The interconnectivity of ESG research within the realm of sustainability: A bibliometric analysis

Iuliana-Madalina Petrica (Papuc)[a,1], Chirata Caraiani[a], Camelia Iuliana Lungu[a], and Liana-Elena Anica-Popa[a]

[a]*The Bucharest University of Economic Studies, Bucharest, Romania*

Abstract

Motivation: The relationship between ESG factors and sustainability is a widely debated topic in the literature, but to our knowledge, there is a gap concerning the investigation of links between groups formed with ESG and other sustainability concepts, such as corporate social responsibility (CSR), green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0.

Idea: The objective of this study is to identify the interest of researchers, their visibility, as well as the trends among publications, regarding the ESG factors in relation to other concepts within the realm of sustainability, like CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0.

Data: The selected sample for the research includes 1430 papers screened from the Web of Science database.

Tools: The aim of this study is achieved by conducting a bibliometric analysis, using VOSviewer and PowerBI.

Findings: The findings of this study include the interconnectivity of selected concepts, the co-occurrence of authors' keywords, the number of publications over time, as well as the paper types, the publishing activity by journal, the most productive authors, the co-authorship, their affiliation, the papers' length, references, and citations trend, the most cited papers, the publishing activity by country and the collaboration patterns between countries.

Contribution: This analysis supports the identification of potential gaps in current ESG-related research and points toward new areas of investigation. It also contributes to the advancement of ESG research and to the achievement of sustainable development goals.

Keywords: ESG, sustainability, CSR, industry 5.0, bibliometric analysis

---

[1] *Corresponding author:* Doctoral School of Accounting, The Bucharest University of Economic Studies; Bucharest, Romania; email address: petricaiuliana16@stud.ase.ro

JEL codes: M410

1. Introduction

Over recent decades, concern has grown about the issue of climate change, which is becoming more pressing each day, as environmental awareness becomes more widespread (Duan, 2023; Dube & Nhamo, 2020). The United Nations formulated 17 sustainable development goals (SDGs) (Hamdy *et al*., 2018), specifically addressing climate change, environmental degradation, and social inequality (Lee *et al*., 2022). Within the context presented, it is crucial to assess the sustainability and social responsibility of business, and an approach to this evaluation is through the application of ESG criteria (Clement *et al*., 2022). ESG are data-driven components of sustainability that highlight an organization's performance in three domains: environment, society, and governance (Khan & Liu, 2023; Senadheera *et al*., 2022). Businesses shift toward sustainable practices by incorporating ESG elements, reducing risks, and leveraging opportunities that support long-term sustainability objectives (Palmieri *et al.*, 2024; Jiang *et al*., 2023b).

Despite the numerous bibliometric analysis papers published on ESG topic, such as Zhao *et al.* (2023b), Steblianskaia *et al.* (2023), Khan (2022), Senadheera *et al.* (2022), and Gao *et al.* (2021), according to our knowledge, there is a gap concerning the investigation of links between groups formed with ESG and other sustainability concepts, such as CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. Identifying new patterns in publications and journal performance, collaboration patterns, and investigating the intellectual structure of the presented topic in the existing literature are some of the primary reasons to undertake a bibliometric analysis (Donthu *et al.*, 2021).

Advancing the relevance of conducting a bibliometric analysis, the objective of this paper is developed based on six main research questions, focused on the ESG factors in relation to other concepts within the realm of sustainability, such as CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. To achieve this aim, 1430 papers were selected from the Web of Science database, which is a worldwide recognized database, covering many journals and international conferences (Lungu *et al.*, 2020). The applied methodology is divided into four steps, as presented by Donthu *et al.* (2021).

The results and the key characteristics in the selected area of research are highlighted through various analyses of the dataset, using descriptive and frequency analysis, and two software tools for visual representation – VOSviewer and PowerBI. Therefore, the findings include the interconnectivity of selected concepts, the number of publications over time, as well as the paper types, the publishing activity by country and the collaboration patterns between countries, the publishing activity

by journal, the most productive authors, and the co-authorship, the length, references, and citations trends, the most cited papers, and the co-occurrence of authors' keywords. We also analyzed the authors' affiliations, particularly those associated with Romanian universities, in order to determine the level of interest that local scholars have in the studied topic. These analyses provide insights into the characteristics of the research landscape related to the chosen subject and help identify key trends and patterns. It also supports the identification of potential gaps in current ESG-related studies and points toward new areas of investigation. Moreover, it contributes to the advancement of ESG research and the achievement of sustainable development goals.

This paper is organized as follows: Section 2 includes an overview of ESG factors in relation to other concepts within the realm of sustainability, such as CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. In Section 3, the key methodological steps of the bibliometric analysis are described. Section 4 highlights the research findings, while the conclusions of this study are covered in Section 5.

2. Literature review and research questions

Earth is currently facing unprecedented social and climate difficulties, and the science behind climate change is becoming increasingly alarmist (Clement *et al*., 2022; Senadheera *et al*., 2021). In the contemporary context, the concept of sustainability has become a critical concern in different fields, which represents a paradigm shift in how global challenges are addressed (Ghazanfari, 2023; Rodriguez-Gonzalez, 2018).

Sustainability covers a comprehensive framework that addresses the complex connections among ecological-economical-social perspectives, in order to accelerate the transition to equitable, resilient, and ethical societies (Marandure *et al*., 2020; Zabaniotou *et al*., 2020). Its importance resides not only in reducing the impact on the environment, but also in incorporating practices that promote long-term ecological preservation, social well-being, and economic development (Su *et al*., 2023). In this context, companies define strategies with the aim of creating value in the short, medium, and long term. Thus, the role of companies is not limited to profit-making only. Consequently, the attention shifts from shareholders to all stakeholders, and from financial reporting to the inclusion of non-financial information in corporate reporting (Caraiani *et al*., 2015). The modern business landscape is designed by an interaction of concepts, such as ESG, sustainability, corporate social responsibility, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0., that drives ethical conduct, sustainable growth, and responsible decision-making (Jiang *et al*., 2023; Wamane, 2023; Zhou & Liu, 2023; Kambe & Tamamura, 2022; Mourtzis *et al*., 2022).

It is necessary for academics, managers, and investors to have a system to classify companies as socially responsible organizations based on a variety of criteria. Given the difficulty of measuring social and environmental challenges, ESG scores are an approach that is frequently used (Clement *et al*., 2022). Although the development of ESG scores may seem like a superficial step, it is one of the critical reforms in shaping sustainable business environments (Khan, 2022). Senadheera *et al*. (2022) argue that organizations with better ESG performance are more likely to be sustainable in relation to their own objectives and strategies. Furthermore, investors and other stakeholders have begun to pay much more attention to ESG scores. Unlike Senadheera *et al*. (2022), who refer to the absolute values of ESG scores, Uyar *et al*. (2022) argue that not only these values should be analyzed, but also the variations of the indicators, as inconsistency may harm organizations, even if the scores are high. On the other hand, Abrudan *et al*. (2021) indirectly support an inversely proportional relationship between companies with high ESG scores and investor interest. To facilitate the understanding of the actions behind this analysis, Galucci *et al*. (2022) advocate for the need to increase transparency levels in the methodology for calculating the indicators.

Sustainability is built on ESG elements, which constitute a connection between responsible business practices and the broader purpose of preserving the world (Dash & Mohanty, 2023; Rajesh, 2020). By highlighting the need for environmental responsibility, ethical behavior, and effective governance practices, ESG principles serve as a map that guides organizations towards sustainability (Liao *et al*., 2023; Nogueira *et al.,* 2018). Incorporating ESG into corporate operations not only ensures compliance and risk mitigation, but also brings an innovation culture into business activities (Khan & Liu, 2023; Jin & Kim, 2022). The importance of ESG in the business landscape may not be overstated (David *et al*., 2023). It represents a fundamental shift in how companies perceive their role in society and the environment, driving a paradigm that recognizes the relationship between business success and societal well-being (Babkin *et al*., 2023; Silva, 2023). The shared vision of ESG and sustainability is to build a future where businesses succeed while preserving the environment and its people for future generations (Chung *et al*., 2023; Izgarova *et al*., 2023). Sustainable development and ESG principles have a strong connection with the economic strength of businesses (Senadheera *et al*., 2022).

In a sustainable environment, CSR generally refers to a company's commitment to contribute to societal, economic and environmental well-being through business practices and activities, which may enhance the reputation and brand of the company, create consumer loyalty, and achieve better financial performance (Alekneviciene, 2023; Chen *et al*., 2023). It represents a company practice that aims to significantly improve society rather than just maximize profits (Torres *et al*., 2023; Hamada, 2022). CSR covers a wide range of topics, including philanthropy, environmental protection, labor rights, and community participation (Kasim *et al*., 2022; Hui-Wen Chuah *et al*., 2022). By helping local communities, making

investments in healthcare and education, or encouraging diversity and inclusion, businesses that participate in CSR aim to align their core values with actions that benefit society (Bastillo-Castillejo *et al*., 2023; Torres *et al*., 2023).

Through the alignment of ethical, social, and environmental values, CSR efforts support an organization's larger ESG aims (Chouaibi & Zouari, 2022; Chouaibi & Chouaibi, 2021). Business models that encourage decentralization and the development of circular value in goods and services make sustainability and CSR possible (Upadhyay *et al*., 2021). Therefore, for companies to make circular economy initiatives a competitive advantage, they need to work on two things at once: changing how they do things now to reduce waste and using this approach to boost their main businesses (Fatimah *et al*., 2023; Mondal *et al*., 2023; Wamane, 2023). The circular economy is a framework for business models that, in order to achieve sustainable development, which includes improving the environment and promoting social equity, replace the idea of e*nd-of-life* with reducing, reusing, recycling, and recovering resources in production and distribution processes (Figge *et al.*, 2022).

The adoption of ESG supports environmentally conscious projects, sustainable technologies and encourages investment in renewable resources, all of which contribute to the expansion of the green economy (Roy, 2023; Zhou & Liu, 2023). The green economy, highlighted as an important pillar in economic and environmental development (Lee *et al*., 2022), is analyzed from three perspectives: conceptual, implementation, and quantification of its implementation results. The conceptual perspective is defined by formulating strategies, creating policies, and elaborating development programs. From the implementation perspective, the green economy includes elements such as sustainable products and services, sustainable management, and sustainable jobs. In the third perspective, the United Nations Environment Programme has established three sets of indicators: environmental (climate change, natural resources, waste), policy (investment, fiscal reforms, ecosystems, educational programs), and social (jobs, access to resources, welfare, health) (Adamowicz, 2022). Sustainable growth in the green economy is fueled by ESG principles, which promote an optimal balance between profit, environment, and people (Wang *et al*., 2024; Hu *et al.,* 2023; Khan & Liu, 2023).

Through the integration of ESG principles with the potential of digitization, technology is developing responsibly, prioritizing environmental conservation, and enhancing social welfare (Zhou & Liu, 2023; Zhang & Jin, 2022). By enabling more effective resource usage (e.g., optimizing energy consumption), decreasing waste, and lowering emissions, digitalization may play a critical role in accomplishing sustainability goals (Peng *et al*., 2023; Lange et *al*., 2020). Better living conditions, active public participation, ethical governance, and transparency in public welfare programs and processes are all benefits of digitalization (Xu *et al*., 2021). In the age

of the digital economy, digital technology opens up new avenues for business growth, while businesses' potential and degree of development are determined by how far they have digitally transformed (Lu *et al*., 2023; Zhao *et al*., 2023).

Innovative technologies are used in sustainable business models to increase resource efficiency, reduce environmental effects throughout the product life cycle, preserve energy, cut emissions, optimize industrial structures, and spread the sustainability of business processes (Li & Liu, 2023; Qian *et al*., 2023; Upadhyay *et al*., 2021). Thanks to its potential to promote innovation while encouraging environmentally beneficial practices across industries, technology is a key factor towards sustainability (Salamzadeh *et al*., 2022). Digitalized manufacturing equipment and information and communication technologies are examples of smart technologies that may benefit the environment by reducing greenhouse gas emissions, for example (Saunila *et al*., 2019). As a result of ongoing research and development, technology is becoming an increasingly efficient tool for promoting positive transformation and an environmentally conscious society in search of a more sustainable future (Qian *et al*., 2023; Costa *et al*., 2022). They also enable companies to anticipate future customer behaviors, by using past or current behavioral patterns as the foundation for their strategic decisions (Anica-Popa *et al*., 2021). Due to the revolutionary impact of Industry 4.0, business models have been transformed with a focus on innovation, restoration, and the integration of digital technology (Abu-Bakar *et al*., 2023; Fatimah *et al*., 2023). This supports a circular economy with improved resource efficiency as a core business orientation (Phiri *et al*., 2022).

Digital technologies are the foundation of the competitive business landscapes in I4.0 (Govindan, 2023). Given the current importance of human-centeredness, resilience, and sustainability, the emerging technologies created under I4.0 are intended to better satisfy industrial and technological goals without compromising socio-economic and environmental performance, which has led to the emergence of I5.0 (Asif *et al*., 2023; Xu *et al*., 2021). Researchers have highlighted various innovative technologies, which transform business models, including artificial intelligence, blockchain, the Internet of Things, digital voice assistants, business intelligence and virtual reality (Saxena *et al*., 2023; Cavalcanti *et al*., 2022; Upadhyay *et al*., 2021; Chen & Bellavitis, 2020). Industry 5.0 underscores three aspects of development: a focus on human-centered, sustainable, and resilient development (Grabowska *et al*., 2022). This evolution represents a synergy between technological, social, and ecological realms, constituting the core of Industry 5.0 (Ghobakhloo *et al*., 2022; Pillai *et al*., 2021). It leverages technologies to enhance workplace safety and human-machine relationships, integrating corporate and social responsibilities with respect to the environment and society (Jafari *et al*., 2022).

In line with previous studies, to cover the gaps in research on interconnectivity of ESG factors within the realm of sustainability, such as CSR, green economy, circular

economy, digitalization, technology, industry 4.0, and industry 5.0, this article addresses six main research questions.

RQ1. How are the analyzed concepts in the scientific literature interconnected and which keywords do authors commonly employ?

RQ2. How has research on ESG factors in relation to other concepts within the realm of sustainability developed over the years?

RQ3. Which are the leading journals in the studied research topic?

RQ4. What general characteristics have the papers' authors within the analyzed topic?

RQ4.1. How do authors collaborate?

RQ4.2. What affiliation do they have?

RQ4.3. Who are the most productive?

RQ5. What general characteristics have the papers within the analyzed topic?

RQ5.1. How may the papers be characterized in terms of general features?

RQ5.2. Which are the most cited studies?

RQ5.3. How has the citation trend changed over the years?

RQ6. Which countries and continents are the most productive in the field of research and which are their collaboration patterns?

The sub-questions are meant to better clarify the details addressed by the main research questions.

3. Methodology

The aim of this study is achieved by conducting a bibliometric analysis, which includes a performance identification that assesses the productivity and impact of various research elements, such as paper types, countries, authors, citations, journals, and keywords. In addition to these traditional bibliometric analysis techniques, this study also uses advanced enhancement techniques, such as visualization. Donthu *et al.* (2021) present four steps that must be followed to conduct a bibliometric analysis: *(1)* defining the aims and scope, *(2)* choosing the techniques, *(3)* collecting the data from a bibliometric database, and *(4)* conducting the bibliometric analysis and reporting the findings.

Step 1: Defining the aim and scope of the bibliometric study. The objective of this study is to identify the interest of researchers, their visibility, as well as the trends among publications, regarding the ESG factors in relation to other concepts within the realm of sustainability. These concepts are CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. The characteristics of ESG-related research, such as length, citation, references, and number of authors were also assessed. Additionally, the analysis examines the collaboration patterns among authors and institutions, and it also identifies potential opportunities for future work in ESG-related areas. Moreover, this paper contributes

to the advancement of ESG research by providing valuable insights into the literature landscape of this field.

Step 2: Choosing the techniques for the bibliometric analysis. To answer the research questions, the study employs various techniques, including performance analysis and science mapping, such as citation analysis, co-citation analysis, co-word analysis, and co-authorship analysis. The performance analysis assesses the productivity and impacts the publications in the ESG research field. Science mapping techniques enable the identification of the most productive authors and journals. Furthermore, the citation, co-citation, co-word, and co-authorship analyses facilitate the exploration of the interrelationships and connections among publications and researchers focused on ESG topics. These techniques are widely utilized in bibliometric studies and have shown effectiveness in providing valuable insights into the research trends and performance in the field of ESG research (Jain & Tripathi, 2023; Khan, 2022).

Step 3: Collecting data for bibliometric analysis. The third step is to collect the data needed for the bibliometric analysis techniques selected in the second step (Donthu *et al*., 2021). Thus, the search terms were defined in a way that relates to the broad and general themes of the concepts analyzed, but at the same time was focused enough to stay within the research area defined in the first step (Lungu *et al*., 2020). The chosen search terms are ESG, sustainability, CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. The Web of Science searches were generated by combining selected terms as follows: ESG and Sustainability, ESG and CSR, ESG and Green economy, ESG and Circular economy, ESG and Digitalization, ESG and Technology, ESG and Industry 4.0, and ESG and Industry 5.0. (Alsmadi & Alzoubi, 2022; Ellili, 2022; He *et al.*, 2022). These chosen combinations of words allow one to determine any paper that addressed the studied associations.

Data are collected from the Web of Science Core Collection bibliographic and bibliometric database. Web of Science is a platform that brings together diverse and specialized information, enabling users to monitor the evolution of concepts across various disciplines. Clarivate Analytics manages this database, which includes many respected journals and conferences subject to rigorous international and national peer review (Lungu *et al*., 2020). No specific time frame was established as the intention was to observe the complete evolution of the research area over time, thereby facilitating the formulation of comprehensive conclusions.

Table 1 presents all the steps that were followed in the data cleaning process, with the aim that the final sample consists only of papers relevant to the research objective.

Table 1. Breakdown analysis of the applied exclusion criteria

Applied criteria	Number of papers
Initial sample	**2611**
Less duplicates	(491)
Distinct papers – taken into consideration	2120
Less Non-English papers	(22)
English papers – taken into consideration	2098
Less papers from research areas not relevant to the topic	(223)
Papers taken into consideration	1875
Less unavailable abstract in WoS	(41)
Add papers with abstracts found on Google	14
Papers with available abstracts	**1848**
Less papers with *ESG* not available in abstract	(604)
Less papers containing ESG with other semantics	(109)
Add papers with *environment* or *social* or *governance* included in abstract	295
Final sample	**1430**

The preliminary search generated 2611 studies. To assess their alignment with the research topic, an Excel file was created to record all available data on the selected papers. After the removal of duplicates, 491 articles were eliminated. Furthermore, an English language criterion was applied, excluding 22 non-English studies. To narrow the scope, out of 226 research areas, only 97 were selected, generating an exclusion of 223 papers. Research areas not taken into account included chemistry, criminology, geography, construction, medicine, architecture, and other domains not related to the scope of our study. To ensure the relevance of the selected studies, the following analysis was conducted on the abstracts. Out of 1875 papers, 41 lacked accessible abstracts in the Web of Science database and were manually searched for on the Internet. This step recovered 14 missing abstracts, while the remaining 27 could not be identified. Therefore, the sample was reduced to 1848 papers. To further refine the selected articles, an Excel filter was applied, to identify the abstracts mentioning the *ESG* term. This criterion showed that out of 1848 papers, 1244 included *ESG* in their abstracts, while 604 did not. Although 1244 studies mentioned *ESG*, 109 articles were eliminated because the acronym was used for concepts not relevant to the research topic, such as: Earth System Grid (ESG), electrostatic gyroscopes (ESG), Expeditionary Strike Group (ESG), early sudden gains (ESG), early seedling growth (ESG), etc. For the 604 papers that did not contain the *ESG* term, another condition was applied to emphasize those that included at least one of the following three terms: *environment*, *social*, and *governance*. Of these, 295 articles were taken into consideration, due to the fact that the abstract incorporated at least one of the selected terms. Finally, the papers' exclusion and inclusion methodology generated a sample of 1430 studies.

Step 4: Conducting the bibliometric analysis and reporting the findings. The results and key characteristics in the selected area summarize the performance of the

research constituents, such as authors, countries, and journals, using the total number of publications, citations, and references. Moreover, different techniques for science mapping are used, such as citation analysis, co-authorship analysis, and co-word analysis. Enhancement methods, such as clustering and visualization, are explored by using Microsoft Excel, VOSviewer, and PowerBI.

4. Results and discussion

4.1 Analysis based on the interconnectivity of concepts and authors' keywords

The total number of studies that resulted from the initial search for the prescribed keyword combinations was 2611. Due to the interconnection of the analyzed terms, 491 duplicates were found. These duplicates underwent a separate analysis aimed at determining how many of the chosen concepts were linked within the specialized literature. A visual representation of this analysis is shown in *Figure 1*.

Initially, the word combinations were segregated into two groups: (1) ESG and Sustainability, ESG and Green economy, ESG and Circular economy, and ESG and CSR, and (2) ESG and Digitalization, ESG and Technology, ESG and Industry 5.0, and ESG and Industry 4.0. Regarding the first group, it is noteworthy that out of the total number of articles, only one addresses all the selected concepts simultaneously. Four articles analyze the connection between ESG and Sustainability, ESG and Green economy, and ESG and CSR; seven articles examine the concepts of ESG and Sustainability, ESG and Green economy, and ESG and Circular economy; two articles investigate the concepts of ESG and Sustainability, ESG and Circular economy, and ESG and CSR, while one article examines the concepts of ESG and Green economy, ESG and Circular economy, and ESG and CSR.
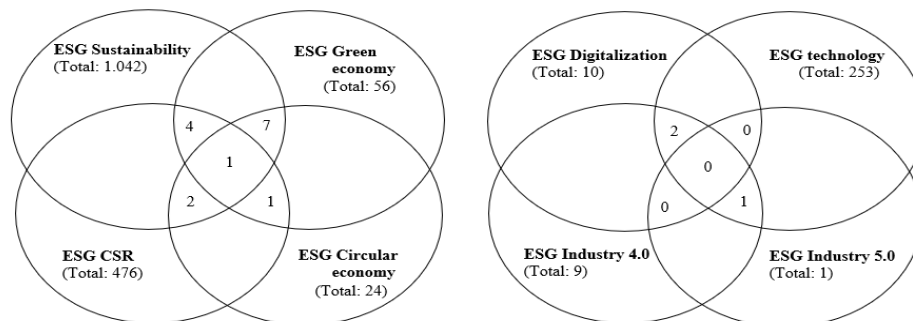

Figure 1. Graphical representation of the analyzed concepts' interconnectivity

Concerning the second group, none of the articles deals with all the concepts simultaneously; two articles cover the concepts of ESG and Digitalization, ESG and Technology, and ESG and Industry 4.0, one article addresses ESG and Technology,

ESG and Industry 5.0, and ESG and Industry 4.0, while none of the articles covers the concepts of ESG and Digitalization, ESG and Industry 5.0, ESG and Industry 4.0, or ESG and Digitalization, ESG and Technology, and ESG and Industry 5.0 at the same time.

Furthermore, a co-occurrence analysis of the authors' keywords was carried out in the VOSviewer, which is shown in *Figure 2*. Throughout this analysis, it is possible to observe not only the clusters formed, representing the words' interconnectivity in the selected papers, but we may also establish which of the analyzed concepts (ESG, sustainability, CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0.) for this research were utilized as keywords in the final sample. According to VOSviewer, the three major co-occurrences are around the concepts of ESG (368 occurrences) and sustainability (184 occurrences) in yellow, and CSR (304 occurrences) in red. To obtain a clearer overview, a minimum threshold of 25 occurrences was applied for the displayed keywords. Of the nine selected concepts, ESG, CSR, and sustainability are also used as authors' keywords.
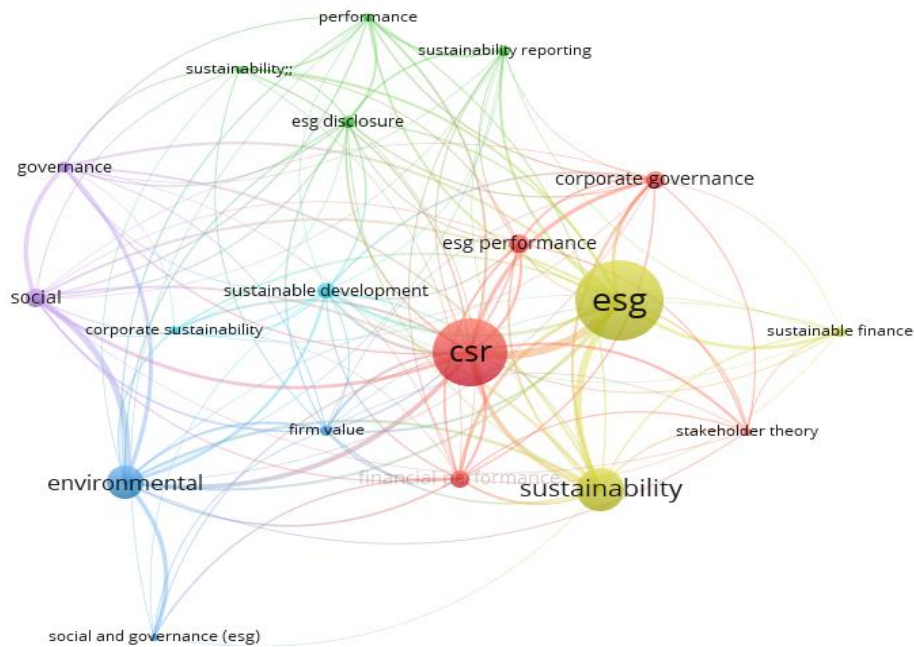

Figure 2. Co-occurrence analysis of author keywords

4.2 Analysis based on the number of publications and paper types

Scholars have only recently begun to investigate ESG criteria as data-driven aspects of sustainability due to its relatively new terminology, which was first introduced in the United Nations *Who Cares Wins* report in 2004 (Senadheera *et al*., 2022). *Figure 3* presents a graphic illustration of the evolution of the number of papers published in the ESG sphere in relation to the selected concepts. The first study that met the search and exclusion criteria described in the methodology is Kocmanova and Nemecek (2009), which explores the evaluation of a company's performance by measuring the integration of economic, environmental, and social issues, and corporate governance. Although the trend has been consistently increasing since the publication of the first paper, it may be observed that starting from 2020, the number of such papers has almost doubled annually. This highlights the growing interest among academics in analyzing ESG factors in relation to other concepts within the realm of sustainability. The peak was reached in 2022, most likely because of the Covid-19 pandemic, which has grown the attention to the importance of environmental, social, and governance factors in the corporate world. As a result, there has been an increased interest in ESG research, as investors seek to align their portfolios with companies that prioritize sustainability (Vineis & Mangone, 2022).
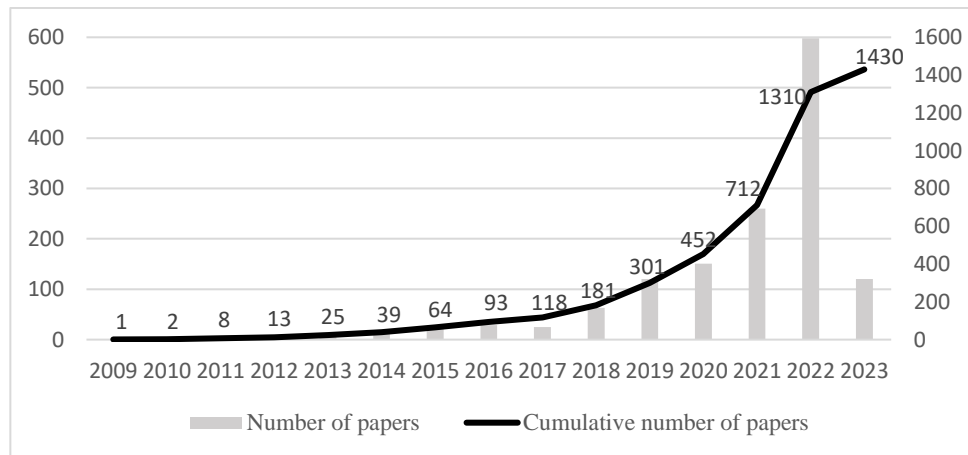

Figure 3. Yearly and cumulative number of identified papers

The following analysis is based on the number of published papers according to their type: article, book chapter, editorial material, letter, proceedings paper, and review, as presented in *Table 2*.

Table 2. The distribution of papers per type and publication year

Year	Paper type						Total	
	Article	Book Chapter	Edit. Material	Letter	Proc. Paper	Review		
2009					1		1	0.07%
2010	1						1	0.07%
2011	3	1			2		6	0.42%
2012	2	1			2		5	0.35%
2013	3	8			1		12	0.84%
2014	6	3	1		2	2	14	0.98%
2015	16	1	1		5	2	25	1.75%
2016	22	1			6		29	2.03%
2017	21	1			3		25	1.75%
2018	48	7	1		5	2	63	4.41%
2019	98	1	1		17	3	120	8.39%
2020	135	1	1		7	7	151	10.56%
2021	235	2	1		9	13	260	18.18%
2022	552		8	1	15	22	598	41.82%
2023	104		1		1	14	120	8.39%
Total	**1246** **87.13%**	**27** **1.89%**	**15** **1.05%**	**1** **0.07%**	**76** **5.31%**	**65** **4.55%**	**1430** **100%**	**100%**

The selection or exclusion of papers from the final sample was not performed based on the type of paper and, therefore, these categories were not deliberately chosen. Consequently, the available papers within the Web of Science database that conform to the research methodology have been delimited by these categories. The category with the highest number of publications is *Article*, which accounts for 87.13% of the total. The following categories, *Proceedings Paper* and *Review*, have considerably smaller shares, collectively representing nearly 10% of the total number of papers. The analysis of articles reveals a threefold increase in their number in 2022 compared to the previous year. This trend indicates a significantly higher interest among academics and journals in this area.

4.3 Analysis of the publishing activity by journals

Across 457 publications, 1430 papers were identified. The top 10 highest-ranked journals, based on the number of articles on the topic of ESG, are presented in *Table 3*, including their research area and impact factor for 2022.

Table 3. Ten most prominent journals

Journal / Research area	No. of articles	Frequency	Impact factor 2022

Sustainability
    Science & Technology – Other Topics
    Environmental Sciences & Ecology
	277	19.37%	3.9

Business Strategy and the Environment Business & Economics	51	3.57%	13.4

Journal / Research area	No. of articles	Frequency	Impact factor 2022
Environmental Sciences & Ecology			
Corporate Social Responsibility and Environmental Management	51	3.57%	9.8
Business & Economics			
Environmental Sciences & Ecology			
Journal of Cleaner Production	39	2.73%	11.1
Science & Technology – Other Topics			
Engineering			
Environmental Sciences & Ecology			
Journal of Sustainable Finance & Investment	36	2.52%	4.3
Business & Economics			
Science & Technology – Other Topics			
Frontiers in Environmental Science	26	1.82%	4.6
Environmental Sciences & Ecology			
Finance Research Letters	24	1.68%	10.4
Business & Economics			
Journal of Business Ethics	24	1.68%	6.1
Business & Economics			
Social Sciences – Other Topics			
Sustainability Accounting Management and Policy Journal	19	1.33%	4.5
Business & Economics			
Environmental Sciences & Ecology			
Energies	18	1.26%	3.2
Energy & Fuels			
Total	**565**	**39.53%**	

The most prominent journal in this field is *Sustainability* (277 papers), with an impact factor of 3.9, being specialized in two research areas - *Science & Technology – Other Topics* and *Environmental Sciences & Ecology*. The following journals are *Business Strategy and the Environment* (51 papers) and *Corporate Social Responsibility and Environmental Management* (51 papers). As may be observed, there is a substantial difference between the highest-ranked journal, which accounts for nearly 20% of all papers, and the other journals included in this top. Furthermore, *Business Strategy and the Environment* leads in terms of the journals with the highest impact factor (13.4), closely followed by the *Journal of Cleaner Production*, with an impact factor of 11.1, and *Finance Research Letters, with an impact factor of 10.4*, according to the specific information collected from each publication's records stats. Although *Sustainability* has the highest volume of published papers, its impact factor is significantly lower (3.9). Among the top-performing journals, research areas *Environmental Sciences & Ecology* and *Business & Economics* include six journals each, while *Science & Technology – Other Topics* is associated with three journals.

4.4 Analysis of the most productive authors, co-authorship, and authors' affiliation

According to the analysis, it was revealed that among the total of 3429 authors, 440 had two or more publications. *Table 4* presents the top 10 most productive authors.

Table 4. Top 10 most productive authors

Author	Papers	First author papers	Single authored papers	Corresp. author papers	Author affiliation	Country
Buallay Amina	17	15	6	15	Brunel University and Ahlia/ University Bahrain	United Kingdom/ Bahrain
Kocmanova Alena	8	7	0	7	Brno University of Technology	Czech Republic
Eccles Robert	7	3	0	2	University of Oxford	United Kingdom
Escrig-Olmedo Elena	7	3	0	4	Universitat Jaume I	Spain
Faldik Oldrich	7	0	0	0	Mendel University in Brno	Czech Republic
Hamdan Allam	7	0	0	0	Ahlia University Bahrain	Bahrain
Hussainey Khaled	7	0	0	0	University of Portsmouth	United Kingdom
Trenz Oldrich	7	4	0	4	Mendel University in Brno	Czech Republic
Uyar Ali	7	4	0	5	La Rochelle Business School	France
Serafeim George	6	1	0	1	University of Genoa	Italy

Furthermore, *Figure 4* presents an overview of the collaborations between authors. In order to create this figure, a condition was set - the authors must have at least 2 published papers.
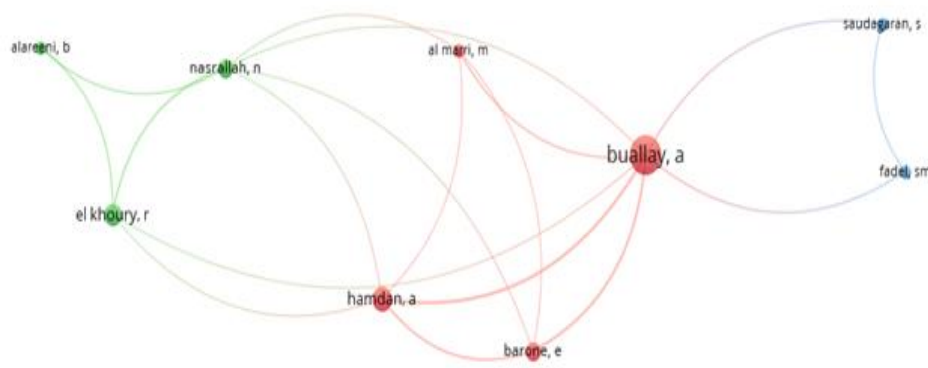
Figure 4. Visual representation of co-authorship

Buallay Amina is not only the author with the highest productivity, but she also has the highest degree of involvement in collaborative efforts. This outcome was anticipated, as *Table 4* reveals that out of a total of 17 publications, Buallay Amina is a single author for 6 papers, while the remaining 11 papers involve collaborations with other authors.

The following analysis was performed taking into account the characteristics of authors' affiliations, utilizing the frequency analysis technique. *Table 5* provides a detailed breakdown of various characteristics of the papers, such as the authors' affiliations, which are presented in terms of the number of papers, the number of authors, and the collaborations between authors affiliated with Romanian universities and those affiliated with international universities.

Table 5. Authors' affiliation analysis

	Number	**Frequency**
Total number of papers	1430	**100.00%**
Papers - authors affiliated with international universities only	1387	96.99%
Papers - at least one author affiliated with a Romanian university	43	**3.01%**
Papers - authors affiliated with Romanian universities only	35	2.45%
Papers - collaborations between authors affiliated with Romanian and international universities	8	0.56%
Papers - the first author affiliated with Romanian universities	39	2.73%
Papers - the first author is affiliated with international universities	4	0.28%
The average number of authors per article	2.94	
The maximum number of authors per article	16	

Among the 1430 papers that were published, only a small proportion of them, namely 43 papers (3.01%), feature at least one author affiliated with a university in Romania.

Of these, 35 articles (2.45%) have their first author affiliated with a Romanian university, while the remaining 8 articles (0.56%) are the result of collaborations between authors affiliated with Romanian and international universities. Furthermore, the average number of authors per article is 2.94, with the highest number of authors for a single article being 16.

4.5 Analysis of paper length, references, and citation trends

To evaluate the length and quality of the papers, the number of pages, as well as the number of references and citations extracted from the WoS analytics database for each paper were taken into consideration. The resultant data are shown in *Table 6*.

Table 6. Number of pages, references, and citations

Aspects	Descriptive statistics
Total number of pages	**26,759**
Average pages per paper	18.71
Min of pages of one paper	2
Max of pages of one paper	80
Total number of references	**98,706**
Average number of references per paper	69.03
Min of references of one paper	0
Max of references of one paper	392
Total number of citations	**19,763**
Average number of citations per paper	13.82
Min of citations of one paper	0
Max of citations of one paper	1220

The cumulative length of the selected papers amounts to 26,759 pages, with an average number of 18.71 pages per paper. The descriptive statistics indicate that the shortest article has 2 pages (there are 2 articles of 2 pages published in 2009 and 2022). The most extensive paper, comprising 80 pages, was published in 2019 in the *University of Pennsylvania Journal of International Law*. Upon conducting an examination of the number of references used in the papers, 98,706 references were identified in 1430 publications, resulting in an average of 69.03 references per research. Notably, six articles did not include any references. Of the six, two were written by a single author, two were co-authored by two authors, one was co-authored by three authors, and the last one was co-authored by four authors. Similarly, the paper authored by Christensen *et al.* (2021), having 73 pages, had the highest number of references, totaling 392.

Among the 1430 articles that were analyzed, which altogether had a citation count of 19,763, it was observed that the top 10 most frequently cited articles contribute to 3067 citations. More details are provided in *Table 7*.

The article *Corporate Social Responsibility and Access to Finance* authored by Cheng *et al.* (2014) has the highest number of citations among the selected literature, signifying its importance in the field. Given that it was published in 2014, it was expected to have a substantial total citation count, which was indeed observed. It also stands out as having the highest average annual citation count, underscoring its significant influence on the field of study.

Table 7. Top 10 most cited papers

Title	Journal	Research area	Authors	Publication year	No. of citations*	Average citations per year
1.Corporate Social Responsibility and Access to Finance	Strategic Management Journal	Business & Economics	Cheng *et al.*	2014	1220	152.50
2.ESG performance and firm value: The moderating role of disclosure	Global Finance Journal	Business & Economics	Fatemi *et al.*	2018	245	61.25
3.The effects of environmental, social, and governance disclosures and performance on firm value: A review of the literature in accounting and finance	British Accounting Review	Business & Economics	Brooks and Oikonomou	2018	222	55.50
4.Corporate social responsibility and financial performance: A non-linear and disaggregated approach	Economic Modelling	Business & Economics	Nollet *et al.*	2016	216	36.00
5.Corporate social responsibility governance, outcomes, and financial performance	Journal of Cleaner Production	Science & Technology – Other Topics Engineering Environmental Sciences & Ecology	Wang and Sarkis	2017	203	40.60
6.Diversity of Board of Directors and Environmental Social Governance: Evidence from Italian Listed Companies	Corporate Social Responsibility and Environmental Management	Business & Economics Environmental Sciences & Ecology	Cucari *et al.*	2018	201	50.25
7.Sensitive industries produce better ESG performance: Evidence from emerging markets	Journal of Cleaner Production	Science & Technology – Other Topics Environmental Sciences & Ecology	Garcia *et al.*	2017	198	39.60
8.Do environmental, social, and governance activities improve corporate financial performance?	Business Strategy and the Environment	Business & Economics Environmental Sciences & Ecology	Xie *et al.*	2019	193	64.33
9.The informational contribution of social and environmental disclosures for investors	Management Decision	Business & Economics	Cormier *et al.*	2011	192	17.45
10.Firms and social responsibility: A review of ESG and CSR research in corporate finance	Journal of Corporate Finance	Business & Economics	Gillan *et al.*	2021	177	88.50

*until February 2023

To better comprehend a research subject in relation to citation trends, Chuang *et al.* (2007) proposed an association between the number of citations and the publication life. The trend of this relationship is illustrated in *Figure 5*, where the publication life is the age of the article from the time of its publication to the date of data extraction.
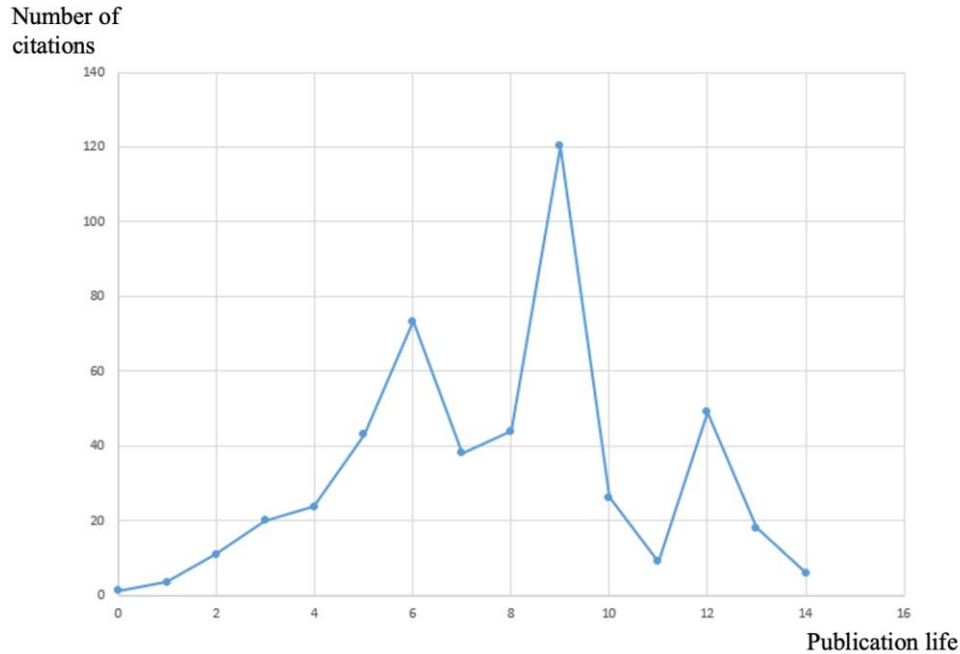

Figure 5. Citation trend visual representation

According to *Figure 5*, a paper addressing ESG factors in relation to other concepts within the realm of sustainability, like CSR, green economy, circular economy, digitalization, technology, industry 4.0, or industry 5.0. is most commonly cited in its ninth year of publication, with a variable trend after that. Up to the sixth year of publication, there is a consistent growth in citations per research. While the publication length influences the number of citations, it also serves as a metric for evaluating the visibility of a paper.

4.6 Analysis of the publishing activity by country and continent

The use of ESG indicators has generated significant scholarly interest, and authors affiliated with institutions in 87 countries around the world contribute to this area of research. *Figure 6* illustrates the distribution of papers considering the country of institutions that authors are affiliated with, using the PowerBI software.
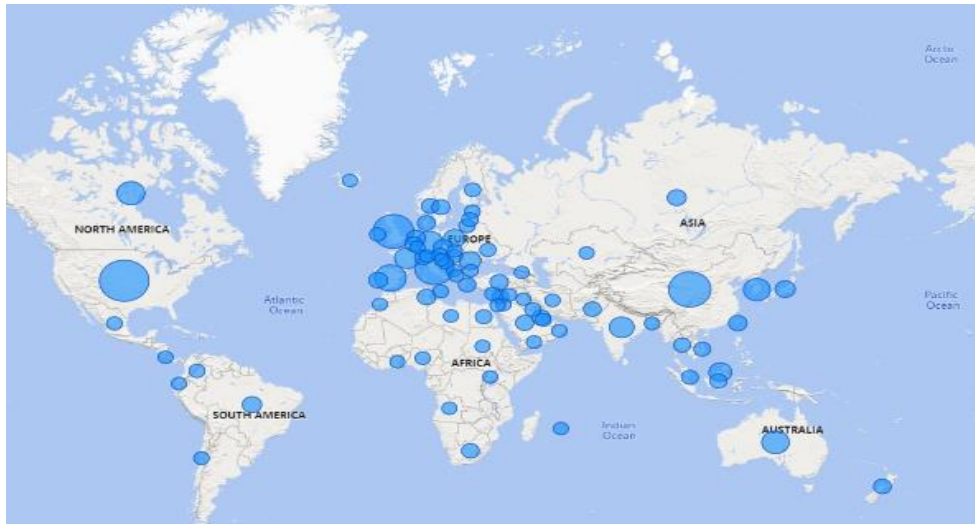
Figure 6. PowerBI map of publishing countries

The selected topic is one that is of global interest, and most publications come from Europe (65.24%). This is followed by Asia (42.17%), North America (20.84%), Oceania (6.57%), Africa (4.34%), and South America (2.87%). Next, *Table 8* displays the 15 main countries in terms of the number of published papers.

Table 8. Top 15 publishing countries on ESG

Countries	Number of papers	Frequency
USA	212	14.83%
China	168	11.75%
United Kingdom	159	11.12%
Italy	150	10.49%
Spain	103	7.20%
Canada	79	5.52%
Australia	77	5.38%
Germany	73	5.10%
South Korea	73	5.10%
France	64	4.48%
India	58	4.06%
Malaysia	48	3.36%
Romania	43	3.01%
Poland	42	2.94%
Japan	32	2.24%
Total	**1381**	**96.58%**

The United States of America occupies the first position with 212 articles, representing 14.83% of the total. Following the US, China, and the United Kingdom

rank second and third with 168 (11.75%) and 159 (11.12%) articles, respectively. In particular, Romania is ranked 13th with 43 articles, which represents 3.01% of the total of articles identified in the Web of Science database.

Moreover, *Figure 7* presents an overview of the co-authorship across different nations. The graphical representation facilitates the detection of collaborative efforts among various countries.
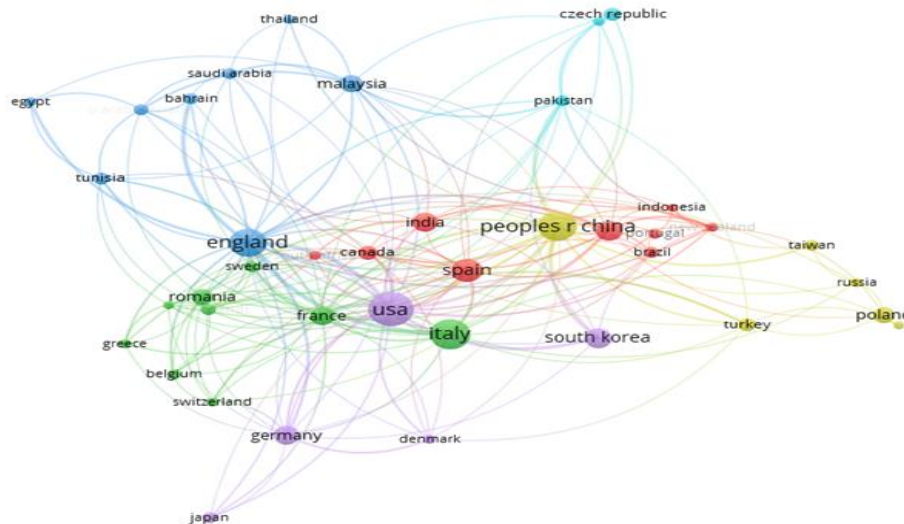

Figure 7. Network analysis of co-authorship based on countries

Through a VOSviewer analysis, five distinct clusters are highlighted. The findings suggest that, regarding ESG research, the United States tends to collaborate with Germany and South Korea, Italy with France and Romania, China with Poland, Russia, Turkey, and Taiwan, the United Kingdom with Malaysia, Tunisia, Bahrain, and Tunisia, while Spain collaborates with India and Canada.

5. Discussion and conclusion

This paper provides an overview of the state of research in the field of ESG factors in relation to other concepts within the realm of sustainability, such as CSR, green economy, circular economy, digitalization, technology, industry 4.0, and industry 5.0. Using a bibliometric analysis, this study explores the available papers that are indexed in Web of Science database. Although the initial search generated 2611 results, after the elimination of duplicates and the application of the exclusion criteria described in the methodology, a number of 1430 papers were included in the analysis.

The results and the key characteristics in the selected area of research are highlighted through various analyses of the final sample, using descriptive and frequency analysis, and two software tools for visual representation – VOSviewer and PowerBI. Therefore, the findings answer the six research questions, including various analyses, such as the interconnectivity of selected concepts, the co-occurrence of authors' keywords, the number of publications over time, as well as the paper types, the publishing activity by journal, the most productive authors, the co-authorship, their affiliation, the papers' length, references, and citations trend, the most cited papers, the publishing activity by country and the collaboration patterns between countries.

Among the identified results, regarding the first research question - *How are the analyzed concepts in the scientific literature interconnected and which keywords do authors commonly employ?*, it is noteworthy that a single article analyzes simultaneously the concepts of ESG and Sustainability, ESG and CSR, ESG and Green economy, ESG and Circular economy, while no article simultaneously treats the concepts ESG and Digitalization, ESG and Technology, ESG and Industry 4.0, and ESG and Industry 5.0. It is also worth noting that 273 papers, i.e. 19.09% of the total, contain studies on ESG in correlation with concepts from the technical area under consideration: digitization, technology, industry 4.0, and industry 5.0. The most often used keywords by the authors are ESG (368 occurrences), CSR (304 occurrences), and sustainability (184 occurrences). Out of the nine selected concepts, ESG, CSR, and sustainability are also employed as authors' keywords. This analysis assists in the identification of potential gaps in current ESG-related research and points to new study topics.

As for the second question - *How has research on ESG factors in relation to other concepts within the realm of sustainability developed over the years?*, the peak in terms of publications was reached in 2022, when 41.82% of all papers identified in Web of Science as pertinent to the research topic were authored. Most probably, this happened because of the Covid-19 pandemic, which has drawn attention to the importance of environmental, social and governance factors in the corporate world. Regarding the type of publications, the top-ranked category is *Article*, which represents 87.13% of the total.

Answering the third research question - *Which are the leading journals in the studied research topic?*, *Sustainability*, *Business Strategy and the Environment*, and *Corporate Social Responsibility and Environmental Management* stand out as the top three most prolific publications. *Business Strategy and the Environment* leads in terms of the journals with the highest impact factor (13.4). Although *Sustainability* has the highest volume of published papers (277 papers), its impact factor is significantly lower (3.9). The most studied research areas within the top publications are *Environmental Sciences & Ecology* and *Business & Technology*.

Considering the fourth research question - *What general characteristics have the papers' authors within the analyzed topic?*, Amina Buallay, who is affiliated with both a university in Bahrain and one in the United Kingdom, is the most productive author (17 papers). She is also the author of most collaborations (11 papers). In terms of the authors' affiliation, among the 1430 papers that were published, only a small proportion of them, namely 43 papers (3.01%), feature at least one author who is affiliated with a university in Romania. Additionally, the highest number of authors for a single article is 16, and the average number of authors per research is 2.94.

Regarding the fifth research question - *What general characteristics have the papers within the analyzed topic?*, it is reported that the publications have, on average, 18.71 pages, 69.03 references, and 13.82 citations per work. The most cited article is *Corporate Social Responsibility and Access to Finance*, authored by Cheng *et al.* (2014) and published by *Strategic Management* Journal, having 1220 citations, with an average of 152.5 citations per year. A paper addressing the ESG factors in relation to other concepts within the realm of sustainability, like CSR, green economy, circular economy, digitalization, technology, industry 4.0, or industry 5.0. is most commonly cited in its ninth year of publication, with a variable trend after that.

Finally, as per sixth research question - *Which countries and continents are the most productive in the field of research and which are their collaboration patterns?*, the three most productive nations in the chosen field are the USA, China, and the UK. The analysis also reveals that each country forms a distinct cluster when it comes to the authors' cooperation, with collaboration between these three countries being avoided.

To examine the interconnection between the chosen ideas, a meta-analysis of the publications mentioned in *Figure 1* could be a future research direction. The potential future paper could analyze the similarities and differences between the two studied groups of the concepts within the realm of sustainability (1) CSR, Green economy, Circular economy and (2) Digitalization, Technology, Industry 4.0, and Industry 5.0. Another potential research direction involves investigating the connection between sustainability and technological advancements, specifically, which technologies are integrated into sustainable business models and how they are transforming the business environment.

Given the wide spectrum of the sustainability field and the ever-changing business landscape, our study had to limit its scope to the selected concepts, since it would be impossible to include all potential terms in a single study. Additionally, rapid technological advances and the emergence of innovative concepts constitute another limitation, as new ideas are continually developed, thereby not included in our paper.

Moreover, limiting our research to the Web of Science database creates challenges in highlighting broader study findings.

Acknowledgment

References

Abrudan, L.C., Matei, M.C., & Abrudan, M.M. (2021) „Towards Sustainable Finance: Conceptualizing Future Generations as Stakeholders", *Sustainability*, vol. 13, no. 24

Abu-Bakar, H., Charnley, F., Hopkinson, P., & Morasae, E.K. (2023) „Towards a typological framework for circular economy roadmaps: A comprehensive analysis of global adoption strategies", *Journal of Cleaner Production*, 140066

Adamowicz, M. (2022) „Green Deal, Green Growth and Green Economy as a Means of Support for Attaining the Sustainable Development Goals", S*ustainability*, vol. 14, no. 10

Alekneviciene, V., & Stralkute, S. (2023) „Impact of corporate social responsibility on cost of debt in Scandinavian public companies", *Oeconomia Copernicana*, vol. 14, no. 2: 585-608

Alsmadi, A.A. & Alzoubi, M. (2022) „Green Economy: Bibliometric Analysis Approach", *International Journal of Energy Economics and Policy*, vol. 12, no. 2: 282-298

Anica-Popa, I., Anica-Popa, L., Rădulescu, C., & Vrîncianu, M. (2021) „The Integration of Artificial Intelligence in Retail: Benefits, Challenges and a Dedicated Conceptual Framework", *Amfiteatru Economic*, vol. 23, no. 56: 120-136

Asif, M., Searcy, C., & Castka, P. (2023) „ESG and Industry 5.0: The role of technologies in enhancing ESG disclosure", *Technological Forecasting and Social Change*, vol. 195, 122806

Babkin, A., Shkarupeta, E., Tashenova, L., Malevskaia-Malevich, E., & Shchegoleva, T. (2023) „Framework for assessing the sustainability of ESG performance in industrial cluster ecosystems in a circular economy", *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 9, no. 2, 100071

Bustillo-Castillejo, M.C., Pérez-Morote, R., & González-Moreno, A. (2023) „Corporate Social Responsibility and Community Legitimacy: Colombian Caribbean Insights", *Sustainability*, vol. 15, no. 18, 13659

Caraiani, C., Lungu, C.I., Dascălu, C., & Colceag, F. (2015) *Green Accounting Initiatives and Strategies for Sustainable Development*, Harshey: IGI Global

Cavalcanti, D.R., Oliveira, T. & Santini, F.O. (2022) „Drivers of digital transformation adoption: A weight and meta-analysis", *Heliyon*, vol. 8, no. 2, 08911

Chen, Y., & Bellavitis, C. (2020) „Blockchain disruption and decentralized finance: The rise of decentralized business models", *Journal of Business Venturing Insights*", vol. 13, no. C

Chen, W., Zhu, Y., & Wang, C. (2023) „Executives' overseas background and corporate green innovation", *Corporate Social Responsibility and Environmental Management*, vol. 30, no. 1: 165-179

Chouaibi, S., & Chouaibi, J. (2021) „Social and ethical practices and firm value: the moderating effect of green innovation: evidence from international ESG data", *International Journal of Ethics and Systems*, vol. 37, no. 3: 442-465

Chouaibi, Y., & Zouari, G. (2022) „The effect of corporate social responsibility practices on real earnings management: evidence from a European ESG data", *International Journal of Disclosure and Governance*, vol. 19, no. 1: 11-30

Chuang, K.Y., Huang, Y.L., & Ho, Y.S. (2007) „A bibliometric and citation analysis of stroke-related research in Taiwan", *Scientometrics*, vol. 72, no. 2: 201-212

Chung, R.K., Margolin, A.M., & Vyakina, I.V. (2023) „Theory and Practice of ESG Transformation of Management Systems", *Ekonomicheskaya Politika*, vol. 18, no. 2: 80-103

Clement, A., Robinot, E., & Trespeuch, L. (2022) „Improving ESG Scores with Sustainability Concepts", *Sustainability*, vol. 14, no. 20: 175-180

Costa, I., Riccotta, R., Montini, P., Stefani, E., Goes, R.D., Gaspar, M.A., Martins, F.S., Fernandes, A.A., Machado, C., Locano, R., & Larieira, C.L.C. (2022) „The Degree of Contribution of Digital Transformation Technology on Company Sustainability Areas", *Sustainability*, vol. 14, no. 1, 462

Dash, A., & Mohanty, S.K. (2023) „The mediating effect of a firm's corporate reputation and sustainability practices in translating CSR into competitive performance in Indian ESG companies", *Society and Business Review*, vol. 18, no. 4: 691-709

David, L.K., Wang, J.L., Angel, V., & Amjad, N. (2023) „ESG scoring and forecasting in China: advancing sustainable business with multidimensional modeling", *Journal of the Asia Pacific Economy*, vol. 28, no. 3: 657-687

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*, vol. 133: 285-296

Duan, L. (2023) „ESG Index Construction and China's ESG System", *BCP Business & Management*, vol. 38: 175-180

Dube, K., & Nhamo, G. (2020). „Tourism business operators' perceptions, knowledge and attitudes towards climate change at Victoria Falls", *The Journal for Transdisciplinary Research in Southern Africa*, vol. 16, no. 1: 1-10

Ellili, N.O.D. (2022) „Is there any association between FinTech and sustainability? Evidence from bibliometric review and content analysis", *Journal of Financial Services Marketing*, Dec21: 1-15

Fatimah, Y. A., Kannan, D., Govindan, K., & Hasibuan, Z. A. (2023) „Circular economy e-business model portfolio development for e-business applications: Impacts on ESG and sustainability performance", *Journal of Cleaner Production*, vol. 415, 137528.

Figge, F., Stevenson Thorpe, A., & Manzhynski, S. (2022) „Value creation and the circular economy: A tale of three externalities", *Journal of Industrial Ecology*, vol. 25, no. 5: 1690-1700

Gallucci, C., Santulli, R., & Lagasio, V. (2022) „The conceptualization of environmental, social and governance risks in portfolio studies A systematic literature review", *Socio-Economic Planning Sciences*, vol. 84, no. 3, 101382

Gao, S., Meng, F.C., Gu, Z.Y., Liu, Z.Y., & Farrukh, M. (2021) „Mapping and Clustering Analysis on Environmental, Social and Governance Field a Bibliometric Analysis Using Scopus", *Sustainability*, vol. 13, no. 13, 7304

Ghazanfari, A. (2023) „An Analysis of Circular Economy Literature at the Macro Level, with a Particular Focus on Energy Markets", *Energies*, vol. 16, no. 4, 1779

Ghobakhloo, M., Iranmanesh, M., Mubarak, M.F., Mubarik, M., Rejeb, A., & Nilashi, M. (2022) „Identifying industry 5.0 contributions to sustainable development: A strategy roadmap for delivering sustainability values", *Sustainable Production and Consumption*, vol. 33: 716-737

Govindan, K. (2023) „How digitalization transforms the traditional circular economy to a smart circular economy for achieving SDGs and net zero", *Transportation Research Part E: Logistics and Transportation Review*, vol. 177, 103147

Grabowska, S., Saniuk, S., & Gajdzik, B. (2022) „Industry 5.0: improving humanization and sustainability of Industry 4.0", *Scientometrics*, vol. 127, no. 6: 3117-3144

Hamada, K. (2022) „A Duopoly of Strategic CSR Firms", *Journal of Institutional and Theoretical Economics-Zeitschrift fur die Gesamte Staatswissenschaft*, vol. 178, no. 3: 258-279

Hamdy, O.M.M, Elsayed, K.K., & Elahmady, B. (2018) „Impact of Sustainable Supply Chain Management Practices on Egyptian Companies' Performance", *European Journal of Sustainable Development*, vol. 7, no. 4: 119-130

He, M., Yu, W., & Han, X. (2022) „Bibliometric Review on Corporate Social Responsibility of the Food Industry", *Journal of Food Quality*, vol. 2022, no. 12: 1-14

Hu, A.J., Yuan, X.Z., Fan, S.S., & Wang, S.L. (2023) „The Impact and Mechanism of Corporate ESG Construction on the Efficiency of Regional Green Economy: An Empirical Analysis Based on Signal Transmission Theory and Stakeholder Theory", *Sustainability*, vol. 15, no. 17, 13236

Hui-Wen Chuah, S., Sujanto, R.Y., Sulistiawan, J., & Cheng-Xi Aw, E. (2022) „What is holding customers back? Assessing the moderating roles of personal and social norms on CSR'S routes to Airbnb repurchase intention in the COVID-19 era", *Journal of Hospitality and Tourism Management*, vol. 50: 67-82

Izgarova, A.I., Rogova, E.M., & Bakhareva, O.V. (2023) „ESG investment relationship with financial performance of Russian companies", *Upravlenets-The Manager*, vol. 14, no. 3: 17-29

Jafari, N., Azarian, M., & Yu, H. (2022) „Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics?", *Logistics-Basel*, vol. 6, no. 2, 26

Jain, K., & Tripathi, P. S. (2023) „Mapping the environmental, social and governance literature: a bibliometric and content analysis", *Journal of Strategy and Management*, vol. 16, no. 3: 397-428

Jiang, Y., Ni, H., Ni, Y., & Guo, X.M. (2023) „Assessing environmental, social, and governance performance and natural resource management policies in China's dual carbon era for a green economy", *Resources Policy*, vol. 85, no. B, 104050

Jiang, Y., Ni, H., Guo, X., & Ni, Y. (2023b) „Integrating ESG practices and natural resources management for sustainable economic development in SMEs under the double-carbon target of China", *Resources Policy*, vol. 87, no. A, 104348

Jin, M., & Kim, B. (2022). The Effects of ESG Activity Recognition of Corporate Employees on Job Performance: The Case of South Korea. *Journal of Risk and Financial Management*, vol. 15, no. 7, 316

Kambe, H., & Tamamura, M. (2022) „Effects of firm-level ESG performance on creditworthiness in Japanese listed companies", *International Journal of Economic Policy Studies*, vol. 16, no. 2: 465-489

Kasim, A., Khuadthong, B., Jailani, N., Mokhtar, M.F., Radha, J.Z.R.R., & Leong, M. (2022) „The Importance of Community Perspectives on Hotel Community-Related CSR: A Position Paper", *Sustainability*, vol. 14, no. 8, 4636

Khan, M.A. (2022) „ESG disclosure and Firm performance: A bibliometric and meta analysis", *Research In International Business And Finance*, vol. 61, no. 4, 101668

Khan. U., & Liu, W.L. (2023) „The link between green innovations, corporate performance, ESG activities, and sharing economy", *Environmental Science and Polution Research*, vol. 30, no. 32: 78763-78775

Lange, S., Pohl, J., & Santarius, T. (2020) „Digitalization and energy consumption. Does ICT reduce energy demand?", *Ecological Economics*, vol. 176, 106760

Lee, C.-C., Wang, C.-W., & Ho, S.-J. (2022) „The dimension of green economy: Culture viewpoint", *Economic Analysis and Policy*, vol. 74: 122-138

Li, W.J., & Liu, Z.Y. (2023) „Social, Environmental, and Governance Factors on Supply-Chain Performance with Mediating Technology Adoption", *Sustainability*, vol. 15, no. 14, 10865

Liao, H.T., Pan, C.L., & Zhang, Y. (2023) „Collaborating on ESG consulting, reporting, and communicating education: Using partner maps for capability building design", *Frontiers in Environmental Science*, vol. 11, 1119011

Lu, Y.Z., Xu, C., Zhu, B.S., & Sun, Y.Q. (2023) „Digitalization transformation and ESG performance: Evidence frofm China", *Business Strategy and the Environment*, vol. 7, 109566

Lungu, C.I., Pompei, M., Caraiani, C., & Constantinescu, D. (2020) „A structured literature review of corporate governance and performance research within an emerging country setting", *Journal of Accounting and Management Information Systems*, vol. 19, no. 4: 707-733

Marandure, T., Dzama, K., Bennett, J., Makombe, G., & Mapiye, C. (2020) „Application of system dynamics modelling in evaluating sustainability of low-input ruminant farming systems in Eastern Cape Province, South Africa", *Ecological Modelling*, vol. 438, 109294

Mondal, S., Singh, S., & Gupta, H. (2023) „Green entrepreneurship and digitalization enabling the circular economy through sustainable waste management - An exploratory study of emerging economy", *Journal of Cleaner Production*, vol. 422, 138433

Mourtzis, D., Angelopoulos, J., & Panopoulos, N. (2022) „A Literature Review of the Challenges and Opportunities of the Transition from Industry 4.0 to Society 5.0", *Energies*, vol. 15, no. 17, 6276

Nogueira, F.G., Lucena, A.F.P., & Nogueira, R. (2018) „Sustainable Insurance Assessment: Towards an Integrative Model", *Geneva Papers on Risk and Insurance-Issues and Practice*, vol. 43, no. 2: 275-299

Palmieri, E., Ferilli, G.B., Altunbas, Y., Stefanelli, V., & Geretto, E.F. (2024) „Business model and ESG pillars: The impacts on banking default risk", *International Review of Financial Analysis*, vol. 91, 102978

Peng, Y.X., Ahmad, S.F., Irshad, M., Al-Razgan, M., Ali, Y.A., & Awwad, E.M. (2023) „Impact of Digitalization on Process Optimization and Decision-Making towards Sustainability: The Moderating Role of Environmental Regulation", *Sustainability*, vol. 15, no. 20, 15156

Phiri, T.C., Singh, P., & Nikoloski, A. N. (2022) „The potential for copper slag waste as a resource for a circular economy: A review – Part I", *Minerals Engineering*, vol. 180, 107474

Pillai, S.G., Haldorai, K., Seo, W.S., & Kim, W.G. (2021) „COVID-19 and hospitality 5.0: Redefining hospitality operations", *International Journal of Hospitality Management*, vol. 94, 102869

Qian, C., Gao, Y.Y., & Chen, L.F. (2023) „Green Supply Chain Circular Economy Evaluation System Based on Industrial Internet of Things and Blockchain Technology under ESG Concept", *Processes*, vol. 11, no. 7, 1999

Rajesh, R. (2020) „Exploring the sustainability performances of firms using environmental, social, and governance scores", *Journal of Cleaner Production*, vol. 247, 119600

Rodriguez-Gonzalez, P.T., Rico-Martinez, R., & Rico-Ramirez, V. (2018) „An integrated stochastic economic-ecological-social model with stratified-population", *Ecological Modelling*, vol. 368: 15-26

Roy, P.K. (2023) „Enriching the green economy through sustainable investments: An ESG-based credit rating model for green financing", *Journal of Cleaner Production*, vol. 420, 138315

Salamzadeh, A., Hadizadeh, M., Rastgoo, N., Rahman, M.M., & Radfard, S. (2022) „Sustainability-Oriented Innovation Foresight in International New Technology Based Firms", *Sustainability*, vol. 14, no. 20, 13501

Saunila, M., Nasiri, M., Ukko, J., & Rantala, T. (2019) „Smart technologies and corporate sustainability: The mediation effect of corporate sustainability strategy", *Computers in Industry*, vol. 108: 178-185

Saxena, A., Singh, R., Gehlot, A., Akram, S.V., Twala, B., Singh, A., Montero, E.C., & Priyadarshi, N. (2023) „Technologies Empowered Environmental, Social, and Governance (ESG): An Industry 4.0 Landscape", *Sustainability*, vol. 15, no. 1, 309

Senadheera, S.S., Gregory, R., Rinklebe, J., Farrukh, M., Rhee, J.H., & Ok, Y.S. (2022) „The development of research on environmental, social, and governance (ESG): A bibliometric analysis", *Sustainable Environment*, vol. 8, no. 1, 2125869

Senadheera, S. S., Withana, P.A., Dissanayake, P.D., Sarkar, B., Chopra, S.S., Rhee, J.H., & Ok, Y.S. (2021) „Scoring environment pillar in environmental, social, and governance (ESG) assessment", *Sustainable Environment*, vol. 7, no. 1, 1960097

Silva, F.C.N.S.E. (2023) „Corporate sustainability and ESG: an imperative distinction", *Revista de Gestao Secretariado-Gesec*, vol. 14, no. 11: 247-258

Steblianskaia, E., Vasiev, M., Denisov, A., Bocharnikov, V., Steblyanskaya, A., & Wang, Q. (2023) „Environmental-social-governance concept bibliometric analysis and systematic literature review: Do investors becoming more environmentally conscious?", *Environmental And Sustainability Indicators*, vol. 17, 100218

Su, Y.Y., Dong, X.H., Li, Y., Hong, Q., & Flower, R. (2023) „Optimizing safe and just operating spaces at sub-watershed scales to guide local environmental management", *Journal of Cleaner Production*, vol. 398, 136530

Torres, L., Ripa, D., Jain, A., Herrero, J., & Leka, S. (2023) „The potential of responsible business to promote sustainable work – An analysis of CSR/ESG instruments", *Safety Science*, vol. 164, 2023

Upadhyay, A., Mukhuty, S., Kumar, V., & Kazancoglu, Y. (2021) „Blockchain technology and the circular economy: Implications for sustainability and social responsibility", *Journal of Cleaner Production*, vol. 293, 126130

Uyar, A., Kuzey, C., & Karaman, A.S. (2022) „ESG performance and CSR awards: Does consistency matter?", *Finance Research Letters*, vol. 50, 103276

Vineis, P., & Mangone, L. (2022) „The need for new metrics in the Anthropocene era", *Frontiers in Public Health*, vol. 10, 2527

Wamane, G.V. (2023) „A "new deal" for a sustainable future: enhancing circular economy by employing ESG principles and biomimicry for efficiency", *Management of Environmental Quality*, Vol. ahead-of-print, No. ahead-of-print

Wang, Z., Chu, E., & Hao, Y. (2024) „Towards sustainable development: How does ESG performance promotes corporate green transformation", *International Review of Financial Analysis*, vol. 91, 102982

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021) „Industry 4.0 and Industry 5.0 – Inception, conception and perception", *Journal of Manufacturing Systems*. 2021, vol. 61: 530-535

Zabaniotou, A., Syrgiannis, C., Gasperin, D., Guevera, A.J.D., Fazenda, I., & Huisingh, D. (2020) „From Multidisciplinarity to Transdisciplinarity and from Local to Global Foci: Integrative Approaches to Systemic Resilience Based upon the Value of Life in the Context of Environmental and Gender Vulnerabilities with a Special Focus upon the Brazilian Amazon Biome", *Sustainability*, vol. 12, no. 20, 8407

Zhang, C., & Jin, S.Y. (2022) „What Drives Sustainable Development of Enterprises? Focusing on ESG Management and Green Technology Innovation", *Sustainability*, vol. 14, no. 18, 11695

Zhao, Q.Q., Li, X.T., & Li, S.Q. (2023) „Analyzing the Relationship between Digital Transformation Strategy and ESG Performance in Large Manufacturing Enterprises: The Mediating Role of Green Innovation", *Sustainability*, vol. 15, no. 13, 9998

Zhao, X.Y., Nan, D.Y., Chen, C.M., Zhang, S.A., Che, S.P., & Kim, J.H. (2023) „Bibliometric study on environmental, social, and governance research using CiteSpace", *Frontiers in Environmental Science*, vol. 10, 2534

Zhou, H.L., & Liu, J. (2023) „Digitalization of the economy and resource efficiency for meeting the ESG goals", *Resources Policy*, vol. 86, no. A, 104199