

Mapping the Intellectual Structure of Green Finance and ESG Research: A Bibliometric Review of Global Trends and Emerging Themes (2000–2025)

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ABSTRACT

The rapid global shift toward sustainability has catalysed substantial academic interest in green finance and Environmental, Social, and Governance (ESG) frameworks, leading to a significant expansion of research across interdisciplinary domains. This study employs a comprehensive bibliometric analysis to map the intellectual structure, publication dynamics, and emerging themes in green finance and ESG literature between 2000 and 2025. Drawing on 353 peer-reviewed articles indexed in Scopus and analysed using VOSviewer, the research investigates global publication trends, identifies leading countries and highly cited works, and uncovers thematic hotspots through keyword co-occurrence networks. Results reveal a sharp rise in scholarly output post-2020, with China, the United States, and Malaysia emerging as dominant contributors. Highly cited articles emphasize ESG's influence on corporate innovation, digital finance, and sustainable performance. Thematic clusters highlight a convergence of green innovation, Islamic finance, ESG measurement, and fintech integration as emergent research frontiers. This study offers critical insights for scholars, policymakers, and financial institutions seeking to navigate and contribute to the evolving discourse on sustainable finance.

Keywords: Green Finance, Environmental, Social and Finance (ESG), Bibliometric Analysis, Sustainable Finance, Co-occurrence

INTRODUCTION

In recent years, the integration of sustainability into global financial systems has transitioned from a peripheral concern to a central strategic imperative. This transformation is driven by escalating environmental risks, growing stakeholder expectations, and the pressing need for financial systems to support long-term economic and social development (United Nations, 2023; OECD, 2021). In this context, Green Finance—which channels investments toward environmental projects and low-carbon technologies—and Environmental, Social, and Governance (ESG) frameworks—used to assess corporate sustainability performance—have gained traction across academic, policy, and industry domains, marking a new chapter in sustainable finance scholarship (Friede et al., 2015; Gillan et al., 2021).

Academic research on green finance and ESG has grown exponentially, reflecting the rising complexity and global relevance of these fields. Scholars have explored themes ranging from ESG performance and corporate value to green bond markets (Flammer, 2021), climate risk disclosure (Amel-Zadeh & Serafeim, 2018), and ESG resilience during economic crises (Kim & Li, 2021). Despite the proliferation of studies, the intellectual structure of the field remains fragmented across disciplines, geographies, and methodologies. Previous narrative reviews and thematic syntheses (Gillan et al., 2021a; Ren et al., 2023) provide foundational insights, but a comprehensive bibliometric mapping—encompassing publication trends, citation impact, geographic productivity, and thematic evolution—remains lacking.

This study addresses this gap by employing bibliometric methods to analyse the global scholarly landscape of green finance and ESG research covering the period 2000–2025. Leveraging data from Scopus and using software tools like VOS viewer for co-occurrence and citation analyses, the study examines structural patterns and emerging knowledge domains. The findings inform researchers, policymakers, and financial practitioners by identifying key contributors, high-impact publications, and nascent research frontiers. The analysis is guided by the following research questions:

- **RQ1:** What are the global publication trends in green finance and ESG research between 2000 and 2025?
- **RQ2:** Which are the top 10 most productive countries contributing to green finance and ESG research, and how have their contributions evolved over time?
- **RQ3:** What are the top 10 most cited articles in the field of green finance and ESG, and what key themes or contributions do they represent?
- **RQ4:** What are the emerging research hotspots in green finance and ESG based on keyword co-occurrence analysis?

LITERATURE REVIEW

Green finance and ESG research

Green finance actively supports the Sustainable Development Goals (SDGs) by directing funds towards environmentally friendly endeavours, aligning financial investments with ESG standards, and promoting sustainable business practices (Ali et al., 2023; Cao, 2025; Khamitdkhanovich et al., 2025). Research indicates that green financing can enhance ESG performance, boost profits, and alleviate financial constraints, especially in developing economies (J. Cao, 2025b; Gao et al., 2024). Green finance and ESG investment have emerged as essential mechanisms for promoting sustainable development globally, with significant traction in the financial landscape (Huang, 2024; Khamitdkhanovich et al., 2025). There is a remarkable relationship between green finance and the synergy of ESG and green innovation performance, with potential influence from stakeholders' green concerns (Liu & Song, 2023). Despite rapid expansion, challenges such as greenwashing and lack of uniformity in ESG measurements exist. However, ongoing legislative initiatives and nascent technologies are expected to improve transparency and precision in ESG reporting, shaping the future of green finance and ESG investment (Khamitdkhanovich et al., 2025).

Global impact

China's green finance reform and innovation policies significantly enhance corporate ESG performance, particularly for growth-stage, private, and small-scale firms (C. Liu et al., 2024; W. Liu et al., 2024). The impact of green finance policies on ESG performance is influenced by factors such as business reputation, industry competition, information asymmetry, and state-owned attributes (C. Liu et al., 2024). Regulatory initiatives and market practices, such as sustainability bonds and ESG integration, positively impact the growth and effectiveness of green finance in Georgia (Surmanidze et al., 2023). Green finance has a remarkable inverted U-shaped relationship with the synergy of ESG and green innovation performance, and the government and media's green concerns can moderate this impact (L. Liu & Song, 2023).

Green finance and ESG investment have emerged as essential mechanisms for promoting sustainable development globally (Khamitdkhanovich et al., 2025). Green finance has a negative and statistically significant impact on carbon emissions globally (Baştürk, 2024). The urgency of global environmental challenges has boosted investor interest in ESG investment, and ESG factors in investment portfolios may increase economic and social satisfaction (Saheb et al., 2025). Green financing can shift corporate focus towards the disclosure of ESG performance, potentially inducing firms to engage in ESG greenwashing (Jin et al., 2024). Green bonds have been highly used as a debt instrument to finance projects with positive environmental impacts, and their issuance is influenced by various country-level variables (Pouyan et al.,

2024). Green financing can boost profits, alleviate financial constraints, and incentivize environmental accountability, discouraging environmentally harmful practices (Cao, 2025).

Emerging theme

Green finance and ESG investment have gained prominence due to global concerns for environmental protection and sustainable development goals (Khamitdkhanovich et al., 2025; Yameen et al., 2024). This has led to the development of financial instruments such as green bonds and the incorporation of non-financial aspects into investment choices to evaluate a company's sustainability performance. The literature also highlights the correlation between green investments and corporate ESG performance, particularly driven by the environmental and social aspects of ESG ratings (M. Cao et al., 2023). Despite the rapid expansion of green finance and ESG investment, challenges such as greenwashing and lack of uniformity in ESG measurements exist (Khamitdkhanovich et al., 2025). However, ongoing legislative initiatives and technological innovations are expected to address these challenges and propel the future of green finance and ESG investment (Khamitdkhanovich et al., 2025). Green finance plays a critical role in directing funds towards environmentally friendly endeavours, supporting the SDGs by providing financing for projects that contribute to environmental protection, social inclusion, and economic growth (Ali et al., 2023). Regulatory initiatives, such as green taxonomies and ESG guidelines, are positively correlated with the growth and effectiveness of green finance, as evidenced by a study in the Georgian financial market (Surmanidze et al., 2023b).

In conclusion, the abstracts provide insights into the growing significance of green finance and ESG investment, their impact on sustainable development goals, challenges, and the role of regulatory initiatives in fostering their growth. However, none of the abstracts directly address "emerging themes" in green finance and ESG research.

METHODOLOGY

Bibliometric Analysis

This study employs a comprehensive bibliometric analysis to systematically explore and map the intellectual structure, research productivity, and thematic evolution of the green finance and Environmental, Social, and Governance (ESG) literature from 2000 to 2025. Bibliometric indicators, including publication output, citation analysis, and co-word mapping, were utilized to provide quantitative insights into scholarly trends and thematic developments within the domain. Specifically, the analysis seeks to address four central research questions: to examine global publication trends (RQ1), to identify the most productive countries (RQ2), to uncover the most influential scholarly contributions (RQ3), and to highlight emerging research hotspots (RQ4). To assess scholarly productivity and impact (RQ1), annual publication counts, and total citation metrics were analyzed longitudinally. This facilitated an evaluation of the field's growth dynamics and academic influence over time, visualized through temporal trend charts (see Figure 2). In addressing (RQ4), a keyword co-occurrence analysis was conducted using author keywords and article title terms. VOS viewer, a widely accepted tool for bibliometric mapping, was employed to generate a co-word network visualization, where nodes represent keywords and edges denote co-occurrence frequency. The algorithmic clustering function of VOS viewer enabled the detection of thematic clusters, revealing core and emerging areas such as green innovation, ESG performance measurement, sustainable investment strategies, and digital finance integration. These bibliometric outputs collectively serve to illuminate the current intellectual landscape and inform future scholarly directions in green finance and ESG research.

Procedural Analysis

To ensure analytical transparency and methodological reproducibility, a structured process was followed in data collection, preparation, and visualization. The Scopus database was selected as the primary data source due to its extensive indexing of peer-reviewed publications across multidisciplinary fields and its established credibility in bibliometric research. A Boolean search string was developed and refined to capture literature relevant to the intersection of green finance, ESG, and related financial practices. The final search query was as follows:

TITLE ("management accounting" OR "costing" OR "auditing" OR "ESG") AND TITLE ("non-profit organization" OR "Islamic" OR "finance") AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")).

This search string ensured the inclusion of high-quality journal articles and reviews published in English, encompassing both conventional and emerging sub-domains. No temporal restrictions were applied, allowing for a comprehensive historical coverage. The data retrieval was conducted on 23 July 2024 to preserve reproducibility. The metadata exported from Scopus included bibliographic fields such as article title, abstract, author(s), institutional affiliations, keywords, year of publication, source title, and citation count. These records were then cleaned and imported into VOS viewer (version 1.6.20), a bibliometric software developed by Van Eck and Waltman (2010), which facilitated the generation of network visualizations. VOS viewer's advanced clustering and layout algorithms were instrumental in identifying collaborative patterns, thematic concentrations, and intellectual linkages across the dataset. The integration of Scopus data with VOS viewer enabled precise mapping of the research field, offering both macro and micro-level insights into how green finance and ESG discourses have evolved and interconnected over time.

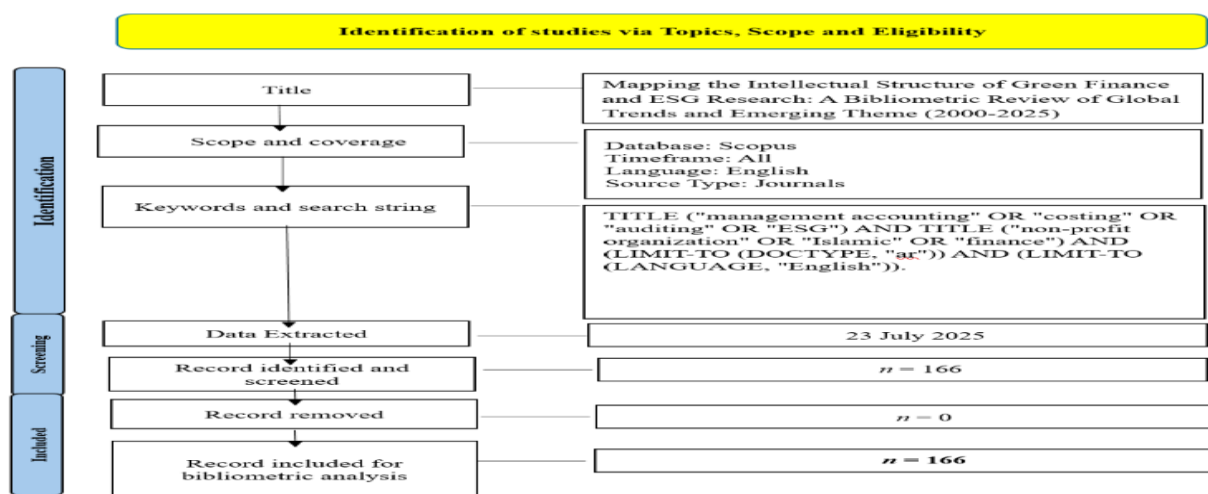


Fig. 1. The Study Flowchart

RESULT

This section presents the findings of the bibliometric analysis, structured into descriptive analytics, productivity and impact indicators, collaboration networks, and thematic structure analysis based on bibliographic coupling and keyword co-occurrence.

RQ1: What are the global publication trends in green finance and ESG research between 2000 and 2025?

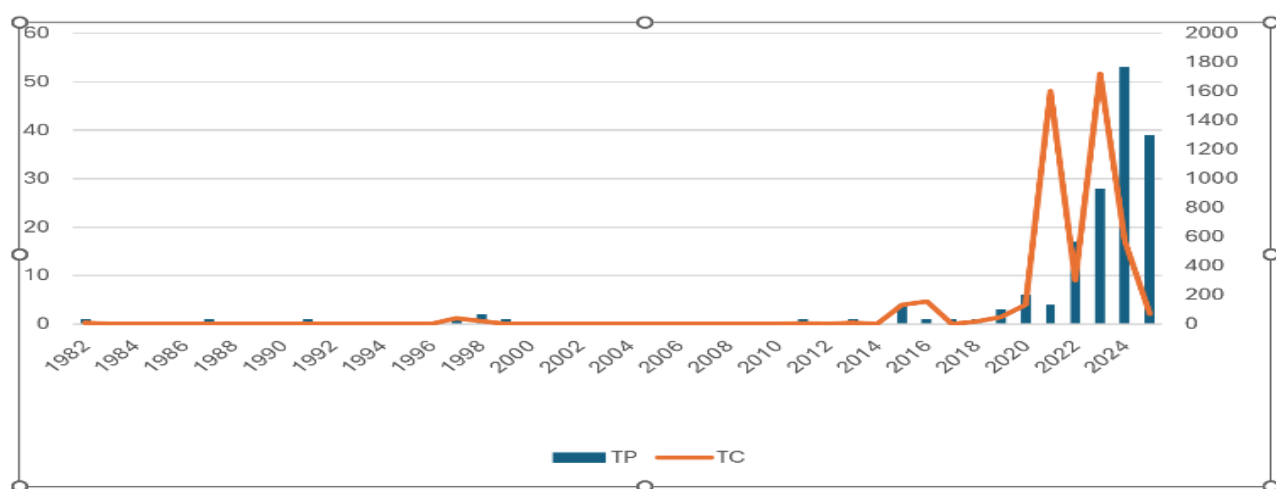


Fig.2. The publication trend.

Figure 2 illustrates the temporal distribution of research output in green finance and ESG from 1982 to 2025, as measured by total publications (TP) and total citations (TC). The data reveal three distinct developmental phases: an initial dormant phase (1982–2014), a transitional growth phase (2015–2019), and a rapid expansion phase (2020–2025).

During the dormant phase, research activity was sporadic, with an average of fewer than two publications per year and negligible citation impact. The turning point emerged post-2015, coinciding with increased global policy attention toward sustainable finance and the formal adoption of the UN Sustainable Development Goals (SDGs). The transitional phase (2015–2019) showed a gradual rise in scholarly output and modest citation growth, indicating early academic interest and foundation-building in the field.

The most notable surge occurred in the expansion phase (2020–2025), where both TP and TC demonstrated exponential growth. The peak in total publications was recorded in 2024, with over 55 scholarly outputs, while total citations peaked in 2022, surpassing 1,800 citations, indicating a lagged citation effect for earlier influential works. However, citation volume showed a decline in 2024 and 2025, which may reflect the natural citation lag for more recent publications.

The steep growth in TP after 2020 reflects the increased prioritization of Environmental, Social, and Governance (ESG) factors in both academic and policy spheres, especially in response to global climate imperatives, investor pressures, and regulatory shifts. Overall, the bibliometric trajectory underscores that green finance and ESG have transitioned from niche research themes into mainstream global academic discourses.

RQ2: Which are the top 10 most productive countries contributing to green finance and ESG research, and how have their contributions evolved over time?



Fig. 3. Geographical Distribution of Research Output in Green Finance and ESG

Figure 3 presents a global heat map indicating the geographical distribution of research publications on green finance and ESG, while Table 2 ranks the top 10 most productive countries based on the number of publications indexed between 2000 and 2025.

The bibliometric data reveals a highly uneven global distribution of scholarly output, with research activity concentrated in a few leading nations. China emerges as the dominant contributor, accounting for 139 publications, which is over four times higher than the next leading country. This significant volume reflects China's national policy agenda on green finance, such as the Green Finance Pilot Zones and leadership in sustainable bond issuance. The intensity of academic engagement corresponds to the country's economic scale and commitment to ecological modernization.

The United States (28 publications) and Malaysia (27 publications) follow as the second and third most productive countries, respectively. The strong showing by the United States reflects its robust institutional and academic infrastructure around ESG investing and sustainable finance regulations. Malaysia's notable output, despite its smaller research base, underscores its strategic emphasis on Islamic finance integration with ESG principles and its regional leadership in green sukuk development.

The United Kingdom (16) and Indonesia (12) also feature prominently, likely due to strong regulatory frameworks, investor engagement, and educational initiatives in sustainable development. Additionally, emerging economies such as Pakistan (11), Iran (10), and Ukraine (7) are beginning to shape the research dialogue, suggesting a growing academic interest in the implications of green finance for developing markets.

Italy and Canada, each contributing 9 publications, represent European and North American perspectives, often centered on ESG disclosure standards, corporate governance, and environmental accountability.

Overall, this geographical analysis underscores a regional clustering of scholarly output, with East Asia, North America, and parts of Southeast Asia serving as primary research hubs. The global disparity also suggests untapped research potential in Africa, Latin America, and parts of the Middle East—regions that could benefit from increased academic investment and international collaboration in sustainable finance.

RQ3: What are the top 10 most cited articles in the field of green finance and ESG, and what key themes or contributions do they represent?

Table 1 presents the most influential works in the domain, ranked by total citations indexed from 2000 to 2025. The findings highlight the intellectual foundation and emerging frontiers within the green finance and ESG research landscape.

Table 1 Top 10 Most Cited Articles

| Rank | Title (Abbreviated) | Year | Citations | Key Themes |
|------|---|------|-----------|---|
| 1 | Gillan et al., <i>Review of ESG & Finance</i> | 2021 | 1,360 | Comprehensive literature synthesis on ESG, financial outcomes, and policy |
| 2 | Wang et al., <i>ESG Ratings and Innovation</i> | 2023 | 421 | Role of ESG scores in fostering corporate innovation |
| 3 | Mu et al., <i>Digital Finance and ESG</i> | 2023 | 241 | Intersection of fintech and ESG compliance in emerging markets |
| 4 | Kim & Li, <i>Impact of ESG on COVID Recovery</i> | 2021 | 208 | ESG resilience during economic crises and pandemic recovery |
| 5 | Ren et al., <i>Digital Finance & Performance</i> | 2023 | 206 | Impact of digital financial tools on ESG-aligned firm performance |
| 6 | Fisher et al., <i>NLP in ESG</i> | 2016 | 156 | Use of AI/NLP in ESG disclosure analysis |
| 7 | Zhang, <i>Green Finance and Hypocrisy Prevention</i> | 2023 | 127 | Addressing greenwashing and authentic ESG practices |
| 8 | Starks, <i>Presidential Address: Sustainable Finance</i> | 2023 | 109 | Strategic vision for integrating sustainability into mainstream finance |
| 9 | Chang et al., <i>ESG and Financial Performance</i> | 2023 | 99 | Empirical link between ESG scores and firm financial returns |
| 10 | Paltrinieri et al., <i>Islamic Banking & ESG Scores</i> | 2020 | 81 | Integration of Shariah finance with ESG ratings and sustainability |

The top 10 most cited articles in the field of green finance and ESG reveal critical thematic trends that have shaped the intellectual landscape of the discipline. *Gillan et al.* (2021) leads with 1,360 citations, offering a seminal review that synthesizes the evolution of ESG in relation to financial performance and policy, thus establishing a foundational reference for scholars and policymakers alike. Notably, a surge in recent high-impact publications—such as those by *Wang et al.* (2023), *Mu et al.* (2023), and *Ren et al.* (2023)—reflects an emerging focus on the integration of ESG considerations within digital finance and corporate innovation. These studies emphasize how ESG ratings influence firm-level innovation and performance, particularly in the context of rapidly digitizing economies and sustainable business practices.

Additionally, other influential works explore the expanding methodological and ethical dimensions of ESG research. *Fisher et al.* (2016) introduces the application of natural language processing (NLP) in ESG disclosure analysis, marking an early methodological advancement in the field. Meanwhile, *Kim & Li* (2021) highlight the resilience of ESG-oriented firms during the COVID-19 pandemic, reinforcing ESG's strategic role in crisis recovery. Ethical concerns are addressed by *Zhang* (2023), who critiques greenwashing, and by *Paltrinieri et al.* (2020), who examine the compatibility between Islamic banking principles and ESG standards. Collectively, these highly cited articles underscore a multidimensional research agenda—spanning digital transformation, sustainability ethics, financial resilience, and cross-cultural integration—demonstrating the field's growing relevance and interdisciplinary depth.

RQ4: What are the emerging research hotspots in green finance and ESG based on keyword co-occurrence analysis?

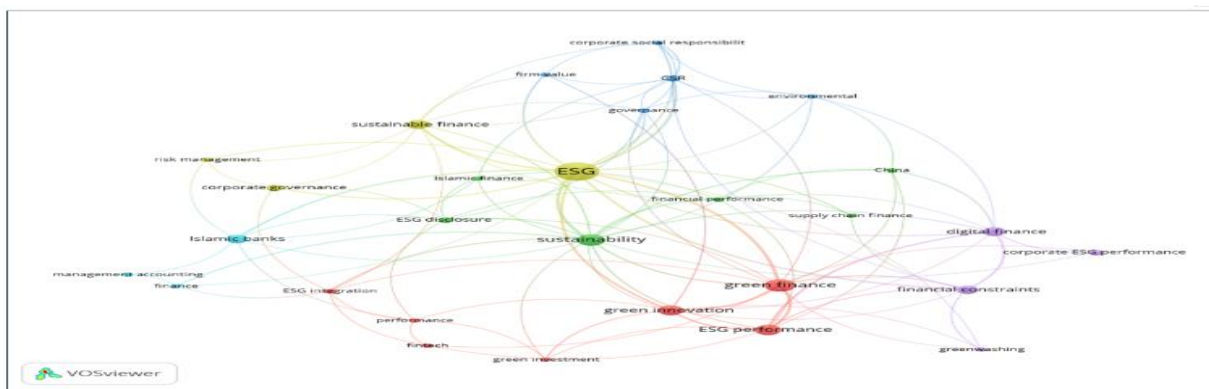


Fig. 4. VOSviewer-Based Co Occurrence Map.]

Figure 4 presents a VOS viewer-based keyword co-occurrence network that reveals the intellectual structure and thematic evolution within green finance and ESG research. The analysis identifies five major thematic clusters, indicating the field's interdisciplinary nature and evolving research frontiers.

At the core of the network, the keyword “ESG” acts as the central node, strongly linked with sustainability, green finance, sustainable finance, and ESG performance, highlighting its centrality across various conceptual domains. One dominant cluster (in red) centers on green finance, green innovation, and ESG performance, indicating a growing scholarly focus on the measurable impact of sustainability practices on innovation and firm outcomes. This cluster also intersects with fintech and green investment, signaling that digital transformation and innovation-led sustainability are critical emerging themes.

Another significant cluster (in purple) emphasizes digital finance, financial constraints, and corporate ESG performance, illustrating the rising relevance of technology-enabled ESG implementation and challenges in financing sustainability. The yellow cluster, anchored by sustainable finance and corporate governance, connects to themes such as risk management and ESG disclosure, indicating a continued focus on regulatory, transparency, and policy-driven research. Meanwhile, a distinct light blue cluster centered around Islamic banks, Islamic finance, and management accounting reflects a niche but expanding body of literature exploring the integration of Shariah principles with ESG frameworks.

Additionally, the presence of greenwashing, China, and supply chain finance in the peripheral nodes suggests geographical specificity and ethical accountability as emerging sub-themes. Collectively, this co-occurrence analysis confirms that the future trajectory of green finance and ESG research lies at the intersection of technology, governance, ethics, and regional dynamics, with a strong push toward performance-based, innovation-driven, and culturally contextualized sustainability strategies.

Table 2. Thematic Clusters of Keyword Co-Occurrence in Green Finance and ESG Research

| Cluster Color | Core Theme | Key Keywords | Interpretation | |
|---------------|-----------------------------------|--|--|--|
| Red | Green Finance & Innovation | green finance, green innovation, ESG performance, ESG integration, fintech, performance, green investment | Focuses on how ESG drives innovation, green investing, and the role of digital transformation (fintech) in sustainable financial strategies. | |
| Purple | Digital Finance & ESG Performance | digital finance, financial constraints, corporate ESG performance, greenwashing, China, supply chain finance | Highlights the intersection of ESG and financial technologies, and addresses challenges in ESG measurement and integrity (e.g., greenwashing). | |
| Yellow | Sustainable Finance & Governance | sustainable finance, corporate governance, ESG disclosure, Islamic finance, risk management | Represents governance mechanisms, transparency, and compliance issues shaping ESG outcomes in financial systems. | |
| Green | ESG & Sustainability Link | ESG, sustainability, financial performance, governance, firm value | Anchors the map—reflects the overarching relationship between ESG, long-term sustainability, and firm value creation. | |
| Blue | CSR & Social Responsibility | CSR, corporate social responsibility, environmental | Traditional CSR focus, now increasingly absorbed under ESG and sustainability narratives. | |
| Light Blue | Islamic Finance & Ethics | Islamic banks, Islamic finance, management accounting, finance | A niche but growing cluster exploring how Islamic financial principles align with ESG practices. | |

DISCUSSION

The findings of this bibliometric study offer a multifaceted understanding of how green finance and ESG have matured as academic disciplines and policy instruments over the past two decades. The exponential growth in scholarly output post-2020 corresponds with heightened global urgency around climate action, stakeholder capitalism, and sustainable investment, affirming the field's centrality in the broader financial discourse. The dominant role of China highlights the influence of national policy in driving both practical and academic attention to green finance. However, the growing contribution from developing economies, such as Malaysia and Indonesia, indicates a rising interest in localized sustainability solutions, especially within Islamic finance contexts.

The analysis of citation patterns reveals that foundational studies—particularly those focusing on ESG performance during crises, digital transformation, and innovation—have shaped the current intellectual terrain. Notably, recent high-impact publications integrate ESG considerations with financial technologies and firm-level strategic behaviour, signalling a paradigm shift toward digital, data-driven, and innovation-centric sustainability research. The keyword co-occurrence network further supports this, revealing new clusters around digital finance, green bonds, green innovation, and governance ethics such as greenwashing.

Importantly, the thematic diversity uncovered points to the field's interdisciplinary maturity yet also underscores persistent gaps—particularly in regional equity, ESG standardization, and longitudinal data availability. There remains substantial untapped potential for comparative studies, industry-academic collaboration, and the incorporation of AI, blockchain, and real-time ESG data in future research. The findings underscore the need for a harmonized global framework that balances regulatory robustness with local contextualization.

In sum, green finance and ESG research are evolving into a sophisticated, multi-domain enterprise. By mapping its trajectory, this study not only contributes to the academic literature but also equips financial stakeholders with evidence-based insights to guide sustainable transformation.

CONCLUSION

This bibliometric review provides a comprehensive mapping of the intellectual and thematic development of green finance and ESG research from 2000 to 2025. The findings reveal a significant upward trend in global publication output, underscoring the rising academic and policy interest in sustainable financial practices. China emerged as the most prolific contributor, followed by the United States and Malaysia, indicating a shift in research dominance towards Asia. The analysis of the most cited articles highlighted key thematic pillars such as ESG performance, digital finance integration, green innovation, and resilience in post-crisis recovery, especially during the COVID-19 pandemic. Furthermore, keyword co-occurrence analysis exposed emerging research hotspots including greenwashing prevention, Islamic finance integration, and the application of artificial intelligence in ESG analysis.

From a policy standpoint, the growing body of literature offers critical insights for regulators, financial institutions, and corporate governance bodies. Policymakers can harness these findings to develop more robust ESG disclosure standards, promote green financial instruments, and encourage innovation in sustainable practices. The prominence of digital finance in the research frontier suggests a need for integrated policy frameworks that support fintech development while ensuring alignment with ESG principles. Additionally, the identification of greenwashing concerns calls for enhanced regulatory mechanisms to ensure transparency and authenticity in sustainability reporting. Finally, the recognition of Islamic finance within ESG discourse provides a pathway for culturally contextualized policy strategies that promote inclusive and ethical financial systems across diverse regions. These insights collectively inform a global agenda that aligns financial systems with the goals of sustainable development and responsible investment.

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