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Global research mapping on the convergence of ESG and sustainable finance: a bibliometric and topic modelling approach

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Abstract: This study maps the intellectual, thematic, and collaborative landscape of environmental, social and governance (ESG) and sustainable finance (SF) research by identifying influential works, core research areas, and emerging trends. Using a mixed-method bibliometric approach combining

citation and co-authorship analysis with latent Dirichlet allocation (LDA) topic modelling, 294 peer-reviewed Scopus articles (2012–2025) were analysed through R-Studio and VOSviewer. Six major research themes emerged: social impact and metrics; AI, big data and innovation; business models and sustainability; ESG ratings and reporting; policy, regulation and governance; and sustainable investment and returns. Results reveal rapid growth in ESG-SF research post-2019, peaking in 2024, with notable dominance of European scholarship. The study highlights a shift toward technology- and regulation-driven research and offers valuable insights for scholars, practitioners, and policymakers to inform ESG policies, reporting frameworks, and sustainable investment models fostering global equity and transparency.

Keywords: environmental social and governance; ESG; sustainable finance; bibliometric analysis; sustainability; innovation; thematic mapping.

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1 Introduction

The combination of environmental, social and governance (ESG) elements with sustainable finance is an indicator of a universal revolution in the financial activities, regulatory oversight, and investment behaviour (Agrawal and Mukti, 2025). With global economies facing the escalating impacts of climate change, biodiversity loss, social injustice, and corporate fraud, the ESG-oriented finance is becoming a part and parcel of sustainable economic performance and corporate citizenship (Khan et al., 2024; Poornima and Gopalakrishna, 2023b). Companies in the capital market are increasingly integrating ESG metrics in their investment analysis and decision-making procedures to ensure that capital is aligned to the goals of sustainable development (SDGs) by regulatory bodies, financial institutions and other stakeholders (Bernardini et al., 2023; Siri and Zhu, 2019). This trend has fuelled the creation of sustainable financial instruments, such as green bonds, social impact investment and sustainability-linked loans, and stricter disclosure requirements in the global reporting standards (Balsalobre-Lorente et al., 2025; de Almeida et al., 2025). The growing attention to ESG and sustainable finance has been met with a rich academic reaction, which is manifested by the fact that the number of peer-reviewed articles, institutional studies, and policy briefs on this topic has grown significantly in the past ten years (Aliano et al., 2024). Such academic works cover a wide range of subjects in corporate finance, environmental science, economics, policy studies and ethics. However, a thorough mapping of the subject is needed to understand the structures, knowledge groups, intellectual foundations, and gaps of this interdisciplinary field.

This has significantly changed the financial environment in the world over the past years as the environmental, social and governance (ESG) principles have been integrated with sustainable finance (Orazayeva and Arslan, 2024). Market stakeholders, in the conditions of growing environmental degradation, social inequalities, and governance scandals, turned to responsible investment patterns that consider the ESG factors in addition to the traditional financial indicators (Al-Issa et al., 2022; Alqudah et al., 2024).

The concept of ESG began as an improvement of the socially responsible investing (SRI) but has since developed into a performance-based model and integrated into risk management, investment strategy, and company valuation models (Chen et al., 2024). Green bonds, climate-aligned investments, and impact finance, all subsets of sustainable finance, have grown globally through policy instruments, including the EU Taxonomy, the Paris Climate Agreement, and the SDGs (Schumacher et al., 2020). Transparency, accountability, and strategic incorporation of ESG aspects have been encouraged through regulatory initiatives like the Task Force on Climate-related Financial Disclosures (TCFD) and the Sustainability Accounting Standards Board (SASB) (Mertens et al., 2023; Wang et al., 2025). Shareholders are increasingly requesting companies to align their corporate activities with ESG, which makes companies reevaluate their environmental footprint, ethical supply chain practices, and composition of boards to ensure better competitiveness and stakeholder confidence over the long term (Chouaibi et al., 2021a, 2022; Khan et al., 2024; Leong et al., 2023).

A consistent line of research conducted between 2012 and 2025 shows that companies that follow the same ESG principles often outperform their competitors in financial, reputational, and operational standards, especially when an economic crisis is occurring like the COVID-19 pandemic (Shalhoob, 2025; Singh et al., 2024; Ziolo and Zaleska, 2025). Research also shows that ESG practices help businesses to minimise systemic risk, raise long-term capital, and better handle stakeholder expectations compared to conventional frameworks (Malik et al., 2023; Rossi et al., 2021). However, the financial impact of ESG is still situational, and it is different across geographical areas, industries, and dimensions of ESG (Eyre et al., 2024; Myklebust, 2020).

Despite the rapid increase in the number of publications in the sphere of ESG, there is still a conceptual fragmentation and a geographic bias of the discipline, and its main inputs are the contributions of Western economies (Ioannidis et al., 2022). Many studies use narrow lenses, focusing on specific ESG attributes, industries, or businesses, and thus do not consider the systemic interdependencies of sustainable finance (Al Abdulla and Muneer, 2023; Nguyen et al., 2021). In addition, inconsistencies in the process of ESG measurements and ratings have led to the issue of greenwashing, reliability of the data, and inter-rater inconsistency (Birk et al., 2025; Jafar et al., 2024). It is based on R-based bibliometric analysis, VOSviewer visualisation, and latent Dirichlet allocation (LDA) topic modelling to systematically explore the intellectual, thematic, and collaborative aspects of ESG and sustainable finance research between 2012 and 2025 to manage the current limitations. These tools supply an in-depth mapping of the knowledge areas, co-authorship, cluster of keywords, and topic trends in the background (Aria and Cuccurullo, 2017; Kumar et al., 2023). The current paper applies these methods to explain the development and spread of ESG topics and outline gaps in research and future directions of the field of study that is rapidly growing. Through a three-fold strategy of mapping ESG and sustainable finance literature in the world, the aim is to identify tendencies of publications, co-authorship and collaboration, cluster of keywords and underlying research issues, providing the basis of future academic research and policy formulation (Abay, 2022; Kumar et al., 2025).

2 Review of literature

The theoretical constructs used to legitimise the scholarly interest in ESG and sustainable finance are based on the following theoretical constructs: stakeholder theory (Freeman and Mcvea, 2001), institutional theory (DiMaggio and Powell, 2000), legitimacy theory (Suchman, 1995), and the resource-based view of the firm (Barney, 1991). These paradigmatic paradigms explain how companies can gain a competitive edge by harmonising internal strengths with external demands, including environmental responsibility, ethical management, and social interaction (Krastev and Krasteva-Hristova, 2024; Yadav et al., 2025).

2.1 Evolution and conceptual development of ESG and sustainable finance

Sustainable finance and the ESG sphere have undergone a significant change over the last twenty years. Originally, as a result of socially responsible investing (SRI), ESG became increasingly significant when institutional investors realised the significance of non-financial factors (Balp and Strampelli, 2022; Beretta et al., 2023). ESG in mainstream finance has been institutionalised through the Principles of Responsible Investment (UNPRI) of the United Nations and the global policy frameworks such as the Paris Agreement (2015) (Myklebust, 2020). In turn, sustainable finance has turned out to be a key tool that can be used to align the capital allocation with the goals of sustainability, especially in the framework of the European Green Deal and the EU Taxonomy of Sustainable Activities (Esty and Cort, 2020; Filippini et al., 2024).

A rapid surge of academic interest can be observed in recent years, particularly after the COVID-19 pandemic, when ESG strategies were identified as the crucial tools that help corporations to stay resilient and deal with crises (Pisani and Russo, 2021). This shift towards voluntary reporting to regulatory reporting in ESG reporting has also enhanced in-depth scholarly exploration of governance frameworks, accountability and financial market reactions (Bax et al., 2024; Shalhoob, 2025).

2.2 Environmental, social, and governance performance and financial implications

There is an emerging body of empirical literature that questions the nexus between ESG performance and corporate financial performance (CFP). Several meta-analyses and cross-sectoral studies confirm a rather positive association, which suggests that ESG could serve as a proxy of the better risk management and strategic foresight (Gennadiy and Lyubich, 2022). This point of view is supported by studies that were conducted as early as 2020 and specifically with regard to long-term investment horizons and those sectors that are prone to reputational or regulatory risks (Abrudan et al., 2021; Kim and Oh, 2024).

However, the results are still fragmented depending on the ESG aspect (E, S, or G), geographical location, and measurement tools used (Fichtner et al., 2024; Kang and Hong, 2025). Indicatively, the valuation in environmentally sensitive industries seems to be improved by the environmental performance conventions, whereas the social and governance metrics can have delayed or conditional impacts (Malone et al., 2025; Poornima and Gopalakrishna, 2023a). These differences highlight the need to have standardised metrics and high quality ESG disclosure, especially in emerging markets.

2.3 Bibliometric and thematic mapping of ESG and sustainable finance

The methodologies of bibliometrics have been integrated in the efforts to identify the structural development of the scholarship in ESG and sustainable finance. All these empirical studies often use citation, co-citation, and key word co-occurrence analysis in order to explain intellectual architecture, author collaboration-network, and thematic hotspots (Ayaz and Zahid, 2024; Bhatia and Thawani, 2024). Interestingly, Bibliometrix R package, which allows paying a high price to obtain sophisticated statistical and graphic tools to conduct a bibliometric analysis, was proposed by Kumar et al. (2023). VOSviewer has also been popularly used to visualise scientific collaboration and clusters of keywords in ESG studies.

Recent bibliometric searches after 2020 shed light on the thematic diversification of ESG studies to other areas like climate risk, social inequality, circular economy, and green innovation (Singhania and Saini, 2022; Srivastava et al., 2022). The intersection of ESG and sustainable finance with digital finance and fintech is a new area though not yet fully explored (Dadabada, 2025). Furthermore, LDA is a topic modelling methodology that is also used to identify latent themes and track topic evolution over time (Mo et al., 2015; Nguyen et al., 2025).

2.4 The geographic and institutional bias in ESG research

Even though the concept of ESG is a universal requirement, the literature is still largely focused on developed economies, specifically the USA, the UK and the European Union, whereas the volume of research in emerging and developing economies is low (Sabbaghi, 2024; Senadheera et al., 2021). This lack of balance reflects not only a lack of data infrastructure but also limited institutional ability to carry out ESG assessments in the Global South. Moreover, in North America and Western Europe, networks of collaboration tend to be concentrated around elite organisations and this limits knowledge sharing and inclusivity in global ESG discourse. The latest bibliometric research is in support of more inclusive studies that capture the local circumstances, indigenous perspectives, and local sustainability threats (Haykel, 2025; Yadav et al., 2025).

The discipline has been characterised by theoretical fragmentation despite the growing number of empirical studies, which have been published over the years. Although some studies have made reference to the stakeholder theory, legitimacy theory, and institutional theory, they in most cases lack a clear theoretical basis, hence reduced explanatory value (Barney, 1991; Beretta et al., 2023). Some researchers also support systems thinking and multi-level governance theories to explain the ESG integration better in terms of corporate, investor, and policy levels (Chouaibi et al., 2021b; Gallo et al., 2023).

3 Research methodology

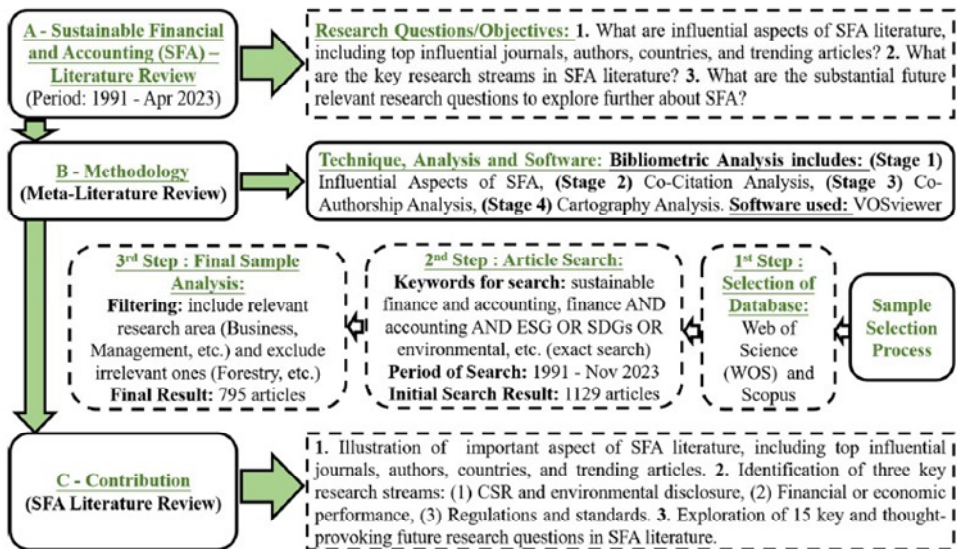
To address the purpose of the study, which is to map the intellectual, thematic and collaborative framework of the environmental, social and governance (ESG) and sustainable finance (SF) literature, a detailed and systematic literature review was undertaken on the Scopus database. The preferred reporting items to systematic reviews

and meta-analyses (PRISMA) framework was implemented to guarantee the methodological transparency and academic rigor (Benabou, 2025). The PRISMA process consists of well-defined eligibility criteria and transparent study selection process, which was utilised during the review and screening phases.

The search strategy used was the Boolean string, which is: ('ESG' AND 'sustainable finance' AND 'sustainability'), the search considered document titles, abstracts, and author keywords that specifically dealt with the interaction of ESG concepts and sustainable finance. The search was limited to the publications in English to guarantee the consistency of interpretation and analysis, and the time frame included 2012–2024, which will allow viewing the evolution of the research over the past decade. The first search gave 301 documents and 294 documents were left after the use of the language filter. There were no other limitations in terms of the type of document, access status, stage of publication, and field of interest, which made it as inclusive as possible and avoided narrowing the thematic range of the field.

This collection of 294 peer-reviewed publications was used to conduct a set of bibliometric and thematic analyses adopting mixed-method approach. In particular, the analysis co-authorship (to examine collaboration patterns on the country level), keyword co-occurrence (to determine dominant themes and knowledge areas), and LDA topic modelling (to uncover underlying conceptual structures and topic evolution) were applied in the study (Nguyen et al., 2025). These methods helped the researchers not only to comprehend the topical diversity of ESG and SF scholarship but also to see the social and intellectual networks which construct it.

Figure 1 PRISMA model (see online version for colours)



Source: Authors' development

In order to conduct these analyses, R-studio was used to perform statistical computations and VOSviewer which is a specialised bibliometric mapping software created by van Eck and Waltman (2010) at the Centre of Science and Technology Studies (CWTS). VOSviewer played a significant role in the creation of knowledge maps which depicted

interrelationship between authors, institutions and thematic cluster. These visualisations played a significant role in revealing trends of influence, collaborative patterns and trends in the field.

Over the past few years, bibliometric analysis has emerged as a common tool of synthesising scholarly landscapes especially in interdisciplinary research domains like ESG and sustainable finance. This study combines the PRISMA flow model with the latest bibliometric methods to guarantee methodological rigor and provide deep insight into the development process and organisation of research on the topic and the rapidly growing segment of research. The entire methodological procedure, its identification, screening, eligibility, and inclusion phases are depicted in Figure 1.

4 Data analysis

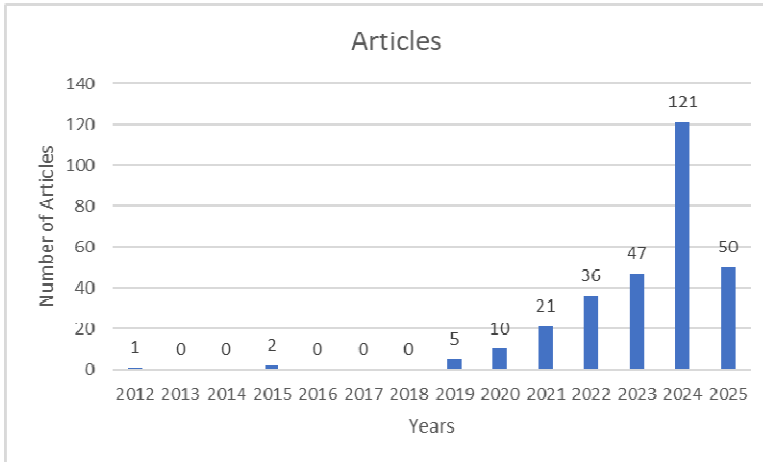
4.1 Annual scientific production

Figure 2 illustrates the annual increase in the number of scholarly publications about the intersection of ESG and sustainable finance between 2012 and 2025. The trend over time shows that the activity of research was gradually becoming active in the first years and that publications were periodically made between 2012 and 2018. The sharp rise begins in 2019 and then it is followed by a steady growth year on year starting in 2020. This trend increased dramatically in 2023, when over 120 articles were published, which indicates that academic interest and policy relevance were growing significantly in this time frame. Even though there is a minor decrease in 2025, the volume is still significantly larger in comparison to previous years, indicating the continuity of the momentum in the field. This trend is in line with the global trend of increased ESG requirements, sustainable finance rules and regulations and the stakeholder pressure on ethical investment conduct. The information indicates that ESG and sustainable finance have ceased to be a niche area of scholarly and institutional interest, especially since the COVID-19 pandemic and regulatory action, including the EU Taxonomy and TCFD frameworks.

4.2 Journal-wise distribution of publications

Figure 3 shows the article distribution of the ESG and sustainable finance articles in different scholarly journals, thus indicating the trends of publications in the field. *Sustainability (Switzerland)* is the most prolific journal with 17 articles and then *Business Strategy and the Environment*, and *Corporate Social Responsibility and Environmental Management* with eight articles each. Other journals that have made significant contributions are the *Journal of Sustainable Finance and Investment* and the *Sustainable Finance*, and interdisciplinary journals like *Journal of Cleaner Production*, *Research in International Business and Finance*, and *Cogent Business and Management* that have relatively fewer publications. This dispensation highlights the fact that ESG and sustainable finance research are multidisciplinary with journals in the fields of environmental science, corporate governance, and finance engaging actively in the discussion. The prevalence of open-access sites like *Sustainability (Switzerland)* is an indicator of increased focus on extensive access and international sharing of ESG information.

Figure 2 Annual scientific production (see online version for colours)



Source: Authors’ own development

Figure 3 Journal-wise distribution of publications (see online version for colours)



Source: Authors’ own development

4.3 Most cited documents

A bibliometric overview of significant influential articles in the sphere of ESG and sustainable finance has been provided in Table 1. The data include the title of the paper (first author, year, and journal), the DOI, the total citations (TC), citations per year (TC/year), and normalised total citations (Normalised TC). These measures help to measure the academic importance and relevance of every publication in the course of time. The source that appeared the most frequently in the dataset belongs to Dremptic et al. (2020), the *Journal of Business Ethics*. It boasts of 731 citations and an outstanding annual citation rate of 121.83, which gives the highest normalised citation score of 7.87. The outcome is an effect that is strong and sustainable in the academic world. The other

impactful work is the article by Al-Sartawi et al. (2022) in the *Journal of Sustainable Finance and Investment*, which, despite being rather recent, was cited 141 times and has a high TC/year of 35.25 and normalised TC of 6.65, which means that it is rapidly and widely adopted by academics. The studies by Cunha et al. (2021) and Macchiavello and Siri (2020) show a strong effect in both areas, as their normalised TC values of 4.45 and 5.33, respectively, indicate strong performance compared to the disciplinary standards. On the other hand, previous publications like Brandstetter and Lehner (2015) have the consistent but less intensive citation measures, which suggest a less intensive but consistent impact. The table represents a blend of both old and new literature, where normalised criteria allow making fair comparisons of the publications of different publication years and research categories, focusing on both timeless and rapidly developing research in the field of ESG and sustainable finance.

Table 1 Most cited documents

| <i>Authors</i> | <i>Title</i> | <i>Source</i> | <i>Total citations</i> | <i>TC per year</i> | <i>Normalised TC</i> |
|------------------------------|--|---|------------------------|--------------------|----------------------|
| Drempetic et al. (2020) | The influence of firm size on the ESG score: corporate sustainability ratings under review | <i>Journal of Business Ethics</i> | 731 | 121.83 | 7.87 |
| Al-Sartawi et al. (2022) | The role of artificial intelligence in sustainable finance | <i>Journal of Sustainable Finance & Investment</i> | 141 | 35.25 | 6.65 |
| Cunha et al. (2021) | Sustainable finance and investment: review and research agenda | <i>Business Strategy and the Environment</i> | 134 | 26.8 | 4.45 |
| Ziolo et al. (2019) | How to design more sustainable financial systems: the roles of environmental, social, and governance factors in the decision-making process | <i>Sustainability</i> | 114 | 16.29 | 1.68 |
| Macchiavello and Siri (2020) | Sustainable finance and Fintech: can technology contribute to achieving environmental goals? A preliminary assessment of 'green fintech' and 'sustainable digital finance' | <i>European Company and Financial Law Review</i> | 113 | 28.25 | 5.33 |
| Muñoz-Torres et al. (2018) | Can environmental, social, and governance rating agencies favour business models that promote a more sustainable development? | <i>Corporate Social Responsibility and Environmental Management</i> | 112 | 16 | 1.65 |

Source: Authors' own development

Table 1 Most cited documents (continued)

| <i>Authors</i> | <i>Title</i> | <i>Source</i> | <i>Total citations</i> | <i>TC per year</i> | <i>Normalised TC</i> |
|--------------------------------|--|--|------------------------|--------------------|----------------------|
| Popescu et al. (2021) | Measuring the sustainability of investment funds: a critical review of methods and frameworks in sustainable finance | <i>Journal of Cleaner Production</i> | 95 | 19 | 3.16 |
| Brandstetter and Lehner (2015) | Opening the market for impact investments: the need for adapted portfolio tools | <i>Entrepreneurship Research Journal</i> , | 82 | 7.45 | 1.64 |
| Schumacher et al. (2020) | Sustainable finance in Japan | <i>Journal of Sustainable Finance & Investment</i> | 82 | 13.67 | 0.88 |
| In et al. (2019) | Integrating alternative data (also known as ESG data) in investment decision making | <i>Global Economic Review</i> | 76 | 10.86 | 1.12 |

Source: Authors' own development

4.4 Key themes in ESG and sustainable finance identified through LDA topic modelling

The ESG and sustainable financial literature on the topic of LDA was used to apply a topic model on the data published between 2012 and 2025. This discussion led to the discovery of six outstanding themes as illustrated in the topic distribution chart per year in Figure 4. Each theme has been interpreted in the following discussion in terms of the clusters of keywords and the density of the documents within a period of time and provides critical insights into the academic development of the research on the subject of ESG.

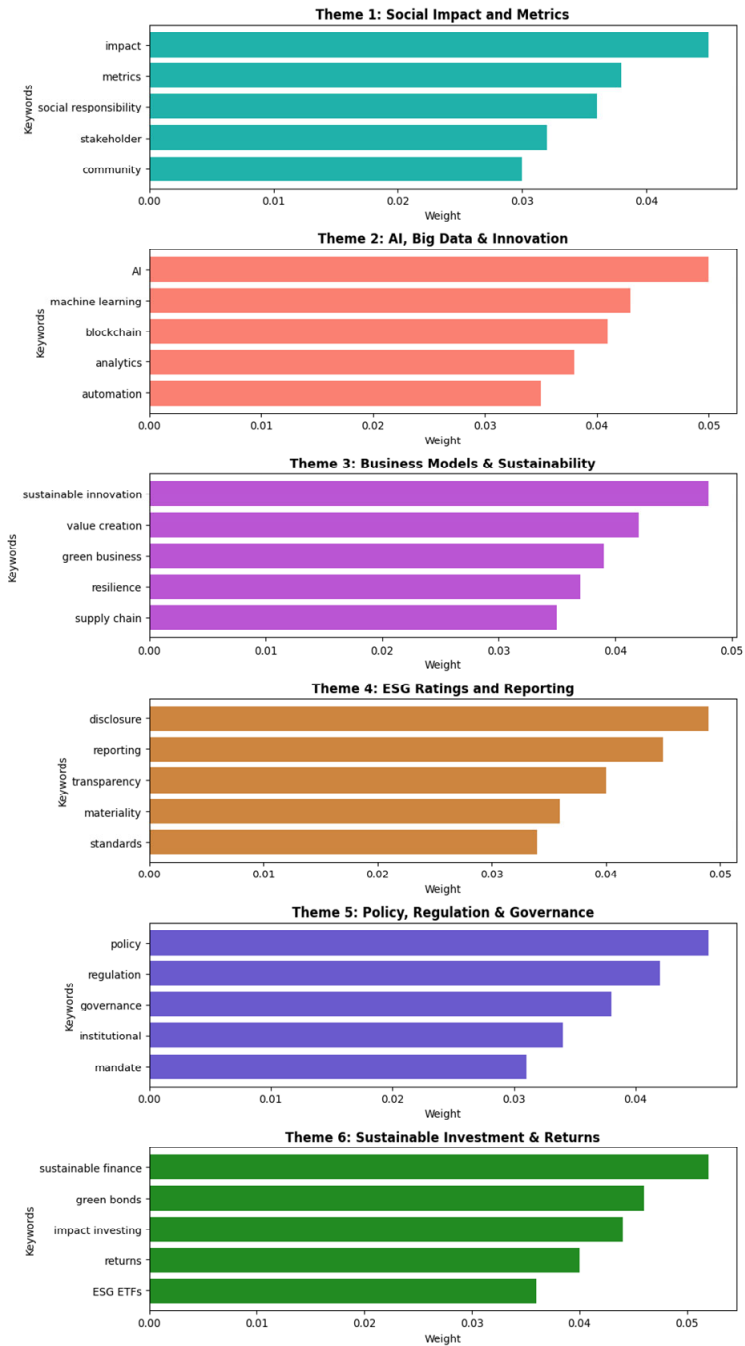
- *Theme 1: Social impact and metrics:* this theme focuses on the social impacts that are associated with ESG practices and highlights the measurable aspects of social responsibility. The use of words like impact, measurement, social responsibility, stakeholder and community highlights the focus on assessing the impact of ESG on communities. The widespread-ness of these words means a strong academic interest in evaluating how corporate ESG programs can be transformed into tangible social benefits. On this basis, research projects are aimed at defining key performance indicators (KPIs) which measure the overall impact of business operations on well-being, equity, and development. The constant popularity of these keywords in the literature informs the need to include social indicators in the framework of sustainable finance and corporate evaluation.
- *Theme 2: AI, big data and innovation:* this theme emphasises how technical instruments are becoming more important in transforming ESG processes. The most common buzzwords, including AI, machine learning, blockchain, analytics, and automation, reflect that the ESG implementation is technologically oriented. The

literature often discusses the potential of big data and artificial intelligence to enhance the accuracy of ESG reporting, evaluate environmental risks, and predict the sustainability trends in the future. These solutions enable the real-time decision-making process and help investors and regulators to work with complicated sustainability data. The prevalence of these buzzwords is an indication of the shift in the discourse of ESG toward more practical, data-driven approaches that are driven by the digital transformation.

- *Theme 3: Business models and sustainability:* this theme explains how companies are reorganising the traditional business models to be in line with the sustainability goals. Sustainable innovation, value creation, green business, resilience, and supply chain are the terms that suggest an emerging business model, which incorporates the long-term elements of the environment and social responsibility. The literature is focused on the transformation of linear to circular models, the strategic incorporation of sustainability in the business missions, and the strength of supply chains to meet the ESG goals. Scholars explore the role of embedding ESG factors in generating new value and competitive advantages and, therefore, making sustainability an economically-oriented strategic goal instead of a moral obligation.
- *Theme 4: ESG ratings and reporting:* this theme looks into the processes used to evaluate and report on the ESG performance with an emphasis on standardisation and transparency. The words disclosure, reporting, transparency, materiality, and standards highlight a major concern on the credibility and consistency of ESG data. The literature examines the discrepancies in ESG rating agencies, the risks of greenwashing, and the need to have uniform reporting systems like GRI, SASB, and TCFD. The main emphasis of this theme is the reliability of ESG information in affecting stakeholder decision making especially as regulatory controls and investor demands of the same reporting increases.
- *Theme 5: Policy, regulation and governance:* this topic is associated with the regulatory and institutional frameworks that influence the adoption of ESG. The use of the terms policy, regulation, governance, institutional, and mandate means that the impact of formal norms and organisational oversight in facilitating ESG compliance. The studies on this topic investigate the impacts of governmental policies (e.g., the EU Green Deal, SEC rules) and institutional contexts on the ESG practices of businesses. The focus on governance includes the discussions of the accountability of boards, the fiduciary duties, and investor activism. The high concentration on the terms of regulation implies that ESG is not just voluntary activity but it is slowly turning into a legal and ethical requirement.
- *Theme 6: Sustainable investment and returns:* this theme dwells on the monetary aspects of ESG, that is, the effect of sustainability on the performance of investments. Sustainable finance, green bonds, impact investing, returns, and ESG ETFs are some of the terms used to denote an area of research that analyses the relationship between ethical investment processes and financial outcomes. Researchers examine the effectiveness of portfolios that include ESG and evaluate their ability to produce competitive risk-adjusted returns and examine innovations, including sustainability-linked loans and green financial instruments. The subject matter represents a growing belief that sustainable investment is a morally sound and

financially sound decision and is thus appealing to a new generation of investors seeking impact in addition to profitability.

Figure 4 Key themes (see online version for colours)

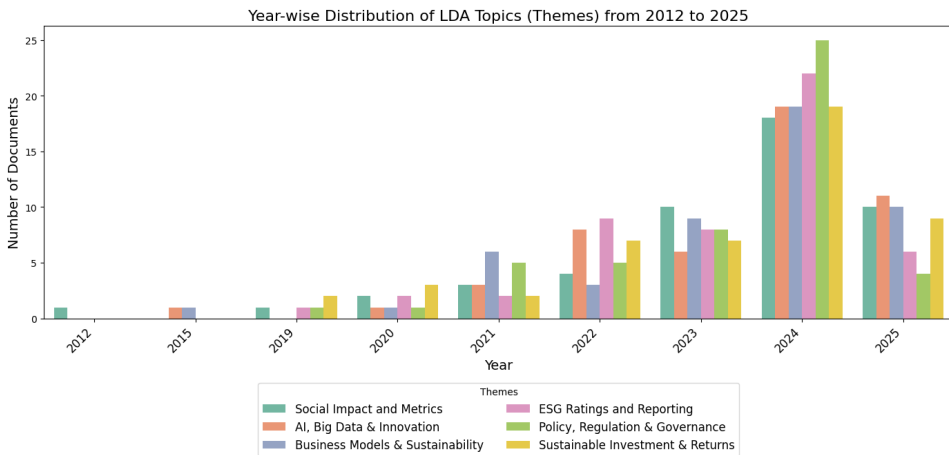


Source: Authors' own development using LDA

4.5 Year-wise distribution of LDA-derived themes

Figure 5 presents the yearly breakdown of papers in six LDA-based themes between 2012 and 2025, thus identifying the longitudinal changes in the theme of research focus with regard to ESG and sustainable finance. The bar chart divides documents into the most popular topic: social impact and metrics; AI, big data and innovation; business models and sustainability; ESG ratings and reporting; policy, regulation and governance; and sustainable investment and returns. At first, the volume of publications in all themes was low and irregular between 2012 and 2020, but starting in 2021, there is a noticeable and consistent growth in the number of documents on each topic. This increase is steeper in 2023 and reaches its highest point in 2024 when the policy, regulation and governance theme reaches the highest number of publications, and then much attention is given to ESG ratings, AI-driven innovation, and sustainable business models. The information also shows that there is a growing academic interest in ESG-related topics, especially in reaction to the global trends of regulatory frameworks, digital transformation, and responsible investment. Overall interest in this field is fairly high in comparison with previous years, and in 2025 a slight drop in most themes is observed, which indicates a well-developed and continuous discussion in this field.

Figure 5 Year-wise distribution (see online version for colours)

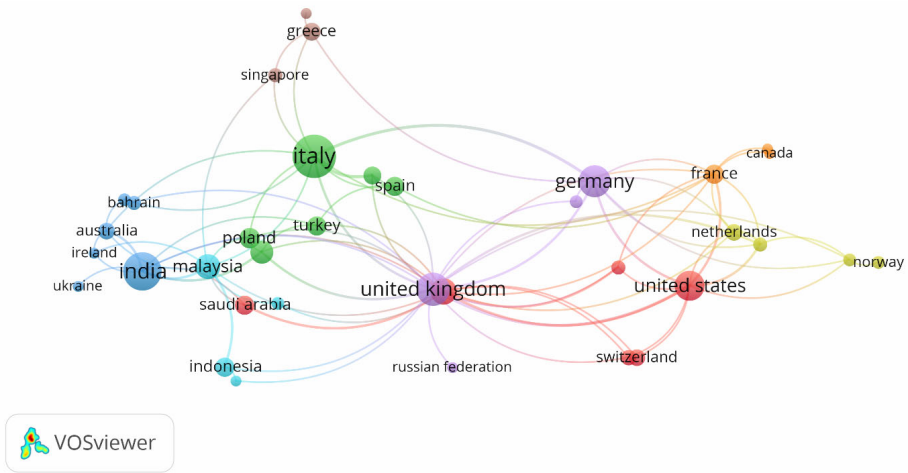


Source: Authors’ own development

4.6 Word cloud

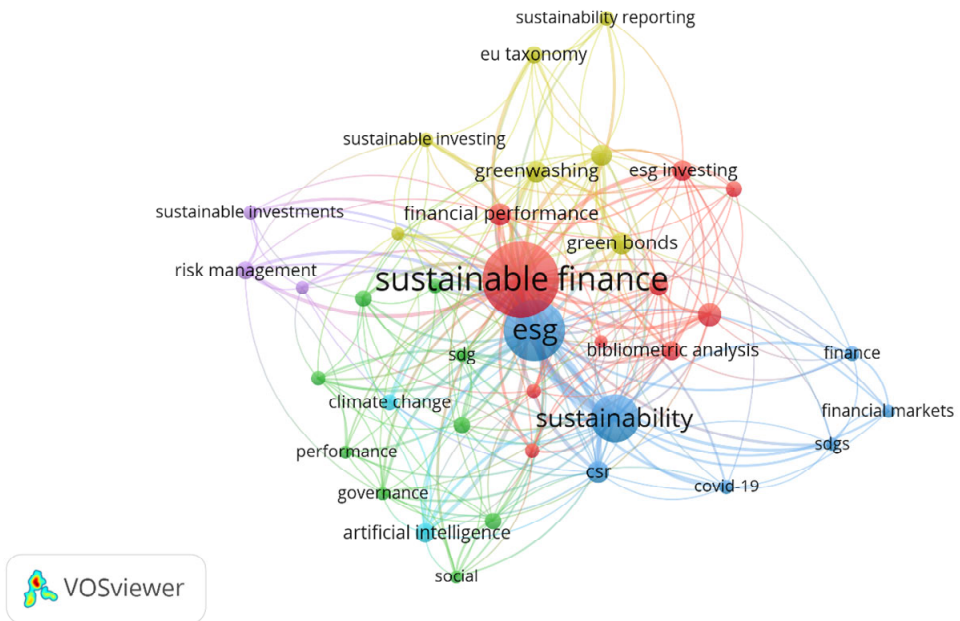
The visual representation of the most used keywords that appeared in the most common frequency among the authors working in the field of ESG and sustainable finance research is presented in the word-cloud image in Figure 6. The keywords, including sustainable, finance, sustainability, investment, ESG, environmental, social, and governance, are written in a large and bold font, which indicates their popularity and importance in the literature. Other keywords that are also central are green, development, financial, disclosure, performance, risk, impact investing, climate change, and policy, which demonstrates the interdisciplinary nature of the field. The use of terms like

Figure 7 Co-authorship of countries (see online version for colours)



Source: Authors' own development

Figure 8 Co-occurrence of author keywords (see online version for colours)



Source: Authors' own development

4.8 Co-occurrence of author keywords

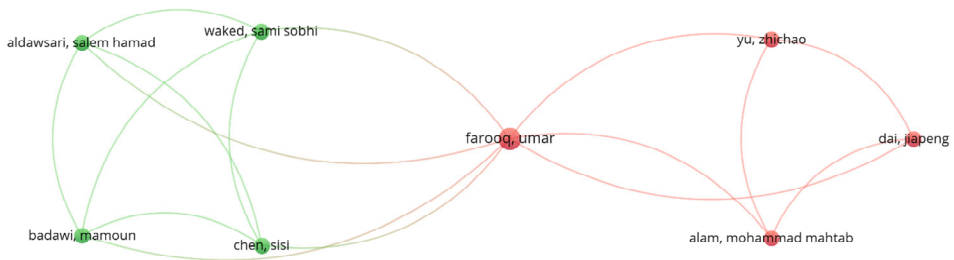
The co-occurrence analysis shown in Figure 8 is a VOSviewer visualisation of author keywords in the sustainable finance field. The nodes are keywords employed by the authors, with bigger nodes representing more frequent use in publications. The frequency

of co-occurrence of these keywords is indicated by the map with the links indicating the co-occurrence. The thematic groupings in the literature are brought to the fore using the colour-coded clusters. The red cluster is centred around the main financial and ESG-based themes of ESG investing, green bonds, and financial performance. The blue cluster is more comprehensive in its sustainability issues, such as sustainability, CSR, SDGs, and COVID-19. The green cluster is also focused on environmental and governance issues including climate change, governance, and artificial intelligence. This review can inform the display of the form of research trends and thematic connections in the ever-expanding literature on sustainable finance.

4.9 Co-authorship network

Figure 9 presents a co-authorship network developed using VOSviewer with a focus on collaborative relationships between scholars working in the sphere of ESG and sustainable finance. The pivotal point of the network is Farooq Umar who is the key connector between two distinct groups of researchers. The red cluster of Yu, Zhichao and Dai, Jiapeng and Alam, Mohammad Mahtab, maybe a research group of East Asia. The green cluster incorporates Aldawsari, Salem Hamad; Waked, Sami Sobhi; Badawi, Mamoun; and Chen, Sisi, which shows a possible collaborative network located in the Middle East. The thickness of the lines between the names indicates the frequency of operation of the names with Farooq and Umar playing a major role in the connection between the various research groups across different places or institutions. This visualisation underscores the structure and the dynamics of scholarly partnership in the field of ESG.

Figure 9 Co-authorship network (see online version for colours)



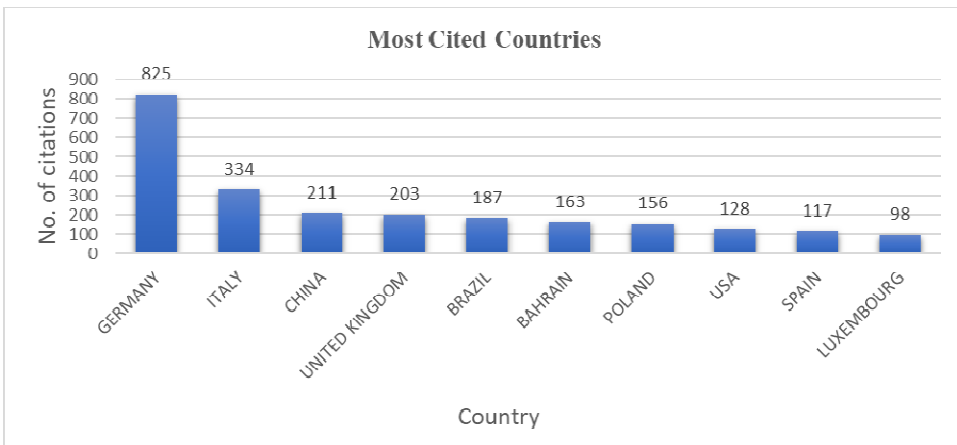
Source: Authors' own development

4.10 Most cited countries

Figure 10 called most cited countries shows the distribution of the citation frequencies by the top ten countries in the research on ESG and sustainable finance. Germany is on the top of the table with 825 citations, which proves its great power and great contribution to

intellectual activity in the sphere. Italy is next with 334 citations, an implication that there is a significant difference between position one and two. This is followed by China and the UK which have 211 and 203 citations respectively, which depicts a strong but somewhat less academic presence. Brazil (187 citations), Bahrain (163) and Poland (156) make significant contributions. As an academic literature powerhouse in the past, the USA boasts 128 citations, second only to Spain (117) and Luxembourg (98), which make up the top ten. This chart consequently shows the geographical dispersion of the current salient ESG research, with European countries especially Germany and Italy taking the lead in the discussion, though the contributions of other countries like Bahrain and Brazil are also emerging, indicating a growing international involvement in the issue of sustainable finance.

Figure 10 Most cited countries (see online version for colours)



Source: Authors' own development

5 Discussion

This paper has conducted a thematic and bibliometric review of the development of ESG and sustainable finance literature between 2012 and 2025. Analytical tools used in the analysis (R, VOSviewer and LDA) were used to interrogate the main themes, areas of focus, and collaboration networks in the field in a systematic way. The results demonstrate that the volume of research has grown significantly after 2019, which can be seen as a sign of the growing academic and institutional understanding of ESG as a crucial element of modern financial systems. The COVID-19 pandemic and regulatory changes, such as the EU Taxonomy and TCFD frameworks, served as drivers of more publication activity, especially in the policy, governance, ESG reporting, and financial performance areas.

The keyword co-occurrence analysis revealed different thematic clusters: a red cluster of ESG investing and financial performance, a blue cluster of more general sustainability issues, such as corporate social responsibility and the sustainable development goals, and a green cluster of climate change, governance, and artificial intelligence. These clusters demonstrate the complexity of the discourse as ESG and sustainable finance have gone

beyond specialised markets and collide with key areas of concern like innovation, risk management and corporate accountability. The analysis also reveals that most of the research output is centred in the economies that are already developed, specifically the UK, the USA, Germany and Italy, but the emerging economies are gradually gaining momentum, though they still are relatively weak in comparison with the world leaders.

The co-authorship analysis showed that there was a strong international cooperation, which was mainly between Western institutions, which highlights the necessity to expand the number of participants by promoting inclusivity in underrepresented nations. The topical modelling findings also highlight the dynamic nature of the industry, where newer topics like AI-based ESG analytics, green fintech, sustainable investment returns and biodiversity financing are becoming more visible. Still, the difference in approaches to the assessment of ESG and the issue of greenwashing remains, and it still hinders the achievement of a single vision and practical use. Irrespective of these difficulties, the research provides a full scope of the research field, which is an essential basis of academic development and practice.

6 Conclusions

The results of this study highlight the accelerated and poly-faceted development of the ESG and sustainable finance scholarship in the last ten years. Previously a peripheral element of socially responsible investing (SRI), ESG has become a core part of the discourse of financial resilience, regulatory compliance as well as stakeholder governance. The use of bibliometric analyses helped to conduct an empirical investigation of how major concepts, authors, countries, and themes evolved over time and how they relate to each other. The study shows that sustainable finance is no longer a fringe issue but a focus in the academia and in policy, which is reflected in the growth in the number of publications, especially in open-access and multidisciplinary journals.

The paper demonstrates that ESG-related research is becoming more aligned with real-world issues, e.g., climate risk, inequality, digital transformation, and responsible investment. However, there is also a strong geographic bias in favour of the Western countries, and this means that more inclusive and diverse viewpoints should be brought on board in the future. Co-occurrence analysis and co-authorship indicate that there is convergence between academic, regulatory and financial discourses, indicating a new period where ESG is viewed as an operating principle and strategy. The research contributes to the understanding of the present state of the field of ESG and sustainable finance and provides insights into the direction of the field in the future to scholars and practitioners by mapping the structural and thematic development of the research.

7 Implications of the study

7.1 Social implication of the study

The research has a great sociocultural implication. The growing focus on ESG and sustainable finance points to a more significant cultural and socioeconomic change of the responsibility, openness, and inclusivity. Since ESG metrics are becoming more and more popular, they are reincorporating corporate responsibility to include not profit

maximisation, but the generation of social and environmental value. The results emphasise the necessity to incorporate local experience and particular risk of various regions, especially those of the Global South that are commonly underrepresented in ESG discussions. The developing nations could be better represented thus providing a better deal with the challenges like poverty, inequality and climate vulnerability. This study can be used to shape the education and awareness campaigns to the population aimed at developing ESG literacy in the consumers, employees, and community stakeholders.

7.2 Managerial implications

The research provides practical implications to managers and decision makers. It underlines the need to incorporate ESG principles in corporate strategies not as a compliance measure but as an agent of value creation. The move towards artificial intelligence, fintech, and sustainable innovation shows that companies need to use digital technologies to improve the measurement and management of ESG performance. Managers need to recognise the increasing demands of standardised, reliable and similar ESG information which is necessary to ensure investment and develop trust in stakeholders. Managers should integrate ESG into risk management and foster an ESG-oriented organisational culture through training and leadership commitment to enhance resilience, strategic alignment, and effective sustainability implementation. The information gained through patterns of collaboration and publication can help organisations to form international research alliances and participate in networks of knowledge sharing. Moreover, the report offers recommendations to regulatory authorities and industry organisations to build more unified and integrated frameworks to mitigate the lack of consistency in ESG ratings, as well as the threat of greenwashing. It provides a strategic map to those organisations that want to shift to sustainable finance and responsible business operation.

8 Limitations

The study has several limitations even though it has strengths. The information was only obtained on the Scopus database, and only English article access was undertaken, which may have omitted valuable input by other indexing databases (e.g., Web of Science) and non-English articles. Such a methodology creates certain bias of language and databases that can limit the extent of the results. Second, co-author and keyword analysis can be a helpful macro-view but it might miss the subtlety or contextual features of ESG-related research, especially those based on diverse cultural or regional backgrounds.

According to the study, there is a strong geographical disparity, and Western countries dominate the ESG research field. This bias restricts the universal use of the results and can neglect the peculiar issues and solutions that emerge due to the developing countries. Fourth, despite the use of rigorous quantitative methodologies, the analysis demonstrated that there is still a theoretical fragmentation as most publications were not based on a strong conceptual framework, thus hindering cross-study comparability and theoretical development. Finally, ongoing challenges in greenwashing and the unevenness in the ESG ratings undermine the validity and usefulness of ESG as the guidance tool, both in research and practice. To handle these issues, it is necessary to

continuously improve measurement instruments, increase regulatory control, and become more transparent with methods.

9 Future direction of the research

The development of similar and consistent ESG measurement frameworks should be the priority of future research to increase consistency and reliability in studies and practices. Also, one should critically discuss the usefulness of the regulatory mechanisms to reduce greenwashing and enhance the level of transparency. Moreover, the discussion of integrating new technologies like artificial intelligence and fintech can also enhance the quality of ESG data and analytics and make informed decisions in sustainable finance.

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