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# Research trends in environmental information disclosure: A bibliometric analysis

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**ABSTRACT**

*This study aimed to investigate the development of environmental information disclosure (EID) research publications from 1992 to 2024 to identify trends and provide valuable insights to researchers in related fields. This study employed performance analysis and science mapping strategies, utilizing VOSviewer software and the Biblioshiny function within the R package software, to achieve its research objectives. The results reveal a gradual growth in the number of citations and published publications related to EID topics, and this trend is projected to continue in the upcoming years. The journal "Sustainability" has the most papers, but "Journal of Cleaner Production" has the most citations. Li, Y., Yang, Y.L. and Yao, S. are the most productive authors in terms of number of publications, however, Zeng, S.X., Garcia-Sanchez, I.M. and Gallego-Alvarez, I. are recognized as having papers ranked in the H-index and G-index, respectively. In addition, thematic map analysis indicates terms in two groups, including Niche and Motor themes should be the focus key terms of future research. Additionally, the results indicate that environmental, social, and governance (ESG) performance, digital transformation, EID, and green innovation are among the top topics in terms of research trends for recent three years (2022-2024). This study suggests several potential future research directions by examining the relationship between these terms in different countries and industries.*

## 1. INTRODUCTION

The concept of corporate social responsibility (CSR), with a specific emphasis on sustainability in the economic, environmental, and societal contexts, has recently garnered significant attention. In addition to exceptional financial performance and profitability, corporations are expected to fulfill a wide range of social, environmental, and ethical obligations (Gao et al., 2021). As a result, the world is witnessing a shift towards environmental, social, and governance (ESG) practices, particularly in established economies. Instead of short-term profit maximization, publicly traded companies are increasingly adopting long-term, sustainable ESG objectives (Zhao et al., 2018). The implementation of ESG practices, which consists of three essential components, demonstrates a company's dedication to the well-being of its stakeholders, as well as to social and environmental concerns that align with societal interests (Reboredo & Sowaity, 2022). Furthermore, by highlighting their commitment to environmental stewardship, businesses can enhance their missions and brand reputation. Disclosure of environmental information, often referred to as

Environmental Information Disclosure (EID), is a critical aspect of corporate planning.

ESG reporting, also known as ESG disclosure, has recently attracted considerable attention. According to a study by Qiu et al. (2016), ESG reporting, which is believed to have originated from a facet of CSR reporting, is believed to have favorable financial consequences. Liu and Anbumozhi (2009) further emphasized the increased significance of environmental concerns for stakeholders through ESG reporting, which encourages organizations to reveal more information about their environmental performance and proactively improve their environmental impact. A relationship exists between the disclosure of non-financial information and improved financial performance, ultimately benefiting stakeholders (Ezeagba et al., 2017; Alipour et al., 2019).

Environmental practices and regulations have been of interest to governments and educational institutions worldwide since the 1970s (Chand et al., 2022). Recently, in developed nations, companies have begun formally exploring and adopting environmental accounting, a trend that appeared in the 1990s (Chand et al., 2022). The American Institute of Certified Public Accountants published Environmental Repair Liabilities in the 1990s, offering comprehensive guidance on confirming, measuring, and demonstrating environmental accounting liabilities (Nie, 2019). Environmental accounting empowers managers to make decisions that minimize adverse environmental impacts. The concept of environmental accounting has been defined in various ways by different authors (Ilelaboye & Alade, 2022). EID refers to reporting a company's resource consumption and environmental protection efforts (Gray et al., 1995). Environmental information encompasses a diverse range of topics, including materials, energy and water consumption, biodiversity, emissions, and environmental grievance procedures. This information is crucial for protecting the environment, preventing and eliminating pollution, using environmental resources, and other environment-related financial information, such as environmental assets, liabilities, benefits, costs, and performance (Nie, 2019). Non-financial information such as environmental information may be provided in annual, sustainability, or CSR reports. Various international organizations, such as the Financial Accounting Standards Board (FASB), the Global Sustainability Standards Board (GSSB), Directive 95/2014/EU, and the International Accounting Standards Board (IASB), have set guidelines for reporting both financial and non-financial information in annual reports. Environmental data points are widely considered important. The Global Reporting Initiative (GRI) is a comprehensive set of globally accepted principles and guidelines for assessing and disclosing social and environmental performance (Ismail et al., 2021a). The information offered by these guidelines spans economics, ecology, human rights, and society. The Environmental Information Disclosure Index is also included in the GRI rules (GRI, 2021).

Numerous aspects of EID have been thoroughly explored. A series of studies have delved into the determinants of EID (Liu & Anbumozhi, 2009; Gamerschlag et al., 2011; Chand et al., 2022). Some studies have focused on examining the relationship between EID and financial performance (Qiu et al., 2016; Ilelaboye & Alade, 2022). Nevertheless, research on EID remains a topic of debate because of the mixed findings based on various countries' regulations. Furthermore, EID is believed to have a positive impact on firms by promoting sustainable business practices, particularly in terms of the environment. As a result, studying EID topics raises global awareness.

Besides, there has been growing interest among scholars in conducting bibliometric analyses, as shown by recent studies (Donthu et al., 2021; Gao et al., 2021; Rodrigues et al., 2021; Bakır et al., 2022). Bibliometrics is a multidisciplinary field that combines quantification, mathematics, statistics, and philology (Gao et al., 2021). The availability of scientific databases such as Scopus and Web of Science has eased the collection of bibliometric data, while software programs such as Gephi, Leximancer, and VOSviewer have simplified data analysis (Donthu et al., 2021).

Proper use of bibliometric analysis in a literature review effectively manages extensive scientific data and produces a significant research impact (Donthu et al., 2021). This type of analysis often involves examining the top institutions, authors, and countries that have published on the topic (Zhang et al., 2021). By conducting a bibliometric analysis, future authors can gain a clearer understanding of the contributions made to specialized fields and aid research experts in their work. This form of analysis also helps to find research topics using scientific mapping, which involves conducting a literature review to assess the major topic and theme clusters within a discipline and provides a clear agenda for

future research with reduced subjectivity (Zhang et al., 2021).

Contemporary literature reviews use a bibliometric technique, which offers an advantage over traditional narrative literature reviews. Prior to reading the narrative literature review, other researchers could benefit from bibliometric techniques by focusing on important articles. It enhances the subjective assessment of a narrative literature review and figures out how current research affects scholarly communities (Abdullah et al., 2017). By examining the visual results of bibliometric analyses, researchers can obtain a better understanding of how scientific fields are combined and change. These characteristics differ between bibliometric and narrative literature reviews.

To the best of our knowledge, there is little bibliometric literature on the disclosure of environmental information, although scholars have stated that there is an existing bibliometric literature on ESG and sustainability disclosure. A recent review of ESG by Gao et al. (2021) used the Scopus database to find trends and trajectories in the topic through performance analysis and science mapping, accompanied by visual aids. Ellili (2022) highlighted the implications of ESG disclosure practices by conducting a bibliometric analysis and systematic review of the Scopus database. Although corporate sustainability is universally recognized as a key indicator of ESG, the specific topic of environmental responsibility remains under-researched (Nassreddine, 2022). Gao et al. (2021) emphasized that ESG also encompasses environmental responsibility, yet results in this specific area are scarce. Khan (2022) conducted a meta-analysis and bibliometric analysis to identify potential research on ESG disclosure and financial performance for ten years. Abdullah et al. (2017) conducted a bibliometric analysis of disclosures that included financial and non-financial information in annual reports. These studies underscored the significance of ESG disclosure and highlighted the importance of EID as a long-term strategy for managers. Although some studies have emphasized the importance of ESG disclosure, research on environmental responsibility is limited. Therefore, managers must consider EID in their long-term strategies. In addition, Wan et al. (2023) applied bibliometric analysis to examine ESG topics by analyzing 755 papers from 2004 to 2021 using VOSviewer and CiteSpace. However, their research only focuses on business, business finance, economics, and management categories, and the analyses might not have fully covered all articles related to the ESG field. Consequently, it is essential to analyze the current research topic and provide future directions in the field of EID. This study focuses on EID topics by adopting performance analysis, including authorship, number of citations, journal sources, publishers, institutions, countries, years of publication, categories, author keywords, and thematic maps. Thus, a topic trend can be drawn in this area of knowledge. Using bibliometric analysis, this study aims to define trends and provide relevant information to researchers working in related fields by ascertaining the trajectory of EID research publications from 1992 to 2024 from the Web of Science (WoS) database. This study examines a limited number of studies on EID and its broader implications and seeks to compare the topics selected by the authors. Specifically, this study addressed the following research questions:

*Research Question 1*: What are the development and knowledge structures related to EID?

*Research Question 2:* What are the EID's research trends and focus areas?

## 2. METHOD

### 2.1. Database

WoS and Scopus are the two most comprehensive databases used for bibliometric analysis (Chadegani et al., 2013). Although Scopus is more convenient for bibliometric analysis (Gao et al., 2021), WoS performs noticeably better than Scopus in terms of journal classification system accuracy (Wang & Waltman, 2016). Additionally, scientists have debated and discussed the citation analysis provided by WoS, which offers superior graphics and greater detail than Scopus (Falagas et al., 2008). Because bibliometric methodology involves applying citation analysis to bibliographic data (Donthu et al., 2021), a comprehensive and detailed source of citation analysis is essential. Moreover, WoS is more selective than Scopus and Dimensions in terms of journal coverage, as highlighted by Singh et al. (2021). Consequently, this study searched the WoS database for relevant document sources based on these rationales.

### 2.2. Search strategy and process

This study employed Boolean operators as a search strategy to identify relevant documents in EID terms. Specifically, the authors employed the "AND" and "OR" operators to narrow down their search by exploring the database. The authors executed a search using the keyword

'*Environmental Information Disclosure*' in *the title, abstract, and author keywords*. Given that this study aims to provide an overview of the current research on the topic, the authors selected documents from WoS journal categories with a minimum of 30 articles. The number of articles in this database varied between specialized and non-specialized subjects. For instance, t*he Business Finance, Management, Business, Economics, and Environmental Studies* categories contain a significant number of articles compared to non-specialized subjects, such as Sociology, Telecommunications, and Physical Geography, which have fewer articles. As a result, the study included papers from specialized journals to offer a complete understanding of each field. Additionally, the documents were limited to those in English and belonged to the articles, early access, and limited access categories. These criteria were established to ensure the readability and relevance of the collected papers. Finally, 1,726 documents were selected for the analysis.

### 2.3. Methodology

This study employed two widely utilized bibliometric methodologies—performance analysis and scientific mapping—to elucidate the literature and evaluate the coherence of topics within it. Furthermore, this study used two prominent software programs, including VOSviewer and Biblioshiny, in the R package, to perform these strategies.

Performance analysis is a common feature in most literature reviews (Donthu et al., 2021). This study incorporated it to assess the frequency of citations, which serves as an indicator of a literature's overall performance (Gao et al., 2021). Furthermore, this study included publication metrics, such as authors, institutions, nations, and journals. While empirical research typically presents participants' backgrounds or profiles analytically (Donthu et al., 2021; Wan et al., 2023), this study focuses on the metrics mentioned above.

Scientific mapping illustrates the structure and dynamics of a topic (Abdullah et al., 2017). To achieve this, this study uses various tools, such as citation analysis, co-citation analysis, keyword occurrence analysis, and co-authorship analysis (Donthu et al., 2021). Citation analysis allows researchers to comprehend the impact of journals, papers, and authors in the field, whereas co-citation analysis uses computational methods to analyze the complex relationship between various papers and express the relationship between them. Keyword co-occurrence analysis examines word relationships and identifies research hotspots (Gao et al., 2021) with the main goal of revealing the similarity between words. The analysis of keyword co-occurrences produced a topical relational network. Using this network, the degree of relatedness between the subjects being investigated was effectively illustrated. This analysis is important because researchers can identify current research hotspots and probable future study topics by examining the co-occurrence of phrases in their research (Donthu et al., 2021; Gao et al., 2021; Stefanescu, 2021; Wan et al., 2023).

## 3. RESULTS AND DISCUSSION

### 3.1. Performance analysis

*3.1.1. Overview information*

**Table 1. Overall statistics of data**

| Background information | Results |
|---|---|
| Timespan | 1992:2024 |
| Sources (Journals, Books, etc.) | 494 |
| Documents | 1,726 |
| Annual Growth Rate % | 19.15 |
| Document Average Age | 4.65 |
| Average citations per doc | 29.92 |
| Author's Keywords | 3,955 |
| Authors | 4,257 |
| Authors of single-authored docs | 186 |
| Publication per author | 0.41 |
| Authors per publication | 2.47 |
| Single-authored documents | 197 |
| Co-Authors per document | 2.97 |
| International co-authorships % | 24.57 |

*(Source: Web of Science database, 2024)*

Table 1 provides a summary of the statistical outcomes derived from the bibliometric data analysis. The investigation encompassed 1,726 papers, primarily consisting of articles and early access journals that were published over 32 years ago and focused on EID as a keyword found in the title, abstract, and authors' keywords. Specifically, the dataset included 1,615 articles, 98 early access articles, 11 proceedings papers, and 2 early access reviews. These documents were sourced from 494 journals and books. On average, each document received 29.92 citations. Furthermore, 4,257 authors have contributed to this topic, resulting in 1,726 documents. The number of publications per author was 0.41, whereas the number of authors per document was 2.47. In addition, the number of co-authors per publication, including the main author, was 2.97.

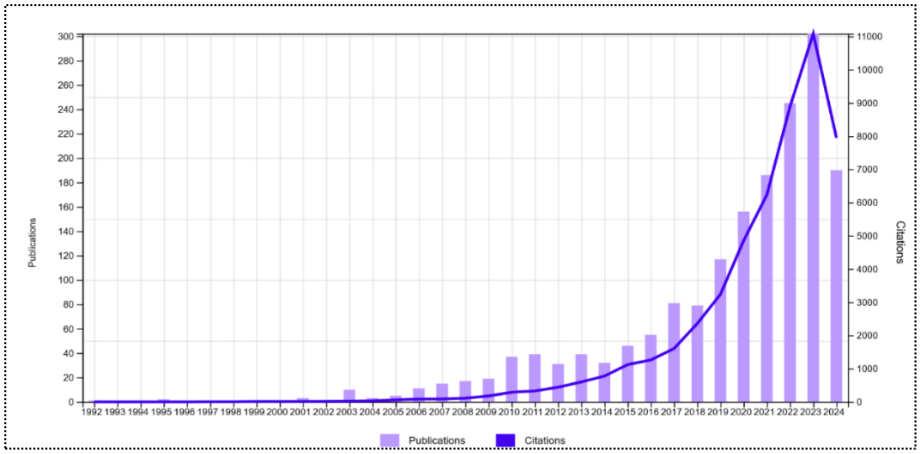


**Figure 1. Number of publications and citations**

*(Source: Web of Science database, 2024)*

### *3.1.2. Publication trend*

Over the past three decades, there has been a discernible upward trend in the publication and citation of EID. As depicted in Figure 1, scientific output during this period has been increasing. Since 2006, the publication and citation rates have significantly increased. It should be noted that this study collected documents until August 2024, implying that findings do not fully represent the entire year 2024. Furthermore, the annual rate of increase in scientific output is estimated to be 19.15%.

### *3.1.3. Leading countries in EID research*

A bibliometric analysis was conducted to assess the most influential authors, organizations, universities, and nations in a particular subject based on their contributions (Zhang et al., 2021). Regarding nations, Table 2 presents a list of the top ten countries that have produced a substantial number of documents in this area.

**Table 2. The most productive countries**

| Rank | Country | No. of documents | Citations | Articles citation/documents |
|---|---|---|---|---|
| 1 | China | 1,476 | 12,205 | 8.269 |
| 2 | USA | 426 | 9,434 | 22.146 |
| 3 | UK | 193 | 3,997 | 20.710 |
| 4 | Italy | 184 | 2,600 | 14.130 |
| 5 | Australia | 172 | 4,725 | 27.471 |
| 6 | Spain | 166 | 3,031 | 18.259 |
| 7 | Canada | 97 | 1,637 | 16.876 |
| 8 | Brazil | 90 | 324 | 3.600 |
| 9 | France | 80 | 1,063 | 13.288 |
| 10 | India | 79 | 426 | 5.392 |

*(Source: Web of Science database, 2024)*

The examination of the most influential and productive countries is an integral part of bibliometric analysis. Over the past 32 years, 83 countries have made significant contributions to EID research, with both developed and developing nations producing articles with an EID focus. As shown in Table 2, China, the USA, the United Kingdom, Italy, and Australia are among the top five countries in terms of publishing articles. This suggests that the majority of the top countries for paper production are highly developed nations, except China. China was found to have the highest number of publications and citations in the EID field, with 1,476 publications and 8,269 article citations/documents. Although the USA has fewer documents than China, the number of citations per document is nearly three times higher. Additionally, other developed countries, such as the UK, Italy, and Australia, have fewer publications than China, but their number of citations/documents is consistently

higher. This suggests that China is increasingly focusing on investigating the EID field, but the articles produced in China are not cited as much as those from developed countries. This can be attributed to the superior legislation on environmental information disclosure in developed countries. Moreover, developing nations, such as Brazil and India, are increasingly showing interest in EID research.

### *3.1.4. Productive Journals*

The journals with the most significant influence on publications were explored in this study. A total of 1,726 papers were published in 494 journals. The ten (10) most prestigious and successful journals are listed in Table 3. Sustainability had the most publications (145 papers and 2,339 citations). On the other hand, the Journal of Cleaner Production was the journal with the most cited articles, with 5,354 citations among its articles. This demonstrates that these two publications are at the forefront of their respective fields. According to Bradford's law, a small number of core journals are responsible for a sizable share of the articles published on a specific topic (Garfield, 1980). As a consequence, the eleven journals entitled Sustainability, the Journal of Cleaner Production, Business Strategy and the Environment, Corporate Social Responsibility and Environmental Management, Sustainability Accounting Management and Policy Journal, Journal of Business Ethics, Environmental Science and Pollution Research, Social Responsibility Journal, Environmental Development and Sustainability, Journal of Environmental Management, and Frontiers in Environmental Science are responsible for 33 percent of all the research that has been conducted in the field of EID, as illustrated in Figure 2. The prestigious publications to which authors submit their work are presented below along with further advice for submitting articles in the future. These journals have provided additional suggestions for authors to select suitable journals.

**Table 3. Most productive journals**

| | Sources | Articles | Citations |
|---|---|---|---|
| 1 | Sustainability | 145 | 2,339 |
| 2 | Journal of Cleaner Production | 96 | 5,354 |
| 3 | Business strategy and the environment | 62 | 3,394 |
| 4 | Corporate social responsibility and environmental management | 58 | 2,288 |
| 5 | Sustainability Accounting management and policy journal | 40 | 1,296 |
| 6 | Journal of business ethics | 38 | 4,751 |
| 7 | Environmental science and pollution research | 33 | 545 |
| 8 | Social responsibility journal | 32 | 785 |
| 9 | Environmental Development and Sustainability | 30 | 237 |
| 10 | Journal of Environmental Management | 30 | 769 |

*(Source: Web of Science database, 2024)*

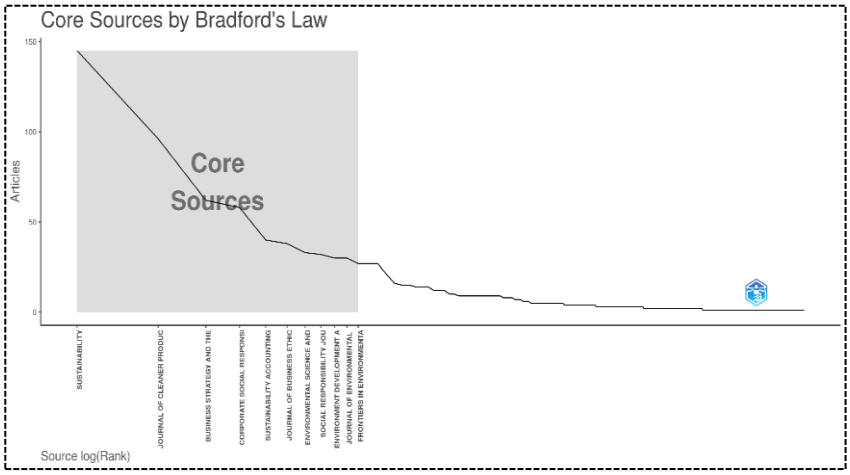


**Figure 2. Source clustering through Bradford's Law**

*(Source: Web of Science database, 2024)*

*3.1.5. Productive Authors*

The authors' publications, which were also examined, are components of the performance analysis. This study also identified authors who had been investigating EID issues for over 30 years. Table 4 shows the top authors regarding the number of documents, as well as the H-index and G-index. A single numerical indicator, the H-index, can assess a researcher's level of scientific accomplishment. It assesses a scientist's output based on the combined number and calibration of all publications (Hirsch, 2005). The G-index sharpens when a researcher receives a "G" score if and only if their five most-cited articles have been mentioned more than "G" times. For this reason, G-indices can draw attention to influential works by identifying the most frequently cited works (Tol, 2008). However, there was little difference between the G-index and H-index in terms of the rankings and values they yielded (Huang & Chi, 2010).

Table 4 shows that the highest number of documents produced by authors during the examination period was 13 documents. Generally speaking, the majority of authors among the top ten are of Chinese nationality. Specifically, Li, Y; Yang, Y.L. and Yao, S are three authors who have produced the largest number of documents, totaling 13 articles during the survey period. In addition, most of the top authors who have a figure of publications in the statistics are Chinese.

Although Li, Y., Yang, Y.L. and Yao, S. have the most publications, their H-index and G-index are lower than those of Zeng, S.X., Gallego-Alvarez, I. and Garcia-Sanchez, I.M. Particularly, based on the scores of citation indices, Zeng, S.X. is recognized as having the highest H-index and G-index scores, followed by Garcia-Sanchez, I.M and Gallego-Alvarez, I. In addition, Chen, X.H.; Cormier, D; De Villiers, C.; Meng, X.H.; and Magnan, M. are authors who are not in the top ten in terms of output but have high H- and G-index publications, making them top-ranking authors.

Zeng's research investigates the factors influencing voluntary disclosure of environmental information, as well as the impact of financial performance on environmental responsibility disclosure in the Chinese context. Meanwhile, Garcia-Sanchez's work is centered on the European setting, with key topics including environmental innovation, sustainability disclosure, corporate governance, and corporate social responsibility assurance quality. Gallego-Alvarez, on the other hand, has conducted research on a range of global topics, such as corporate social responsibility, greenhouse gas emissions, environmental disclosure, and environmental responsibility. These authors have contributed to the existing literature on EID research in developed and developing countries.

**Table 4. Author impact is measured by the number of produced documents, the H-index, and the G-index.**

| Authors | No. of documents | H-index | G-index |
|---|---|---|---|
| Li, Y | 13 | 7 | 13 |
| Yang, Y.L. | 13 | 7 | 10 |
| Yao, S | 13 | 7 | 10 |
| Zeng, S.X. | 12 | 12 | 12 |
| Zhang, L | 12 | 7 | 12 |
| Gallego-Alvarez, I. | 10 | 9 | 10 |
| Li, H | 10 | 8 | 10 |
| Lu, J. | 10 | 8 | 10 |
| Garcia-Sanchez, I.M. | 9 | 9 | 9 |
| Raimo, N | 9 | 6 | 9 |
| Chen, X.H. | 7 | 6 | 7 |
| Cormier, D. | 8 | 6 | 8 |
| De Villiers, C. | 8 | 8 | 8 |
| Meng, X.H. | 8 | 8 | 8 |
| Magnan, M. | 8 | 7 | 7 |

*(Source: Web of Science database, 2024)*

**3.2. Science mapping analysis**

*3.2.1. Keyword co-occurrence analysis*

In these papers, the keywords that were employed shed light on prominent themes and issues associated with the subject of research (Bakir et al., 2022). An in-depth analysis of the prevalence of relevant keywords and the development of recurring themes within the field of business studies was conducted to find the most potential pathways for future studies on EID. Figure 3 depicts the co-occurrence graph of the study phrase generated by the authors using VOSviewer software. To be considered for inclusion in the study, keywords had to be set at a minimum of ten occurrences, and keywords with low occurrences were not included to form clusters. This study applied this threshold so that the node of "*environmental information disclosure*" was defined as the largest co-occurrence keyword in comparison with the node of other keywords. Earlier studies also set a minimum threshold for ten keywords (Ismail et al., 2021b; Gao et al., 2021). Out of the 3957 keywords, 88

fulfilled this condition. As shown in the figure, one part of CSR activities involves the disclosure of environmental information.

When researching the co-occurrence of terms, it is important to evaluate the number of nodes. Specifically, the dimensions of labels are expressed by their size, and a term's larger size indicates that it is related to a larger number of publications (Stefanescu, 2021). According to Gao et al. (2021), the intensity of co-occurrence between two terms is proportional to the separation between the two nodes and the thickness of the line that connects them. Five different clusters expressed interest in EID research to analyze co-occurring keywords over a 32-year period.

The key study subject of EID is presented in the first cluster, with 21 keywords. This cluster comprises keywords that have been studied since 2020. A few terms highlight the linked nature of environmental information disclosure and other current occurrences. For instance, sustainable development, ESG disclosure, digital transformation, green innovation, green technology innovation, internal control, media attention, air pollution, and public participation are some keywords in this cluster. A corporation's environmental performance serves as the starting point for environmental disclosure. EID is the process of making the public aware of the degree to which an organization's management and activities consider environmental and community concerns (Gao et al., 2021). According to Tamimi and Sebastianelli (2017), ESG disclosure can be attributed to the significance of ESG concerns in a firm's reputation, brand, competitive advantage, and investment decision-making processes. To keep up with the expansion of the capital market, publicly traded corporations are anticipated to commit to social, environmental, and long-term sustainability. However, ESG is primarily driven by investors' interest in the capital market. This cluster also explores the relationship between green innovation, ESG disclosure, green technological innovation, and digital transformation, which is expected to be a global trend in future economic development.

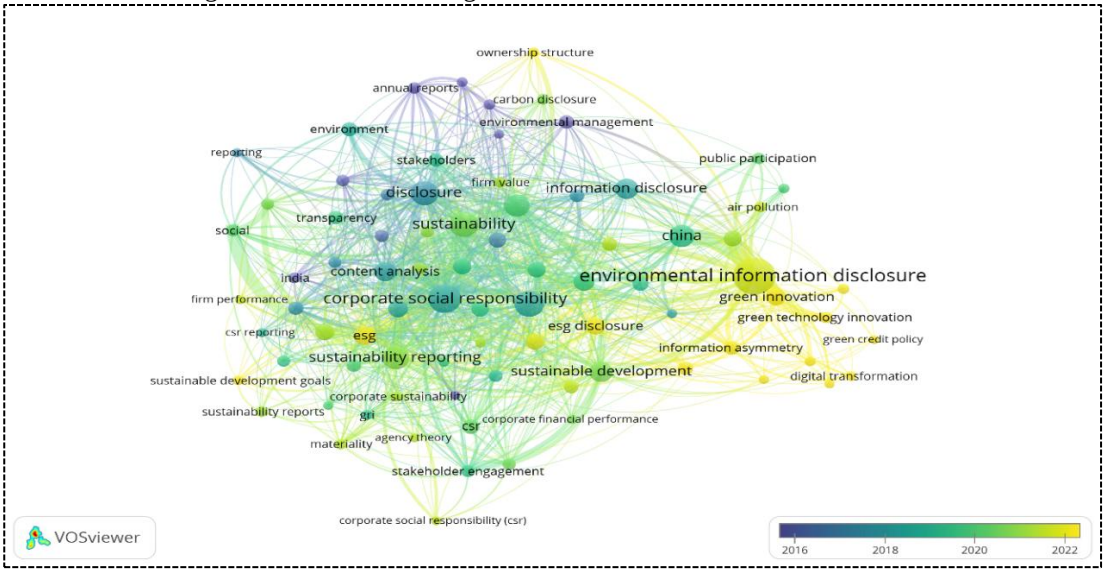


**Figure 3. Keyword co-occurrence by author's keywords**

*(Source: Web of Science database, 2024)*

Cluster 2 includes a range of topics, such as sustainability reporting, sustainability, stakeholder engagement, environmental policy, greenwashing, firm performance, carbon disclosure, and GRI. All these terms pertain to CSR. This cluster comprises 17 keywords. Considering the majority of CSR, this cluster reveals that most studies have examined it in the Indian context. CSR is defined as how businesses incorporate social, environmental, and economic concerns into their company's values, culture, strategy, decision-making, and operations in a manner that is both transparent and accountable (Reverte, 2016). Institutional theory and signaling theory are highlighted in this cluster, implying these theories are adopted to explain the relationship between variables. These theories effectively explain voluntary disclosure and CSR. Besides, CSR disclosure is also a key topic currently being

discussed. It investigates the connection between a firm's performance and its financial returns to investors. Alternatively, ESG applications are used for investor purposes and are often managed by investors' managerial boards. This cluster also examines ESG, which is inherent in implementing CSR strategies (Odriozola & Baraibar-Diez, 2017). The terms "CSR" and "ESG" do not have the same meaning, but concerns about environmental, social, and corporate governance now play an essential role in CSR to increase the well-being of a variety of stakeholders and communities (Gao et al., 2021). As "triple-line" reports that include both financial data and ESG disclosures that highlight sustainability and CSR metrics become more important. This cluster also focused on climate change and its connections to other related topics, such as carbon emissions, environmental policy, and greenwashing. The term "greenwashing" which refers to a corporate strategy for sustainability, emerges in this cluster. Yildirim (2023) explains that greenwashing has both negative and positive aspects. On one hand, it can represent a hasty departure from sustainability, while on the other hand, it may symbolize a gradual shift towards sustainability. Given that sustainable development is a crucial topic that every company needs to address to survive, examining greenwashing would be an intriguing area of research.

Cluster 3 focuses on CSR disclosure and some theories to explain CSR disclosure, including CSR disclosure, CSR reporting, environmental policy, stakeholder theory, legitimacy theory, GRI, and sustainability reports. This cluster includes 16 items. Among these terms, "*content analysis*" has emerged as a widely accepted methodology that has been widely embraced in most previous publications. This suggests that content analysis is a suitable approach to explore various types of topics. Besides, legitimacy theory, agency theory, and stakeholder theory are some theories used to explain the nexus between factors in non-financial information disclosure.

Cluster 4's primary focus is on the relationship between environmental disclosure and firms' performance and firm value. This cluster has 16 items and prioritizes environmental disclosure and financial performance. Besides, companies with higher social responsibility performance may be forthcoming with information about sustainability. By contrast, companies with poorer social responsibility performance may be less open to disclosing environmental topics. This cluster also examines the relationship between environmental disclosure and governance with the aim of providing implications for management to increase disclosure transparency.

Cluster 5 mainly focuses on the role of corporate governance and owner structure in environmental performance and reporting. This cluster's study theme was relatively small compared to the other clusters because it has 12 items. Among the disclosed ESG information, EID has the lowest disclosure score, followed by governance and social information disclosure. This cluster focuses on disclosing environmental information related to climate change, such as carbon disclosures and greenhouse gas emissions, rather than general environmental information. As recorded as the most frequently cited in examining influential publications, Liao et al. 's (2015) study on the voluntary disclosure of greenhouse gas emissions proves that it is a concern for academics and industries. EID, which is critical to CSR policies, is growing worldwide, not only in developed countries but also in developing nations. Furthermore, this cluster emphasizes the importance of corporate governance, and climate change strategies are useful for managers and regulators.

### *3.2.2. Thematic map*

Thematic mapping is essential to examine bibliometric data and trace the development of primary themes in a field. By applying a clustering method to a keyword network, a thematic map was created to highlight the various themes present (Stefanescu, 2021). The map features two axes: the centrality axis, which quantifies the connections between a cluster and other clusters, and the density axis, which describes the strength of the interconnections between the keywords that form a cluster.

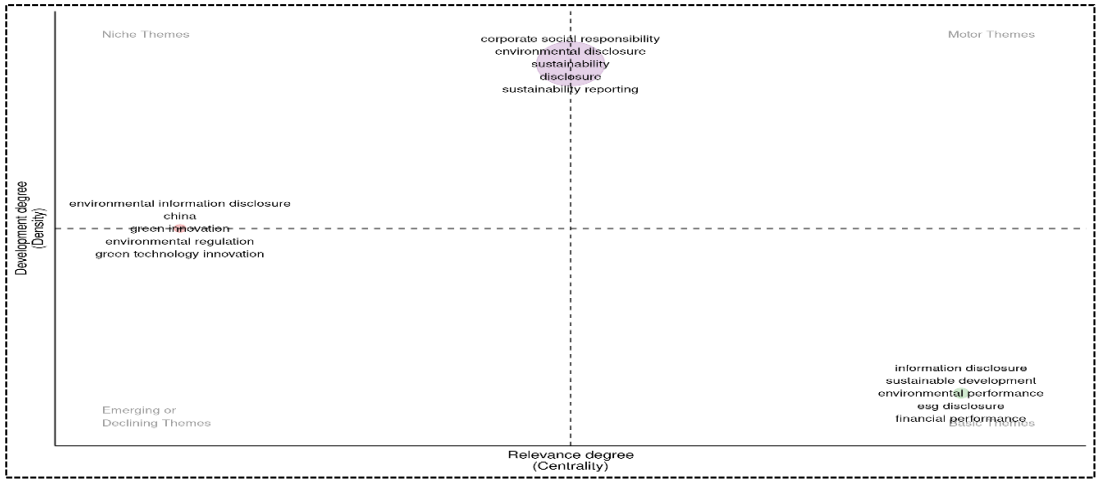


**Figure 4. The thematic map**

*(Source: Web of Science database, 2024)*

The map was divided into four quadrants based on the degree of centrality and the density of the terms. According to Bakır et al. (2022), advanced themes with high centrality and high-density values are in the upper-right quadrant, whereas less important advanced themes are in the top-left quadrant, which has low centrality and high density. Topics in the lower right quadrant, with high centrality and low density, are essential to the subject of study, but they also change over time. Themes that did not develop well were found in the lower-left quadrant with low centrality and density values. These motifs either appear recently or fade (Bakır et al., 2022).

In this study, walktraps were used to cluster algorithms while analyzing thematic maps. Figure 4 depicts a thematic map that shows a combination of motor and niche themes, making up fully integrated advanced themes. The topic between the two groups, along with key terms such as "*corporate social responsibility*", "*environmental disclosure*", "*sustainability*", "*disclosure*", and "*sustainability reporting*" are the most critical to the knowledge domain under examination. Co-occurrence analysis revealed the study topic in cluster 2 in the upper-right quadrant, confirming the research. The Niche theme includes the research topic "Environmental Information Disclosure" and "China" and "green innovation" which are highly specialized and of limited importance. This theme is also relevant to Cluster 2 in the aforementioned section. The emerging topics include "green innovation", "environmental regulation" and "green technology innovation". The key term "green innovation" is located in the middle of the Niche themes and the Emerging themes, suggesting that green innovation will also become an issue attracted by stakeholders in the future; in particular, green technological innovation is supposed to relate to sustainability (Asadi et al., 2023; Cheng et al., 2023). Consequently, it is recommended that future research explore this topic in greater depth. Likewise, the basic themes identified in previous studies on environmental information disclosure include key terms, such as "information disclosure", "sustainable development", "environmental performance", "ESG disclosure", and "financial performance".

### *3.2.3. Topic trend*

In this investigation, the "*Biblioshiny*" function from the R package was used to examine keyword trends. Figure 5 presents the outcomes of the topic trends for the period in which years are displayed along the abscissa and occurrences are depicted along the ordinate.

The graph indicates that the subject matter of EID research has been concentrated and appealing in the previous three years (2021–2024). For the past three years, six topics have attracted authors, including environmental information disclosure, ESG, green innovation, digital transformation, ESG disclosure, and performance. These trends are expected to increase in the future. However, the topic of "environmental disclosure" has been a persistent issue, lasting almost a decade from 2012 to 2021, with the most frequency in 2017, while "environmental information disclosure" has attracted authors from 2021 to 2023. ESG

performance is a trending topic for academics around the world since 2022 and has increased in frequency in the year 2024. Although ESG practices have been adopted in developed countries, developing nations lack these practices. Therefore, EID, which is one of the pillars of ESG, is expected to remain an attractive topic in the future because it is typically related to environmental reporting, sustainable development, and CSR. Specific types of content within a publication cannot be justified and/or modified in the analysis, including keywords, citations, references, and in-text citations. It is imperative to acknowledge that some keywords in the text have multiple meanings, such as "environmental information disclosure" and "environmental disclosures," or "ESG performance" and "ESG disclosure". This could have resulted in biased outcomes.

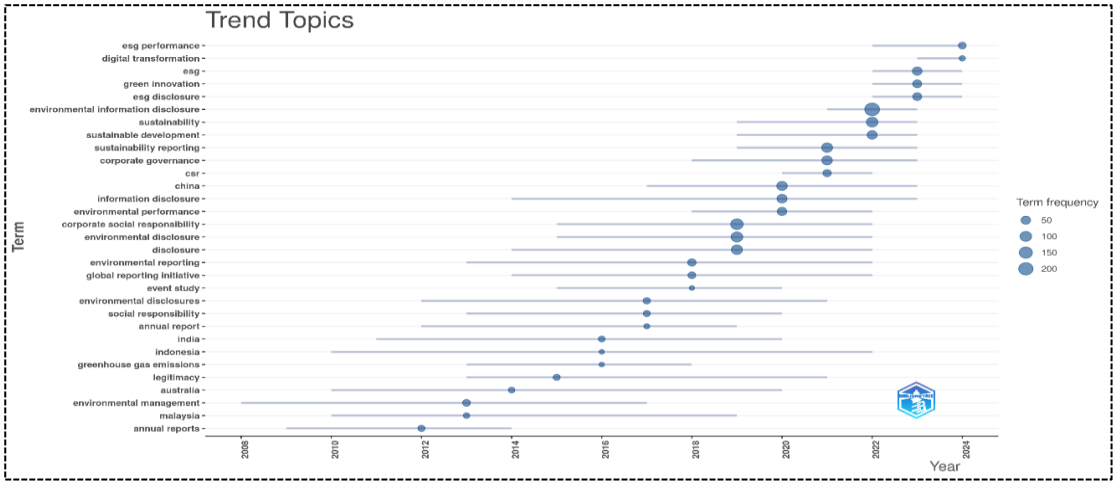


**Figure 5. Topics trend**

*(Source: Web of Science database, 2024)*

The presence of new keywords with low frequency, such as digital transformation, suggests that the theme has gained attention, but has not been fully explored. Based on this analysis, we propose areas for further study, including ESG performance, digital transformation, green innovation, EID, ESG disclosure, and sustainability.

### 3.3. Discussion

This study aimed to provide relevant information to researchers in related fields and evaluate patterns by analyzing the growth of EID research publications over the past 30 years. This research project employed two approaches: *performance analysis and science mapping*. The findings show that, while research in the field of EID is still in its early stages, it has made significant progress over the past decade and yielded major research outcomes.

This study demonstrates that the most prolific authors, such as Zeng, S.X., Garcia-Sanchez, I.M. and Gallego-Alvarez, I., are among the most prominent and influential scholars, as evidenced by their high score of H-index and G-index. China, the United States, and the United Kingdom were the top three countries contributing to this area of study. Most of these countries, except for China, have been developed. According to the overwhelming majority of studies, China is leading in terms of publications.

Regarding publication journals, journals such as Sustainability, the Journal of Cleaner Production, Business Strategy and the Environment, Corporate Social Responsibility and Environmental Management, Sustainability Accounting Management and Policy Journal, Journal of Business Ethics, Environmental Science and Pollution Research, Social Responsibility Journal, Environmental Development and Sustainability, Journal of Environmental Management, and Frontiers in Environmental Science fall under this category, following Bradford's Law.

According to the study's findings, the terms "ESG performance", "digital transformation" "environmental information disclosure", "ESG disclosure "green innovation", "and "sustainability reporting" were the most frequently used topic trends by writers. Furthermore, the topic trends that have attracted authors since 2022 include ESG, green innovation, and information asymmetry. These concepts are relevant to the growing concerns

surrounding EID topics. The observed topic trends can be explained by the rising demand for ESG disclosure by stakeholders' concerns, which has created a new tide of sustainability reporting, including Sustainable Development Goals (de Silva Lokuwaduge et al., 2022). In addition, digital transformation is a topic trend that has appeared since 2023 and is increasingly attracting attention in the year 2024.

Additionally, environmental issues, as one of the concerns of climate change, pose unprecedented challenges for firms towards sustainability. Consequently, both governments and firms need strategic management to implement environmental protection policies. As a result, implementing green innovation benefits companies. First, innovation can assist firms in fulfilling environmentally sensitive consumer needs (Chang, 2011; Amores-Salvado et al., 2014; Takalo et al., 2021). Specifically, enterprises that provide customers with eco-friendly products and services gain a competitive advantage over their competitors (Eiadat et al., 2008). Second, green innovation boosts companies' ability to achieve both environmental and economic performance. Hence, these topics trends emerged in the relationships related to EID.

The study's thematic map emphasizes sustainability, disclosure, stakeholders, environment, corporate social responsibility, environmental disclosure, sustainable reporting, and content analysis as the most relevant topics in the focal knowledge area. EID is a significant aspect of CSR and a topic of considerable interest in the business world. Previous research has shown that companies that disclose more positive EID information tend to perform better (Charumathi & Ramesh, 2020; Chouaibi et al., 2022). Moreover, sustainability is a key concern for companies that aim to enhance their market value and global performance. EID reports on firms' activities and their impact on the environment, as well as the measures taken to protect them, and these activities can ensure the sustainability of firms and the continuity of their operations. Consequently, EID can help firms achieve sustainable development.

Content analysis can be employed to investigate ESG and EID, as indicated by the thematic map and topic trend analysis findings. ESG and/or EID data were collected from annual and/or sustainability reports obtained from stock exchanges. However, a comprehensive and universal national EID database is lacking. It is uncommon for the same company to have different EID ratings because of various factors. Researchers worldwide must explore best practices for creating a clear and uniform EID information disclosure and grading system.

A comprehensive non-financial business performance evaluation system can improve a company's financial performance and consequently, its value. Therefore, there is an immediate need to investigate the relationship between non-financial information, such as environmental and social information, and financial metrics, such as return on assets, return on equity, sales growth rate, and Tobin's Q, which have received limited attention in the literature. This is necessary because the relationship between these two types of data is crucial.

Apart from these findings, green innovation is a significant trend that needs to be investigated. Aguilera-Caracuel and Ortiz-de-Mandojana (2013) highlight the importance of sustainability for businesses, as it may have a positive impact on their financial, social, and environmental outcomes, which are essential to both governments and businesses today. Several studies have demonstrated the significance of green innovation in fostering and achieving sustainability in various industries (Asadi et al., 2020; Cheng et al., 2023). Furthermore, in the digital transformation era, stakeholders increasingly emphasize green technological innovation. Digital transformation can advance green technology innovation by reducing financing obstacles and attracting government subsidies (Xue et al., 2022; Tang et al., 2023; Zheng & Zhang, 2023; Xu et al., 2024). However, these studies focused on different industries in the Chinese context. Therefore, it is necessary to investigate other countries and industries as well.

## 4. CONCLUSIONS

This study has significant implications for future research in terms of theoretical and practical implications, as it employs two well-established bibliometric analytical approaches. First, it provides a comprehensive assessment of the literature, as well as an in-depth analysis of the published findings and research trends related to EID. This study suggests that future research should focus on themes such as ESG performance, digital transformation, green innovation, EID, ESG disclosure, and sustainability. Several potential future research directions could be investigated in different countries and industries, such as (1) examining the tripartite relationship between

environmental information disclosure, green innovation, and company performance; (2) investigating the impact of environmental management on the implementation of green innovation; (3) examining the moderating role of corporate governance on the relationship between environmental information disclosure and financial performance; (4) evaluating the relationship between information asymmetry and ESG disclosure; (5) examining the relationship between EID and digital transformation; (6) the moderating effect of digital transformation on the relationship between EID and firm performance; (7) investigating the relationship between green technology innovation and digital transformation. etc.

This study provides a comprehensive overview of the EID literature by highlighting the topics relevant to this field. This study is beneficial for researchers who are new to the field, as it equips them with the necessary information to swiftly acquire a solid foundational understanding of the topic. Moreover, it can aid researchers in currently exploring EID by organizing existing materials and enhancing the effectiveness of their scientific inquiry.

This study has implications for policymakers, with a clear indication of the necessity of modifying regulations regarding ESG practices within the industry. By doing so, corporations are encouraged to disclose more information about ESG factors, resulting in a mutually beneficial outcome for all parties involved. Moreover, because content analysis is a commonly used methodology for analyzing non-financial information, it is crucial to establish an online national database system to facilitate the organized collection of ESG scores. This platform serves two purposes: it manages the environmental disclosure records of listed companies and provides data sources to the public, customers, investors, academics, and other stakeholders.

This study has several limitations. First, the WOS database was the sole data source for this study. Other databases, such as Scopus and Dimension, can also extract data. Consequently, to enhance the reliability of the findings, future research may consider incorporating data from additional databases or a combination of WOS and Scopus. Second, the data for the year 2024 were obtained only up to August, which means that the research did not cover the entire year. Consequently, subsequent studies should extend the data collection period from the database for the full and current years to provide future accuracy research.

Furthermore, this study investigated the possibility that bibliometric data may contain redundant information, such as singular and plural variants of the same keyword or meanings that are comparable to one another. For instance, when investigating the topic trend, the research found that the phrases “environmental disclosure" and "environmental disclosures” were both present in annual reports, and terms with comparable meanings, such as “corporate social responsibility” and “CSR’”. To address this, future investigations could consider moving some keywords that have the same meaning out of the analysis and employing different retrieval strategies, such as focusing on queries that are relevant to the research topic.

In conclusion, the findings of this study suggest that potential linkages between subthemes should be further investigated in subsequent research by building networks of bibliographical coupling and keyword co-occurrence with varying threshold settings. Future research should focus on bibliometric analyses, such as the relationship between greenwashing and EID, climate change, and EID. New areas of study can be identified and explored in future research by connecting subtopics or applying different grouping strategies to the literature.

## REFERENCES

Abdullah, A., Waemustafa, W., & Mat Isa, H. (2017)). Disclosure of Information in the Company’s Annual Reports: a Bibliometric Analysis. *Proceeding of the 2nd International Research Conference on Economics Business and Social Sciences, Malaysia 2*(2), 66. http://www.globalcsrc.org/irc2017-my/2ndIRCMalaysiaProceedings.pdf

Aguilera-Caracuel, J., & Ortiz-de-Mandojana, N. (2013). Green Innovation and Financial Performance: An Institutional Approach. *Organization and Environment*, *26*(4), 365–385. https://doi.org/10.1177/1086026613507931

Alipour, M., Ghanbari, M., Jamshidinavid, B., & Taherabadi, A. (2019). The relationship between environmental disclosure quality and earnings quality: a panel study of an emerging market. *Journal of Asia Business Studies*, *13*(2), 326–347. https://doi.org/10.1108/JABS-03-2018-0084

Amores-Salvado´, J., Martı´n-de Castro, G., & Navas-Lo´pez, J. E. (2014). Green corporate image: Moderating the connection between environmental product innovation and firm performance. *Journal of Cleaner Production*, *83*, 356–365. https://doi.org/10.1016/j.jclepro.2014.07.059

Asadi, S., OmSalameh Pourhashemi, S., Nilashi, M., Abdullah, R., Samad, S., Yadegaridehkordi, E., Aljojo, N., & Razali, N. S. (2020). Investigating influence of green innovation on sustainability performance: A case on Malaysian hotel industry. *Journal of Cleaner Production*, *258*, 120860. https://doi.org/10.1016/j.jclepro.2020.120860

Bakır, M., Özdemir, E., Akan, Ş., & Atalık, Ö. (2022). A bibliometric analysis of airport service quality. *Journal of Air Transport Management*, *104*, 102273 https://doi.org/10.1016/j.jairtraman.2022.102273

Chadegani, A., Salehi, H., Md Yunus, M. M., Farhadi, H., Fooladi, M., Farhadi, M., & Ale Ebrahim, N. (2013). A comparison between two main academic literature collections: Web of Science and Scopus databases. *Asian Social Science*, *9*(5), 18–26. https://doi.org/10.5539/ass.v9n5p18.

Chand, A., Kumar, N., Kumar, R. R., Prasad, S., Patel, A., & Stauvermann, P. J. (2022). Determinants of Social and Environmental Accounting Information Disclosure: An Analysis of top 50 Firms in New Zealand. *Engineering Economics*, *33*(2), 118–131. https://doi.org/10.5755/j01.ee.33.2.20819

Chang, C.-H. (2011). The Influence of Corporate Environmental Ethics on Competitive Advantage: The Mediation Role of Green Innovation. *Journal of Business Ethics*, *104*(3), 361-370. https://doi.org/10.1007/s10551-011-0914-x

Charumathi, B., & Ramesh, L. (2020). Impact of voluntary disclosure on valuation of firms: Evidence from Indian companies. *Vision*, *24*(2), 194-203. https://doi.org/10.1177/0972262920914138.

Cheng, X., Chen, K., & Su, Y. (2023). Green innovation in oil and gas exploration and production for meeting the sustainability goals. *Resources Policy*, *87*, 104315. https://doi.org/10.1016/j.resourpol.2023.104315

Chouaibi, S., Chouaibi, J., & Rossi, M. (2022). ESG and corporate financial performance: the mediating role of green innovation: UK common law versus Germany civil law. *Euro Med Journal of Business*, *17*(1), 46-71. https://doi.org/10.1108/EMJB-09-2020-0101

de Silva Lokuwaduge, C. S.,Smark, C., & Mir, M. (2022). The surge of environmental social and governance reporting and sustainable development goals: some normative thoughts. Australasian Accounting, Business and Finance Journal, *16*(2), 3-11. https://doi.org/10.14453/aabfj.v16i2.2

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. https://doi.org/10.1016/j.jbusres.2021.04.070

Eiadat, Y., Kelly, A., Roche, F., & Eyadat, H. (2008). Green and competitive? An empirical test of the mediating role of environmental innovation strategy. *Journal of World Business*, *43*(2), 131-145. https://doi.org/10.1016/j.jwb.2007.11.012

Ellili, N. O. D. (2022). Bibliometric analysis and systematic review of environmental, social, and governance disclosure papers: current topics and recommendations for future research. *Environmental Research Communications*, *4*(9), 092001. https://doi.org/10.1088/2515-7620/ac8b67

Ezeagba, C. E., Rachael, J.-A. C., & Chiamaka, U. (2017). Environmental Accounting Disclosures and Financial Performance: A Study of selected Food and Beverage Companies in Nigeria (2006-2015). *International Journal of Academic Research in Business and Social Sciences*, *7*(9), 162-174. https://doi.org/10.6007/ijarbss/v7-i9/3315

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, web of science, and Google scholar: strengths and weaknesses. *The FASEB journal*, *22*(2), 338-342. https://doi.org/10.1096/fj.07-9492LSF.

Gamerschlag, R., Möller, K., & Verbeeten, F. (2011). Determinants of voluntary CSR disclosure: empirical evidence from Germany. *Review of managerial science*, *5*, 233-262. https://doi.org/10.1007/s11846-010-0052-3

Gao, S., Meng, F., Gu, Z., Liu, Z., & Farrukh, M. (2021). Mapping and clustering analysis on environmental, social, and governance field bibliometric analysis using Scopus. *Sustainability*, *13*(13), 7304. https://doi.org/10.3390/su13137304

Garfield, E. (1980). Bradford law and related statistical patterns. *Current Contents*, 19, 5-12.

Gray, R., Kouhy, R., & Lavers, S. (1995). Corporate_social_and_environmental reporting a review of the literature and a longitudinal study of UK disclosure. *Accounting, Auditing and Accountability*, *8*(2), 47–77. https://doi.org/10.1108/09513579510146996

GRI. (2021). *GRI standards.* Global Reporting Initiative. The Netherlands. https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(46), 16569-16572. https://doi.org/10.1073/pnas.0507655102

Ilelaboye, C. S., & Alade, M. E. (2022). Environmental Accounting and Financial Performance of Listed Family-Owned Companies in Nigeria. *International Review of Business and Economics*, *6*(1), 71–82. https://doi.org/10.56902/IRBE.2022.6.1.3

Ismail, H., Saleem, M. A., Zahra, S., Tufail, M. S., & Ali, R. A. (2021a). Application of Global reporting initiative (Gri) principles for measuring quality of corporate social responsibility (CSR) disclosure: Evidence from Pakistan. *Sustainability*, *13*(20), 11409. https://doi.org/10.3390/su132011409

Ismail, M. I., Abrizah, A., & Samsuddin, S. F. (2021b). Mapping the Knowledge Domains of Research Data Management: A Co-occurrence Analysis. In Reimagining libraries for a post-pandemic world. *Proceedings of the 8th International Conference on Libraries, Information and Society*, 84-103.

Khan, M. A. (2022). ESG disclosure and firm performance: bibliometric and meta-analysis. *Research in International Business and Finance*, *61*, 101668. https://doi.org/10.1016/j.ribaf.2022.101668

Liao, L., Luo, L., & Tang, Q. (2015). Gender diversity, board independence, environmental committee and greenhouse gas disclosure. *The British Accounting Review*, *47*(4), 409–424. https://doi.org/10.1016/j.bar.2014.01.002

Liu, X., & Anbumozhi, V. (2009). Determinant factors of corporate environmental information disclosure: an empirical study of Chinese listed companies. *Journal of Cleaner Production*, *17*(6), 593–600. https://doi.org/10.1016/j.jclepro.2008.10.001

Huang, M. H., & Chi, P. S. (2010). A Comparative Analysis of the Application of H-index, G-index, and A-index in Institutional-Level Research Evaluation. *Journal of Library and Information Studies*, *8(*2), 1-10. https://doi.org/10.6182/jlis.2010.8(2).001

Nassreddine, G. (2022). Structural analysis of factors influencing environmental disclosure. *Cogent Economics and Finance*, 10(*1*), 2024723. https://doi.org/10.1080/23322039.2021.2024723

Nie, Y. (2019). Environmental Accounting Information Disclosure: A Summary. *Proceedings of the 5th International Conference on Economics, Business, Finance, and Management*, 689-693. https://doi.org/10.25236/icebfm.2019.131

Odriozola, M. D., & Baraibar-Diez, E. (2017). Is Corporate Reputation Associated with Quality of CSR Reporting? Evidence from Spain. *Corporate Social Responsibility and Environmental Management*, *24*(2), 121–132. https://doi.org/10.1002/csr.1399

Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *British Accounting Review*, *48*(1), 102–116. https://doi.org/10.1016/j.bar.2014.10.007

Reboredo, J. C., & Sowaity, S. M. A. (2022). Environmental, social, and governance information disclosure and intellectual capital efficiency in Jordanian listed firms. *Sustainability*, *14*(1), 115. https://doi.org/10.3390/su14010115

Reverte, C. (2016). Corporate social responsibility disclosure and market valuation: evidence from Spanish listed firms. *Review of Managerial Science*, *10*(2), 411–435. https://doi.org/10.1007/s11846-014-0151-7

Rodrigues, M., do Céu Alves, M., Oliveira, C., Vale, V., Vale, J., & Silva, R. (2021). Dissemination of social accounting information: A bibliometric review. *Economies*, *9*(1), 41. https://doi.org/10.3390/economies9010041.

Singh, V.K., Singh, P., Karmakar, M. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics*, *126*, 5113–5142. https://doi.org/10.1007/s11192-021-03948-5

Stefanescu, C. A. (2021). Sustainability reporting in the public realm—trends and patterns in knowledge development. *Sustainability*, *13*(8), 4128. https://doi.org/10.3390/su13084128

Takalo, S.K., Sayyadi Tooranloo, H., & Shahabaldini, Z.P. (2021). Green innovation: A systematic literature review. *Journal of Cleaner Production*, *279*, 122474. https://doi.org/10.1016/j.jclepro.2020.122474

Tamimi, N., & Sebastianelli, R. (2017). Transparency among S&P 500 companies: an analysis of ESG disclosure scores. *Management Decision*, *55*(8), 1660–1680. https://doi.org/10.1108/MD-01-2017-0018

Tang, M., Liu, Y., Hu, F., & Wu, B. (2023). Effect of digital transformation on enterprises' green innovation: Empirical evidence from listed companies in China. *Energy Economics*, *128*, 107135. https://doi.org/10.1016/j.eneco.2023.107135

Tol, R. S. J. (2008). A rational, successive g-index applied to economics departments in Ireland. *Journal of Informetrics*, *2(*2), 149-155. https://doi.org/10.1016/j.joi.2008.01.001

Wan, G., Dawod, A. Y., Chanaim, S., & Ramasamy, S. S. (2023). Hotspots and trends of environmental, social and governance (ESG) research: A bibliometric analysis. *Data Science and Management*, *6*(2), 65-75. https://doi.org/10.1016/j.dsm.2023.03.001

Wang, Q., & Waltman, L. (2016). Large-scale analysis of the accuracy of the journal classification systems of Web of Science and Scopus. *Journal of Informetrics*, *10*(2), 347–364. https://doi.org/10.1016/j.joi.2016.02.003.

Xu, C., Sun, G., & Kong, T. (2024). The impact of digital transformation on enterprise green innovation. *International Review of Economics &Amp; Finance*, *90*, 1-12. https://doi.org/10.1016/j.iref.2023.11.001

Xue, L., Zhang, Q., Zhang, X., & Li, C. (2022). Can Digital Transformation Promote Green Technology

Innovation. *Sustainability*, *14*(12), 7497. https://doi.org/10.3390/su14127497

Yildirim, S. (2023). Greenwashing: a rapid escape from sustainability or a slow transition? *LBS Journal of Management & Research*, *21*(1), 53-63.

Zhang, J. Z., Srivastava, P. R., Sharma, D., & Eachempati, P. (2021). Big data analytics and machine learning: A retrospective overview and bibliometric analysis. *Expert Systems with Applications*, *184*, 115561. https://doi.org/10.1016/j.eswa.2021.115561

Zhao, X., Fan, Y., Fang, M., & Hua, Z. (2018). Do environmental regulations undermine energy firm performance? An empirical analysis from China's stock market. *Energy Research and Social Science*, *40*, 220–231. https://doi.org/10.1016/j.erss.2018.02.014

Zheng, Y., & Zhang, Q. (2023). Digital transformation, corporate social responsibility and green technology innovation-based on empirical evidence of listed companies in China. *Journal of Cleaner Production*, *424*, 138805. https://doi.org/10.1016/j.jclepro.2023.138805