regulatory greenwashing, particularly in response to frameworks like CSRD. The development of research also shows a clear progression over time. In 2020–2021, studies focused on stakeholder theory and environmental management under external pressure. By 2023–2025, attention shifted to critical evaluation of sustainability reporting as a transparency tool. In 2025–2026, the focus becomes more technical, emphasizing standardized ESG disclosure supported by AI, NLP, and blockchain to enable automated detection and ensure data integrity in sustainability reporting.

Based on Figure 6, which answers RQ_7, it is clear that greenwashing has become a central point connecting various crucial dimensions of current corporate reporting. This phenomenon is driven by strong pressure from stakeholders and demands for Corporate Social Responsibility (CSR), which force companies to align with environmental norms to maintain their reputation and legitimacy. The close relationship between the greenwashing node and ESG and ESG disclosure indicates that companies' ambition to achieve high sustainability scores in the capital market is often a key driver of information manipulation, especially when they have not been able to effectively integrate environmental management into their operations.

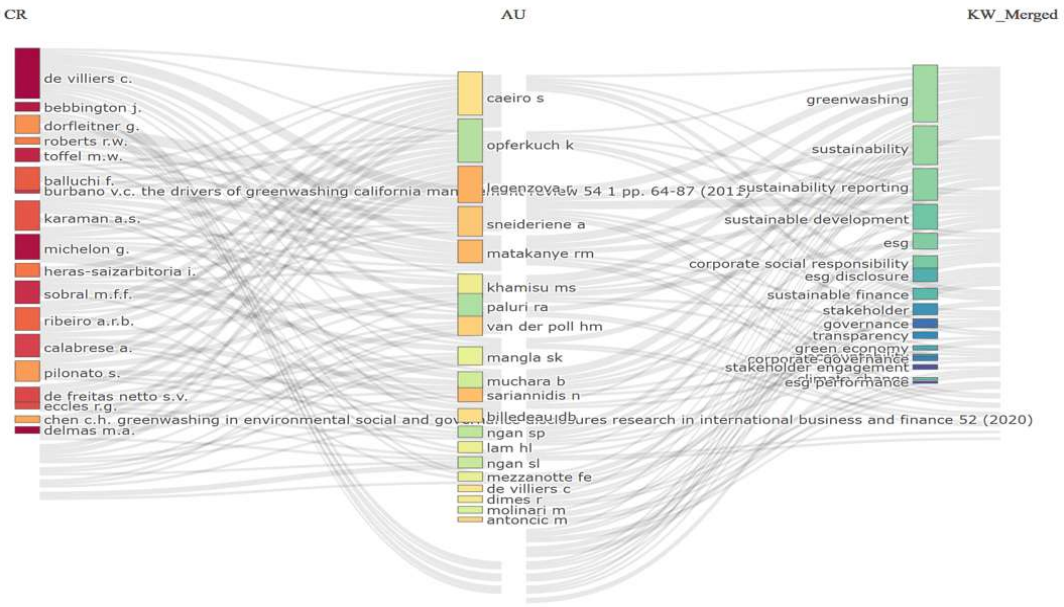

Figure 6. Network visualization

Current literature shows that greenwashing detection is primarily based on critical analysis of sustainability reporting to identify gaps between corporate claims and actual performance. From a governance perspective, detection also involves assessing how effectively internal governance structures ensure transparency and accountability. In addition, the circular economy perspective strengthens detection by emphasizing operational verification, where green claims must be supported by real implementation of sustainable practices rather than symbolic disclosure. Overall, research in the 2020–2026 period highlights a growing focus on aligning disclosure with verifiable environmental actions. Bibliometric mapping further confirms that “greenwashing” is the dominant keyword, closely linked with sustainability reporting and corporate social responsibility, indicating its central role in the academic discourse.

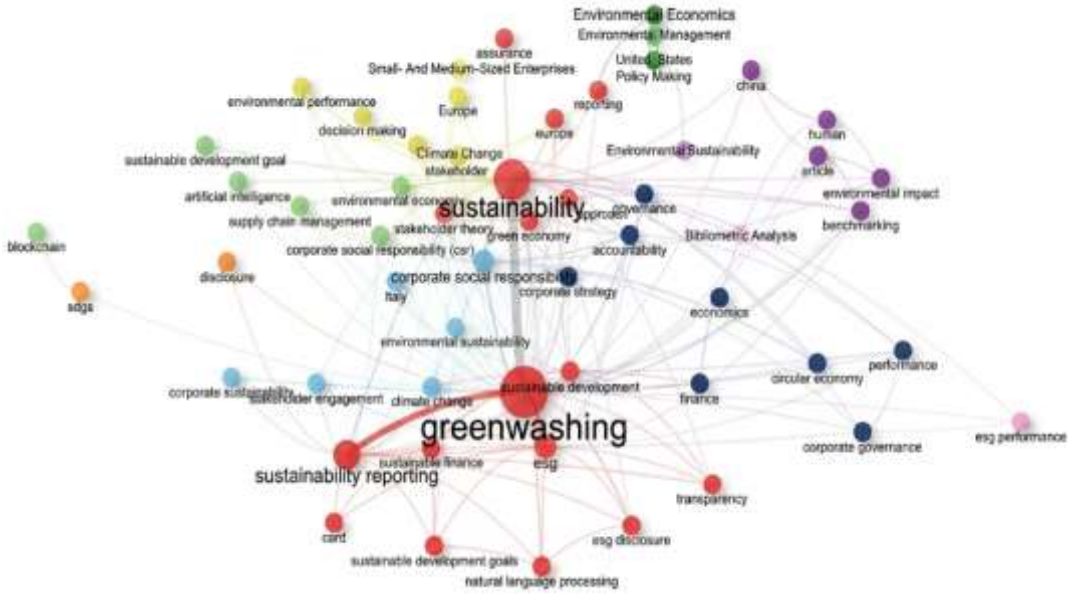

Figure 7. Keyword co-occurrence network visualization

Main labels in the network such as stakeholders, ESG, environmental management, and governance form the core contextual framework for understanding how information manipulation occurs in corporate reporting. The strong connections among these elements indicate a systemic relationship in which they function not only as triggers of greenwashing risks but also as key preventive mechanisms. Sustainability reporting and ESG disclosure operate as transparency tools that standardize environmental performance information and reduce opportunities for manipulation. Governance mechanisms strengthen accountability through internal oversight and external regulation, while environmental management systems ensure that green claims are supported by verifiable data. At the same time, stakeholders provide external pressure through market and social control. Collectively, these interconnected elements reinforce the integrity of corporate reporting through transparency, governance, and continuous public oversight.

This research mapping revealed nine thematic clusters that comprehensively analyzed the greenwashing ecosystem to answer *RQ9*. The main dominance is seen in the first cluster (Red) with the label Greenwashing (88), which becomes the epicenter of the discussion by integrating fundamental aspects such as sustainability reporting (45), ESG disclosure (10), and stakeholders' roles (9). This relationship confirms that the core of the research focuses on how environmental information is manipulated in sustainability reports to meet the expectations of stakeholders.

Table 6. Thematic clustering analysis

Words	Cluster	Cluster Label	Colors
Greenwashing, Sustainability, Sustainability Reporting, Esg Disclosure, Stakeholder, Governance, Esg Performance, Stakeholder Engagement, Corporate Social Responsibility (Csr), Governance Approach, Corporate Sustainability, Assurance, Italy, Reporting, Stakeholder Theory, Sustainable Investing, Communication, Csr, Ethics, Global Reporting Initiative, Spatiotemporal Analysis, Australia, Civil Society, Climate Risk, Conceptual Framework, Corporate Communication, Corporate Social Performance, Csr Disclosures,			

Words	Cluster	Cluster Label	Colors
Environmental, Social, And Governance (Esg), Esg Communication, European Green Deal, Ghg Emissions, Greenhushing, Gri, Impression Management, China, Industrial Performance, Information Management, Legitimacy, Management Practice, Mining Industry, Readability, Strategic Silence, Sustainability Assurance, Sustainability Committee, Sustainability Disclosure, Sustainability Report, Sustainability Reporting Assurance	1	Greenwashing	Red
Esg, Green Economy, Accountability, Corporate Governance, Corporate Strategy, Economics, Sdgs, Finance, Performance, Bibliometric Analysis, Environmental, Social, And Governance, Innovation, Big Data, Energy Sector, Environmental Monitoring, Green Development, Green Finance, Green Innovation, Investing, Regulatory Approach, Risk Management, Sustainability Governance	2	Esg	Dark Blue
Corporate Social Responsibility, Sustainable Finance, Sustainable Development Goals, Circular Economy, Csrd, Natural Language Processing, Artificial Intelligence, Double Materiality, Environment, Eu Taxonomy, Bibliometrics, Big Data Analytics, Circularity Indicator, Competitiveness, Compliance, Corporate Sustainability Reporting, Corporate Transparency, Due Diligence, Esg Investing, European Union, Industrial Enterprise, Information Disclosure, Institutional Theory	3	Corporate Social Responsibility	Light Blue
Sustainable Development, Transparency, Benchmarking, Supply Chain Management, Blockchain, Carbon Footprint, Content Analysis, Corporates, Emission Control, Greenhouse Gas, Carbon Emissions, Corporate Financial Performance, Economic and Social Effects, Esg Controversies, Greenhouse Gas Emission, Investments, Life Cycle, Net Zero, Supply Chains	4	Sustainable Development	Light Green
Climate Change, Europe, Decision Making, Financial Performance, Data Envelopment Analysis, Environmental Factor, Green Accounting, Small- And Medium-Sized Enterprises	5	Climate Change	Yellow
Environmental Economics, Environmental Management, Environmental Performance, United States, Environmental Policy, Investment, Policy Making, Sustainability Accounting, Advertising,Brown Washing, Business, Environmental Conditions, Environmental Disclosure, Environmental Responsibility, Esg Assurance, Esg Rating, Greenwashing Prevention, Performance Assessment	6	Environmental Economics	Dark Green

Words	Cluster	Cluster Label	Colors
Disclosure, Article, Human, Environmental Sustainability, Environmental Impact, Biodiversity, Commerce, Commercial Phenomena, Carbon Emission, Certification, Data Quality, Environmental Impact Assessment, Government, Industry, Information Asymmetry, Interpersonal Communication, Manufacturing, Multinational Corporation, Organization, Private Sector, Social Responsibility, Socioeconomics	7	Disclosure	Purple
Sustainable Development Goal, Green Washing, Business Development, Climate Governance, Sdg Washing, Sustainable Development Goals (Sdgs)	8	Sustainable Development Goal	Orange
Esg Reporting, Financial Materiality	9	Esg Reporting	Pink

Table 6 a clear shift toward a more technical and multidisciplinary framework in greenwashing studies. The second and third clusters highlight ESG and CSR as core themes, while the emergence of AI, Natural Language Processing, and other digital tools signals a methodological transformation toward automated analysis of corporate disclosures. Additional clusters expand the discussion into supply chain transparency, climate policy in Europe, environmental economics, SDG-washing, and financial materiality, showing that greenwashing is now studied across technological, economic, and governance dimensions.

Future research should therefore focus on integrating Big Data Analytics, AI, and NLP to detect manipulation in corporate reporting, alongside blockchain technology to enhance supply chain transparency and reduce false claims. Studies should also address emerging risks such as SDG-washing, evaluate new regulatory frameworks like CSRD and double materiality, and strengthen research on SMEs and sustainability assurance to improve the overall quality and reliability of ESG disclosures.

4.2 Discussion

Recent research suggests that the transition from voluntary disclosure to mandatory regulation is key to combating environmental information manipulation. Luu, Le, Luu, and Nguyen (2025) revealed that mandatory greenhouse gas emissions reporting programs significantly reduced greenwashing, particularly among large companies with high levels of environmental innovation, by forcing companies to align their claims with substantive ESG performance. However, the effectiveness of these regulations remains a challenge in high-carbon sectors. Siddique, Karim, Haque, and Mia (2025)noted that despite regulatory pressure to increase disclosure volume, many companies still use ESG reports as a symbolic impression-management tool rather than reflecting real operational changes.

Conversely, strong internal governance has emerged as a second line of defense in maintaining reporting integrity. Permatasari, Rosyidah, Sabaruddin, Embuningtiyas, and Yuniawati (2025) highlighted how the existence of sustainability committees in the ASEAN-5 region effectively mitigates greenwashing practices by increasing internal accountability, although their effectiveness depends heavily on the company's maturity level and the local regulatory environment. The widespread phenomenon of information manipulation, which now includes SDG and diversity washing, has prompted the adoption of stricter global governance standards, such as ISO 37000:2021, to ensure deeper transparency across non-financial parameters (Asif et al., 2023). Literature mapping using a bibliometric approach shows that recent research trends are increasingly focused on strengthening ESG policies and measurable reporting. Balaji (2025) highlights that despite growing global ESG regulations, there is still a major gap in the use of advanced technologies such as AI and blockchain for verifying sustainability claims. From a Legitimacy Theory perspective, greenwashing emerges as a corporate response to increasing regulatory and social

pressure, where firms may rely on symbolic disclosure rather than substantive environmental improvements to maintain legitimacy.

This study further identifies emerging research directions, including the integration of greenwashing with digital verification technologies (AI and blockchain), the role of internal governance mechanisms (e.g., sustainability committees and oversight quality), and the expanding linkage of greenwashing with ESG performance, corporate governance, and sustainable finance. These findings indicate a shift from detection-oriented studies to prevention-oriented and system-based approaches. Despite stronger regulations, a persistent gap remains between symbolic disclosure and actual performance, especially in high-emission sectors. Overall, this study shows that greenwashing is a dynamic phenomenon shaped by the interaction of regulation, governance, and technology. It also refines the research questions on how regulatory pressure and governance affect greenwashing, and whether technology and global standards can reduce the gap between disclosure and real sustainability performance.

5. CONCLUSIONS

5.1 Conclusion

Analysis of 174 Scopus-indexed articles shows that greenwashing research has evolved into a systemic risk issue within sustainable finance and corporate governance. Publication trends peaked in 2025, indicating ESG transparency has become a strategic requirement rather than a voluntary practice. The literature is dominated by countries with strong regulatory frameworks, while Indonesia also shows increasing contribution from developing economies. The focus has shifted from general CSR topics to more technical ESG disclosure analysis, particularly the gap between reported claims and actual corporate performance. The use of big data analytics and text mining is increasing to detect misleading disclosures, although regulatory efforts must avoid unintended effects such as green-hushing. Overall, effective mitigation requires integrated approaches combining standards, auditing systems, and advanced technologies. From a legitimacy theory perspective, firms continuously adjust disclosures to maintain social legitimacy under stakeholder pressure.

5.2 Research Limitations

Future research should move beyond traditional financial variables by adopting interdisciplinary and technological approaches. This includes integrating multiple databases (Scopus, Web of Science, Google Scholar) and applying AI-based and linguistic methods such as Semantic Gap Score and AI adoption in reporting. Governance studies should expand into digital governance using blockchain-enabled transparency and digital audit trails, while organizational and external factors such as CEO traits, board tech-savviness, sentiment analysis, media scrutiny, and ESG rating divergence should also be explored. Future studies should also address emerging phenomena (green-hushing, blue-washing, SDG-washing) and apply cross-country comparisons with mixed-method validation.

5.3 Suggestions and Directions for Future Research

Future studies should incorporate technological and psychological dimensions to better understand greenwashing prevention. Key variables include AI-based linguistic analysis (Semantic Gap Score, AI adoption in reporting), digital governance tools (blockchain transparency, digital audit trails), and organizational behavior factors (CEO narcissism/overconfidence, board tech-savviness). In addition, external pressure indicators such as public sentiment analysis, media scrutiny, and ESG rating divergence should be used to detect manipulation. Overall, integrating these elements will strengthen theoretical and empirical understanding of greenwashing in the digital era.

AUTHOR CONTRIBUTIONS

MPA conceptualized and designed the study, conducted the bibliometric analysis, and was responsible for the overall methodology and the data interpretation. AK contributed to the literature review, assisted with data collection and analysis, and provided valuable insights into the evolving

trends in greenwashing research. LA supported the data analysis process, assisted with the interpretation of the trends, and contributed to the writing and revision of the manuscript. All authors have reviewed and approved the final manuscript.

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