SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 4, (2026), pp. 7085-7114
Open Access. Online & Print

DOI: 10.5281/zenodo.12426724

FROM ETHICAL INVESTING TO ESG INTEGRATION: A TWO-DECADE BIBLIOMETRIC MAPPING OF SUSTAINABLE INVESTMENT IN FINANCIAL MARKETS (2005 - 2025)

M. Vijayananth[1], N. Saravanabhavan[2]*

[1] *Research Scholar, Department of Commerce, Vellore Institute of Technology, Vellore, Tamil Nadu, India.*
[2] *Assistant Professor (Sr.), Department of Commerce, Vellore Institute of Technology, Vellore, Tamil Nadu, India.*

Received: 06/12/2025
Accepted: 25/01/2026

Corresponding author: N. Saravanabhavan (saravanabhavan.n@vit.ac.in)

ABSTRACT

This study presents a systematic bibliometric analysis of sustainable investment research in financial markets over the period 2005 - 2025, drawing on 1,251 publications retrieved from the Scopus database. Utilizing the frameworks of Bradford's Law, Lotka's Law, and Zipf's Law, the analysis examines the evolution of scholarly output, identifies the most influential journals, authors, and articles, and maps the conceptual and intellectual structure of the field through keyword co-occurrence, co-citation networks, and thematic analysis. The results indicate a substantial acceleration in research output after 2020, reflecting the growing global emphasis on the integration of environmental, social, and governance (ESG) considerations into investment strategies. "Sustainability (Switzerland)" emerges as the most prolific journal, whereas "Energy Economics" holds the highest citation count. Naeem Muhammad Abubakr demonstrates the greatest citation impact, while Tiwari Aviral Kumar is identified as the most productive author. Thematic mapping reveals that research on ESG investing, corporate social responsibility, and socially responsible investment constitutes the field's motor themes, while emerging topics such as green bonds, climate finance, and post-COVID sustainability transitions represent promising avenues for further inquiry. Despite the rapid expansion of literature, gaps remain in areas such as ESG integration metrics, retail investor participation, and the application of sustainable investment frameworks in developing markets. This study highlights the strategic role of sustainable finance in advancing the United Nations Sustainable Development Goals (SDGs) by directing capital flows toward environmentally and socially responsible enterprises, thereby contributing both theoretical insights and practical implications for scholars and policymakers.

KEYWORDS: Sustainable investment, ESG, Financial markets, Bibliometric analysis, Sustainable finance, Ethical investing

1. INTRODUCTION

Sustainability has become an analytic framework that we place at the centre of our interrogation of environmental, social, and economic issues, based on the idea of ensuring that the needs of the present are fulfilled without compromising the well-being of future generations (Purvis et al., 2019). With the world economies struggling with climate threat, social inequality, and natural resource depletion, financial markets are becoming a conduit that directs capital to responsible and sustainable economic activity. The financial system presents its control on the sustainability behaviour of corporations, transparency, and value creation over long periods through the equity and bond markets, the institutional investors, and the stewardship practices (Busch et al., 2016).

Sustainable investing, which includes ethical investing and SRI, and ESG integration, has evolved in this intellectual environment as a niche to an inseparable part of the modern investment strategy. Starting with ethical exclusions of goods, e.g. tobacco or arms, as defined in the work of Sparkes & Cowton (Sparkes & Cowton, 2004), the modern ESG integration introduces the environmental, social, and corporate governance indicators into the financial analysis, predicting material risks, robustness, and performance relevance. The same evolution is reflected in the works of Friede, Van Duuren and Schramade (Friede et al., 2015, Van Duuren et al., 2016, and Schramade, 2016). The valuation of ESG indicators to the climate exposure, governance quality, social responsibility, and sustainability practices of the entity level is now transferable to a firm, which is further explained by Kotsantonis (Kotsantonis et al., 2016).

As a result, sustainable finance can make a direct contribution to the achievement of the United Nations Sustainable Development Goals, namely, SDG 8 (economic growth), SDG 12 (responsible consumption), and SDG 13 (climate action), by targeting low-carbon, more-transparent, and more-socially-inclusive business models (Sachs et al., 2019; Han & Gao, 2024). With the changes in regulation and investor demands, sustainability has become one of the most essential motivators of financial market behaviour and corporate valuations.

1.2 Global relevance and research trends in sustainable investing within financial markets

The past decade has seen the pace of sustainable investing increase across the world with the increased risk associated with climate change, regulatory changes and strong institutional demands on responsible capital allocation (Broadstock et al., 2021). To enhance the level of transparency and standardisation of sustainable investment practices, governments and regulatory authorities have established compulsory ESG disclosures, sustainability taxonomies, and climate-risk reporting frameworks (Amel-Zadeh & Serafeim, 2018). These efforts highlight an emerging global awareness that sustainability concerns have become a major part of financial stability and long-term economic sustainability.

At the same time, the amount of scholarly literature on sustainable finance has increased significantly. The scholarship since 2014 demonstrates that the number of published papers on ESG investing, climate finance, sustainability disclosure, and green financial instruments is on a drastic increase (Chandran & Chandran, 2024). The sustainability-related research themes have been expanded to include climate-risk modelling, ESG-quant analytics, sustainable portfolio optimisation, and investor behaviour in addition to ethical screening and CSR (Donthu et al., 2021; Aria and Cuccurullo, 2017). This intellectual growth requires a methodical bibliometric mapping that not only summarises the conceptual development of the area but also its new directions in research.

1.3 Research gap

Although considerable academic work has been conducted on the topic of ethical investing, SRI, and integration of ESG, there are still a number of key gaps.

- **To begin** with, the literature is inclined to analyse these paradigms separately and does not explain how they developed over time; thus, the conceptual continuity of these paradigms is perceived in pieces (Sparkes & Cowton, 2004; Liu & Peifer, 2022).
- **Second,** the existing reviews rarely frame sustainable investment as a part of the processes and internal processes of financial markets, limiting the ability to understand how ESG is relevant to the processes of valuation, pricing of risks, trading, and institutional capital flows (Broadstock et al., 2021; Kotsantonis et al., 2016).
- **Third,** bibliometric studies tend to have small regional or thematic focus and hence limit the observability of global patterns of collaboration, intellectual structures and thematic development (Donthu et al., 2021; Chandran & Chandran, 2024).
- **Lastly,** very little research is conducted on long-term sustainable investment at large milestones, including the UN PRI in 2006, the Paris Agreement in 2015, and the EU Taxonomy in 2020, so the scope of historical

and conceptual knowledge of the field is limited (Amel-Zadeh & Serafeim, 2018).

All these gaps highlight the need for a comprehensive two-decade bibliometric study (2005-2025), tracing the intellectual, conceptual, and global development of the field of sustainable investment, and the shift in the field in terms of ethical investing traditions to modern ESG-based financial systems.

2. RESEARCH QUESTIONS & OBJECTIVES

This research aims to comprehensively examine the evolution and dynamics of sustainable investment in financial markets, with a particular emphasis on ethical investing and ESG (Environmental, Social, and Governance) practices.

The study will address the following key questions:

1. How has the scholarly literature on sustainable investment and ESG in financial markets evolved between 2005 and 2025 in terms of publication growth and citation impact?
2. Which journals, authors, and articles have been most influential in advancing sustainable investment and ESG research in financial markets?
3. What are the prevailing conceptual, intellectual, and social frameworks that define the literature on sustainable investing in financial markets?
4. How do emerging themes, research gaps, and international collaboration patterns highlight future directions for sustainable investment and ESG studies in financial markets?

To address these questions, the study sets out the following objectives:

- **First**, to analyze the evolution of scholarly output on sustainable investment and ESG in financial markets from 2005 to 2025, focusing on publication trends and citation patterns.
- **Second**, to identify the most influential sources of knowledge, including leading journals, highly cited publications, and prolific authors contributing to the sustainable investment in financial market discourse.
- **Third**, to examine the conceptual, intellectual, and social structures of the sustainable investment literature through co-word analysis, co-citation mapping, thematic mapping, and author collaboration networks.
- **Finally**, to uncover emerging research fronts, thematic shifts, and unexplored areas, thereby offering guidance for future research on sustainable investment and ESG in financial markets.

3. METHODOLOGY

The methodology used in the present study follows the approaches adopted in the recent bibliometric article in the prominent journals (Hussain et al., 2023). The study undertook detailed bibliometric research to trace and examine the academic literature on the subject of sustainable investment in the financial market. This method enables one to discover thematic patterns, prolific writers, the impactful journals, the country of contribution, and noteworthy publications (Chowdhury et al., 2023). Bibliometric techniques are necessary in explaining research development, collaboration systems, and cognitive frameworks (Donthu et al., 2021; Zupic & Čater, 2015).

3.1 Data Source

The information used in this study was retrieved in **Scopus database** which is readily recognised as a leading, broad based abstract and citation index of peer-reviewed texts (Baas et al., 2020; Singh et al., 2021). Scopus offers strong search and filtering options, such as publication year, document type, the source type, subject area, country/territory, institutional affiliation, or language (Oyewola and Dada, 2022). In order to achieve methodological precision and comparable results, a systematic search was performed on **8th August 2025** with an intention to search **Title, Abstract and Keywords** (TITLE-ABS-KEY) fields.

The Boolean query used to be comprehensive was as follows:

(TITLE-ABS-KEY ("Sustain* Invest*" OR "ESG invest*" OR "Ethical invest*" OR "responsible investing" OR " Sustainable finance" OR "SDG" OR "Green invest*" OR "Green finance" OR "Environment* invest*") AND TITLE-ABS-KEY ("Financial market" OR "Share market" OR "Stock market" OR "Capital market" OR "Equity market")) AND PUBYEAR > 2004 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ENVI")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (LANGUAGE , "English"))

The initial search strategy enabled the retrieval of 1,563 documents thus forming the background of the further processing and analysis of data.

3.2 Screening Process

Honing of the dataset was done using a multi-stage screening protocol. To eliminate these papers, first, a time filter was implemented to include only articles published within 2005 to 2025, and 94 articles were excluded.

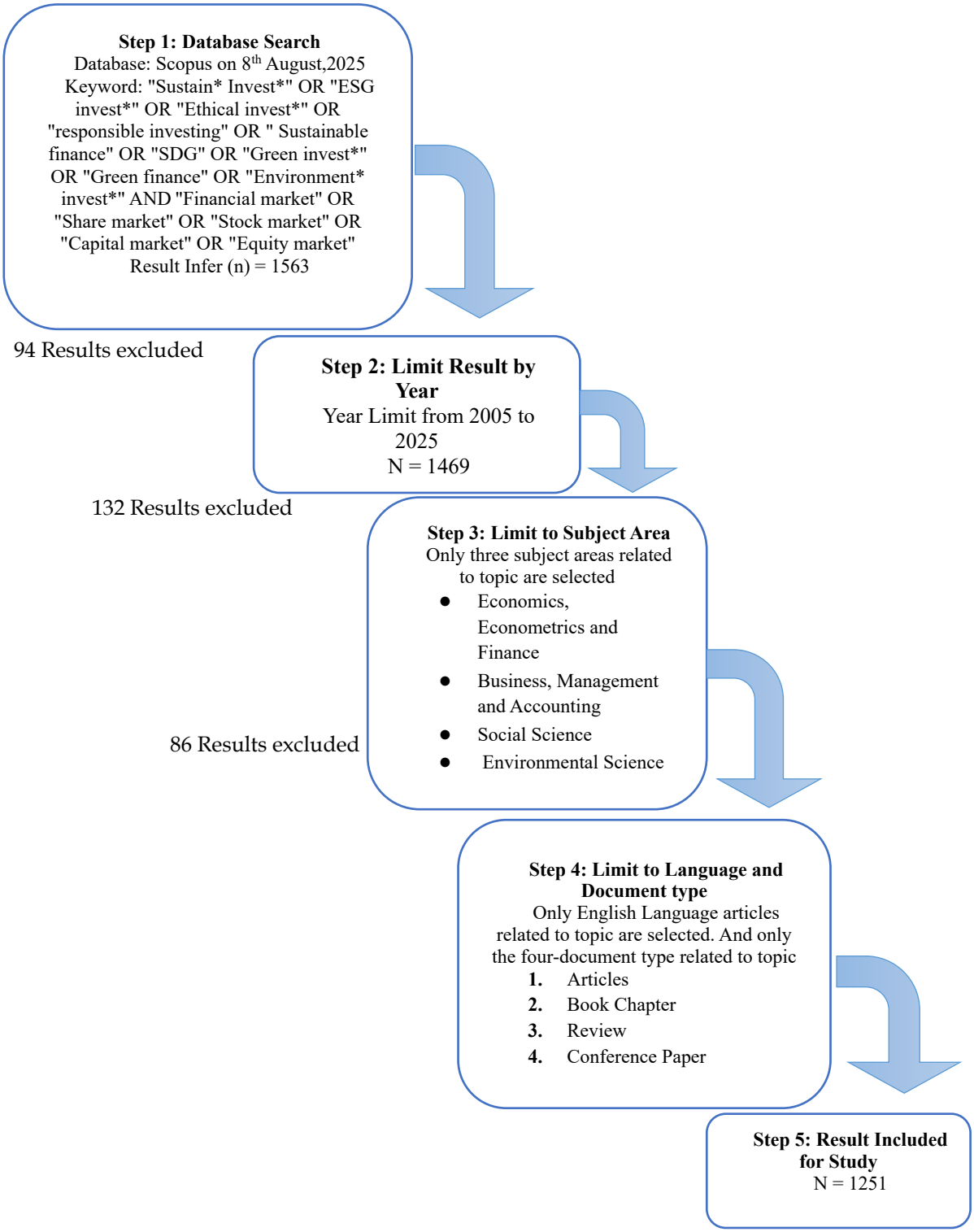


Fig 1: Data extraction process

A subject-area filter was then applied to remove 132 items that were not within the given topical scope, leaving behind the records under Economics, Econometrics and Finance, Business, Management and Accounting, Social Science and Environmental science. A language filter was then applied to reduce the corpus to English-language publications and caused the removal of 48 articles. Lastly, a document-type filter was applied which limited the sample to journal articles, reviews and conference proceedings, resulting in the exclusion of 38 documents such as editorials, notes, and book chapters. Following these systematic exclusion procedures, a total of **1,251 documents** were retained as the final dataset forming the foundation for the bibliometric analysis.

The comprehensive screening and selection process is systematically illustrated in the **Figure 1.**

3.2.1 Inclusion Criteria

- Publications within the timeframe 2005 - 2025 (n = 1,469 after excluding 94 earlier records).
- Studies indexed under the subject areas of Economics, Econometrics and Finance, Business, Management and Accounting, Social science, and Environmental Science (n = 1,337 after excluding 132 unrelated records).
- Documents published in English language (n = 1,289 after excluding 48 non-English records).
- Document types restricted to journal articles, reviews, and conference papers (n = 1,251 after excluding 38 other types).

3.2.2 Exclusion Criteria

- Publications **prior to 2005** (n = 94), to maintain a contemporary focus.
- Records indexed under **irrelevant subject areas** outside Economics, Econometrics and Finance, Business, Management and Accounting, Social science, and Environmental Science (n = 132).
- Documents published in **languages other than English** (n = 48)
- **Non-research outputs** such as editorials, notes, and book chapters (n = 38)

3.3 Bibliometric Tools and Parameter Settings

This bibliometric analysis was conducted using a mixture of VOSviewer, Biblioshiny (Bibliometrix R environment) and Microsoft Excel. The initial steps in data cleansing, eliminating duplicates, and simple descriptive tabulation were performed with the help of Microsoft Excel (2019). Then, using RStudio (version 4.5.1), Biblioshiny was used to perform higher-order computations to include conceptual structure analysis, thematic evolution mapping, and performance indicators (Aria and Cuccurullo, 2017). These outputs were underpinned with network visualisations created using VOSviewer (version 1.6.20) on co-authorship, co-citation, bibliographic coupling and keyword co-occurrence. In this way, a definite representation of thematic clusters and intellectual connections was created (Van Eck and Waltman, 2014). The combination of these analytical approaches made it possible to ensure the quantitative and visual components of the study, thus contributing to the transparency of the methods (Patel and Jhalani, 2023; Jaishree and Dogga, 2025).

3.3.1 Contribution Counting Procedure

The current research uses the full-counting approach through giving equal weight to each author, keyword, and document link in order to ensure unbiased representation across the dataset.

- This will help to prevent dominance of those who have made many contributions in order to identify both the existing and new research directions in sustainable finance in an equitable manner.

3.3.2 Cluster Identification and Mapping Methodology.

- Louvain modularity algorithm is used to find coherent thematic clusters in large bibliometric networks effectively (Van Eck & Waltman, 2014).
- This clustering can be visually represented using a force-directed layout which arranges the nodes in proportion to the relational strength hence making it easy to understand intellectual and thematic structures.

3.3.3 Framework of Link normalization.

- Normalizing the strength of association can reduce the differences in keyword/citation frequency, and eradicate the possibility of artificially exaggerated linkages.
- Therefore, this normalization increases the consistency of both co-occurrence and coupling networks and guarantees that the relationships represented in a visualization are truly representative of the real conceptual proximity.

3.3.4 Network Construction Minimal Inclusion criteria.

There were some set thresholds to gain maximum clarity and minimise noise in the network:

- Minimum number of keyword appearances: 5;
- Minimum number of co-citation analysis: 10;
- Minimum number of references needed for bibliographic coupling: 5.

These parameters guarantee that the linkages between themes can be understood and the network remains clear

3.4 Summary for Parameters

To ensure the methodological transparency and reproducibility, all bibliometric parameters are summarized in Table 1. This table summarizes the tools, analysis processes, clustering algorithms, normalization methods and threshold values that are used and thus, make reproducibility, cross-study comparability and methodological soundness of bibliometric inquiry possible in sustainable finance and ESG literature.

Table 1: Summary of Bibliometric Tools and Parameters

Parameter	Configured Specifications
Software Used	Biblioshiny (Bibliometrix R), VOSviewer 1.6.20, MS Excel 2019
Analyses Conducted	Performance indicators; citation & co-citation mapping; bibliographic coupling; keyword co-occurrence; thematic evolution; author–country collaboration
Counting Method	Full counting applied to authors, keywords, and documents to ensure equal weighting (Aria & Cuccurullo, 2017)
Clustering Method	Louvain modularity algorithm for detecting coherent thematic communities (Van Eck & Waltman, 2014)
Layout Algorithm	Force-directed mapping for clear spatial representation of network relationships
Normalization	Association Strength normalization to reduce frequency-based distortions
Keyword Threshold	Minimum of 5 occurrences
Citation Threshold	Minimum of 10 citations for co-citation analysis
Coupling Threshold	Minimum of 5 shared references
Timeframe	January 2005 – August 2025
Inclusion Criteria	Peer-reviewed journal articles, reviews, chapters, conferences (English language)
Exclusion Criteria	Editorials, book reviews, notes, non-refereed items, incomplete metadata
Database Source	Scopus, chosen for its breadth and high-quality metadata (Baas et al., 2020; Singh et al., 2021)
Data cleaning procedures	Removal of duplicate records; harmonization of authors and affiliations; unification of variant keywords (e.g., "ESG investing," "ESG investment"); manual verification of anomalies;
Rationale for parameter selection	Ensures methodological clarity, stable network structures, and alignment with established bibliometric standards (Donthu et al., 2021).

RESULT & ANALYSIS

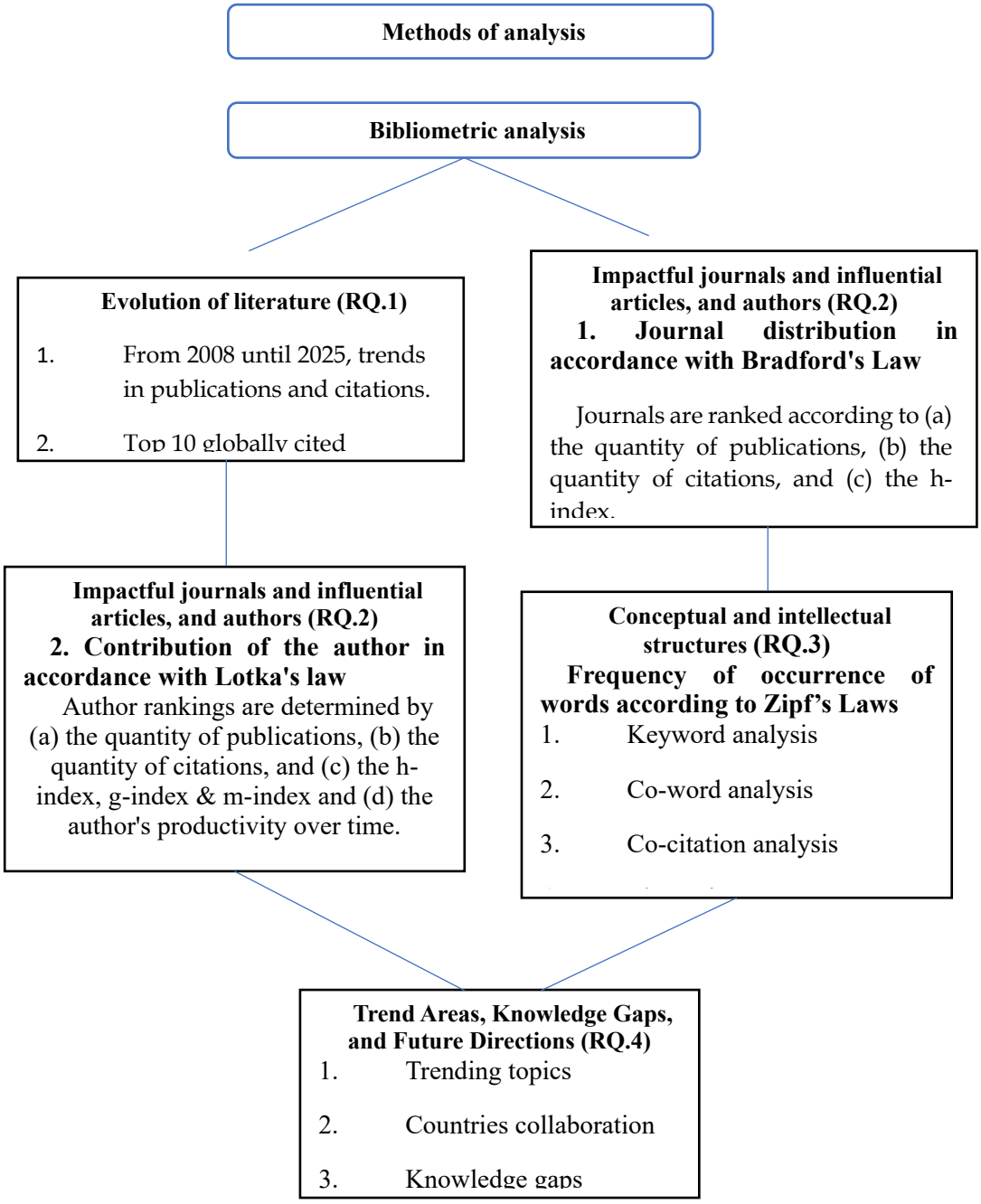


Fig 2: Scheme of analysis used in present study

The comprehensive analytical framework linking the research questions to the appropriate bibliometric tools is depicted in Figure 2. This framework guarantees methodological rigor by associating each research objective with the best suitable analytical method, thereby establishing a structured framework for upcoming performance analysis and scientific mapping.

4.1 RQ1: Evolution of literature & Current Status of Publications, Citation trends and Influential Documents

To address Research Question 1 (RQ1) "How has the scholarly literature on sustainable investment and ESG in financial markets evolved between 2005 and 2025?", this section summarizes publication growth, citation patterns, and key intellectual contributions. The Scopus dataset (Fig. 3) comprises 1,251 documents published in 525 different sources as the field is wide and mature. The field has up-to-date research agenda with a 31.58 immediate growth rate and an average age of documents of 3.02 years.

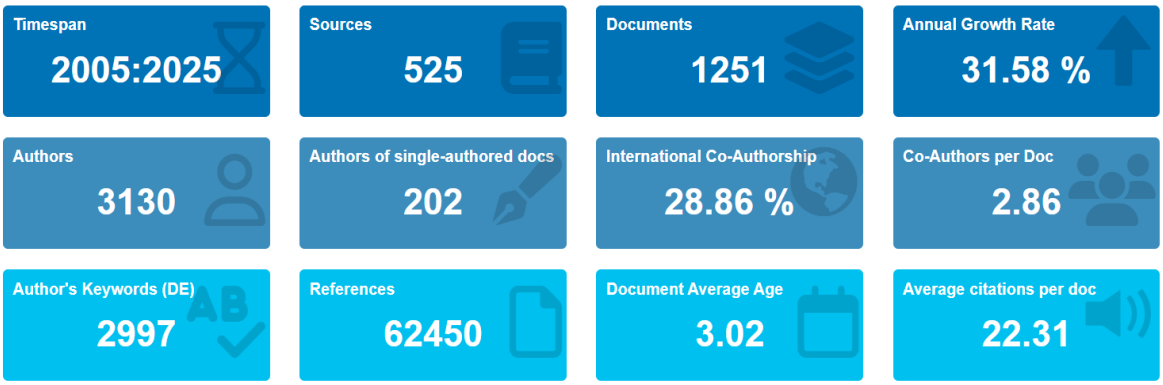


Fig. 3: Main Information Source: Scopus data analyzed through Biblioshin

The academic influence is strong as the average number of citations per document is 22.31, and the total number of references is **62,450**, which represents a strong and well-developed knowledge base. Authorship patterns indicate that **3,130 contributing scholars**, of which 202 authored single-authored works, resulted in collaborative intensity of **2.86 co-authors** per document, 28.86% of which studies were of international co-authorship, which highlights the global and interdisciplinary character of the ESG research. The **2,997 author-assigned keywords** represent conceptual diversity with a broad range of themes including ethical and responsible investment and climate finance to ESG integration. The pointers represented in Figure 3 describe the sustainable investment scholarship as a booming, global, and thematically diverse research field.

4.1.1 Publication Trends

The growth trajectory of publications trends in Fig. 4 illustrates a significant and steady increase in the number of publications during 2005 2025. During the first years, 2005-2010, the volume of annual publications was modest, which is indicative of the immaturity of ethical investment and SRI literature. Between 2011 and 2018, the number of publications has gradually increased, as the scheme of global sustainability reporting has expanded, and more investors have shown interest in ESG issues.

It is interesting to note that there is an acceleration after 2019, which is associated with regulatory reforms globally, increased demands on disclosures of ESG and mainstreaming of climate finance. Publications were up by 56 in 2019, to 296 in 2023, which is an indication that ESG has no longer been a niche concern but rather a research theme in its own right

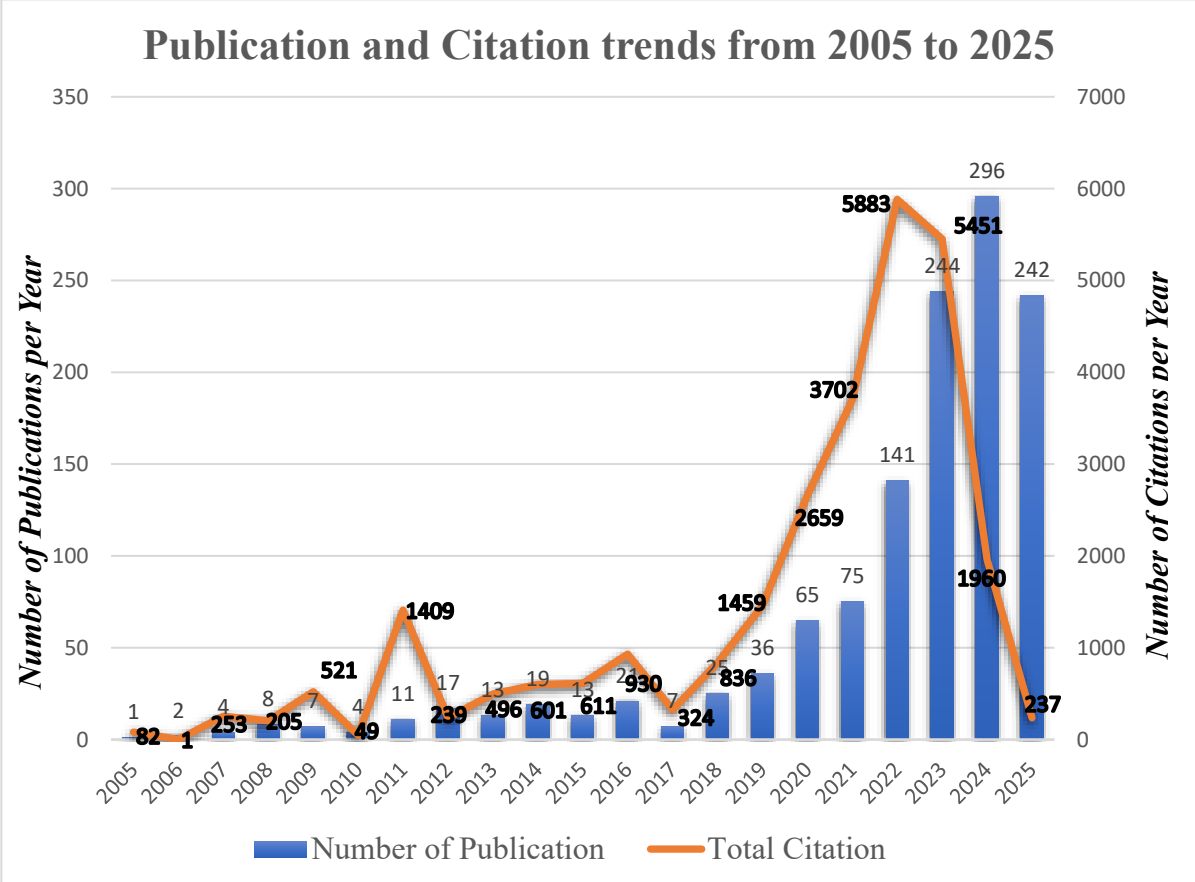


Fig. 4: Publication and Citation trends from 2005 to 2025

This growth is further shown in a decade-over-decade comparison: whereas 2005-2014 had only 118 publications, 2015-2025 had 1,133 publications, which is almost ten times more, and thus demonstrates the transformation of sustainable finance into a multidisciplinary research topic.

4.1.2 Citation Trends

The citation trends in Fig 4 reflects the rising academic influence and maturity of ESG-related research. Citations have been small before 2010, then have started to increase since 2011, as a result of the growing interest in sustainability-linked risk management, corporate responsibility and climate governance. The salient rise is between 2019 and 2022, when citations increased by a margin of about 1,459 and above 5,800 respectively. This steep increase is linked to significant worldwide sustainability trends like the Paris Agreement, the EU Sustainable Finance Disclosure Regulation (SFDR), and the growth of TCFD-based reporting, all of which increased the applicability of ESG research in terms of academic, regulatory, and market settings. The recent agglomeration of high-impact citations highlights how the field has become a massively referenced and potent field in the financial scholarship community.

4.1.3 Most Influential Documents in the Field

In addition to the trends of publication and citation, Table 2 determines the top ten documents that are most frequently cited in the Scopus data. These conclusions constitute the intellectual heritage of sustainable finance to date and, therefore, outline the theoretical and empirical path of ESG scholarly development in the future.

The pioneering work by Edmans (2011), Revelli (2015), and Busch (2016) is the initial evidence on the corporate responsibility, ethical screening, and governance features, which correlates these aspects with the performance of firms. The expansion of the field of climate risk, energy transition, environmental modelling, and green finance is captured in more modern high-impact publications such as Lee (2022), Wang (2022), and Shen (2021). Taken as a whole, the articles demonstrate a shift towards the fundamental ethics and governance-oriented literature to the high-level and data-oriented analysis of ESG performance, carbon risk, and sustainable investment approaches. The high number of citations and normalised citation metrics are consistent and testify to the relevance of the academic discourse and practical financial decision-making.

Table 2: The Top 10 Internationally Cited Documents

Author/Year/Journal	DOI	Total Citations	TC per Year	Normalized TC
Edmans A, 2011, Journal of Financial Economics	10.1016/j.jfineco.2011.03.021	1251	83.40	9.77
Lee C-C, 2022, Energy Economics	10.1016/j.eneco.2022.105863	848	212.0	20.33
Shen Y, 2021, Science of The Total Environment	10.1016/j.scitotenv.2020.142538	562	112.4	11.39
Arner Dw, 2020, European Business Organization Law Review	10.1007/s40804-020-00183-y	414	69.00	10.12
Revelli C, 2015, Business Ethics: A European Review	10.1111/beer.12076	348	31.64	7.40
Chien F, 2021, Technology in Society	10.1016/j.techsoc.2021.101587	341	68.20	6.91
Capelle-Blancard G, 2019, Journal of Business Ethics	10.1007/s10551-017-3667-3	337	48.14	8.32
Yang Y, 2021, Resources Policy	10.1016/j.resourpol.2021.102445	333	66.60	6.75
Busch T, 2016, Business & Society	10.1177/0007650315570701	307	30.70	6.93
Wang Q-J, 2022, Energy Economics	10.1016/j.eneco.2022.106004	284	71.00	6.81

Source: Scopus database

4.2 RQ2: Impactful journals and influential authors

This section gives a general analysis of all the pertinent articles (1251) through citation analysis to identify the key and impactful journals, as well as top authors. The application of the bibliometric analysis method is intended to give a response to the second research question of the present study, i.e., RQ2: "Which journals, articles, and authors have been the most influential in shaping the field of sustainable investment in financial market?". This analysis is a very handy tool for future authors to apply, guiding them not only to where the pertinent published materials can be found but also where suitable outlets can be found to publish their work.

4.2.1 Most impactful journals

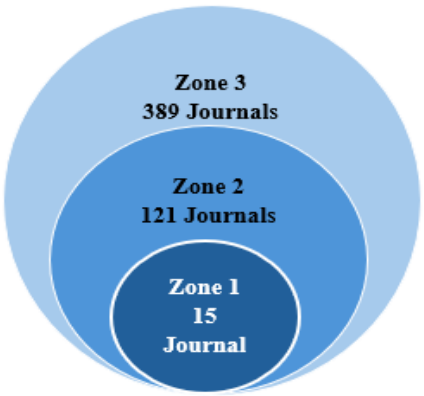
Bradford (1934) proposed a strategy for categorizing journals into three zones according to the total number of published articles within a certain topic. The quantity of published scholarly articles in a specific discipline is almost equal in each zone (Brookes, 1969; Drott, 1981). Bradford (1934) formulated it as a law that states "If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus when the numbers of periodicals in the nucleus and succeeding zones will be as 1: n: n^2 …". More precisely, the number of journals in the second and third zones is n and n2 twice that of Zone 1, respectively. As shown in **Figure 4**, the distribution of journals and citations across zones demonstrates the applicability of Bradford's Law in identifying the core sources of sustainable finance literature. For the sake of this analysis, we have separated the journals into three zones with about equal numbers of articles, as shown in Fig. 4 (panel a). About one-third of the papers in our database are from the 419 articles that were found in 15 core journals. There are 121 journals in the second zone and 389 journals in the third zone. The distribution of citations for each zone is shown in Fig. 4 (panel b). While Zones 1 and 3 each received roughly 33% of citations, Zone 2 garnered the highest share among the latter two zones, with about 34%.

The top 15 core journals contributing to sustainable investment in financial markets are ranked in terms of (a) the number of published articles, (b) total citations received, and (c) their h-index. As shown in

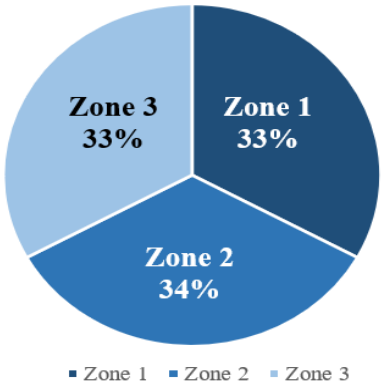
the table 3, Sustainability (Switzerland) ranks first in publication volume with 84 articles, representing the largest share among all journals in this domain. It is followed by Energy Economics (54 articles) and Resources Policy (40 articles). The journals which ranked in the top three combine to realize a large share of the overall research production in the segment.

Nevertheless, when the total number of citations are put into consideration, a different picture is created. Energy Economics, though second in terms of article count, tops the most cited publication with 3,437 citations, testifying to its great scholarly impact. The journal Sustainability (Switzerland) is the second most cited publications with 1,984 citations, while Journal of Business Ethics is third with 1,561 citations, though it possesses only 15 articles with a high number of citations per article.

a) Distribution of Journal in Zones



b) Distribution of Citations received by each zone



Zone 1: Core Journals 15 Journals, 419 Articles (Sorted by number of publications in descending order)

1. Sustainability (Switzerland)
2. Energy Economics
3. Resources Policy
4. Finance Research Letters
5. Journal of Sustainable Finance and Investment
6. International Review of Financial Analysis
7. Journal of Environmental Management
8. Business Strategy and the Environment
9. Journal of Cleaner Production
10. Environmental Science and Pollution Research
11. Journal Of Risk and Financial Management
12. Research In International Business and Finance
13. Journal of Business Ethics
14. Applied Economics
15. Economic Research-E konomska Istrazivanja

Fig. 5: Zone-wise Journal Classification and Citation analysis as per Bradford's law

The h-index is another index used to measure the scholarly impact of the academic journals. Sustainability (Switzerland) once again earns the highest value, with the h -index of 27 and then Energy Economics (27) and Resources Policy (16). The consistency of these metrics indicates that not only these journals generate a significant amount of research output but also have a steady scholarship impact. Notably, some journals, including the Journal of Business Ethics and the Journal of Cleaner Production that cannot be considered the leaders regarding the number of publications have larger citation counts and h-index scores which means that the contribution that these journals distribute has a specific impact on the discussion of environmental taxation. This distribution conforms to the concepts of the Law of Bradford, according to which, only a few core journals can accumulate most of the research production as well as the interest of the scholarly community in the field.

Table 3: Ranking of Core Journals Using Tri-Criteria Evaluation: a) Publications, b) Citations, and c) h-Index

Source	Number of Articles (Rank)	Total Number of Citation (Rank)	h-index (Rank)
Sustainability (Switzerland)	84(1)	1984(2)	27(1)
Energy Economics	54(2)	3437(1)	27(2)
Resources Policy	40(3)	1364(4)	16(3)
Finance Research Letters	32(4)	713(7)	12(7)
Journal of Sustainable Finance and Investment	32(5)	682(8)	12(8)
International Review of Financial Analysis	25(6)	525(11)	13(9)
Journal of Environmental Management	24(7)	542(10)	10(10)
Journal of Cleaner Production	20(8)	1123(5)	15(4)
Business Strategy and the Environment	20(9)	836(6)	13(6)
Environmental Science and Pollution Research	18(10)	603(9)	10(11)
Journal of Risk and Financial Management	17(11)	254(12)	7(12)
Research In International Business and Finance	16(12)	216(13)	7(13)
Journal of Business Ethics	15(13)	1561(3)	14(5)
Applied Economics	13 (14)	210(14)	4(15)
Economic Research-Ekonomska Istrazivanja	9(15)	209(15)	7(14)

Source: Scopus database

4.2.2 the most influential and prolific author

Lotka's Law explains author productivity allocation in scholarly research (Youngblood & Lahti, 2018) such that the number of authors writing n papers is approximately proportional to $1/n^2$ of authors who write only one paper, and about 60% of all authors yielding only one publication (Lotka, 1926). Figure 5 shows author productivity distribution empirically in environmental taxation research compared to Lotka's theoretical predictions.

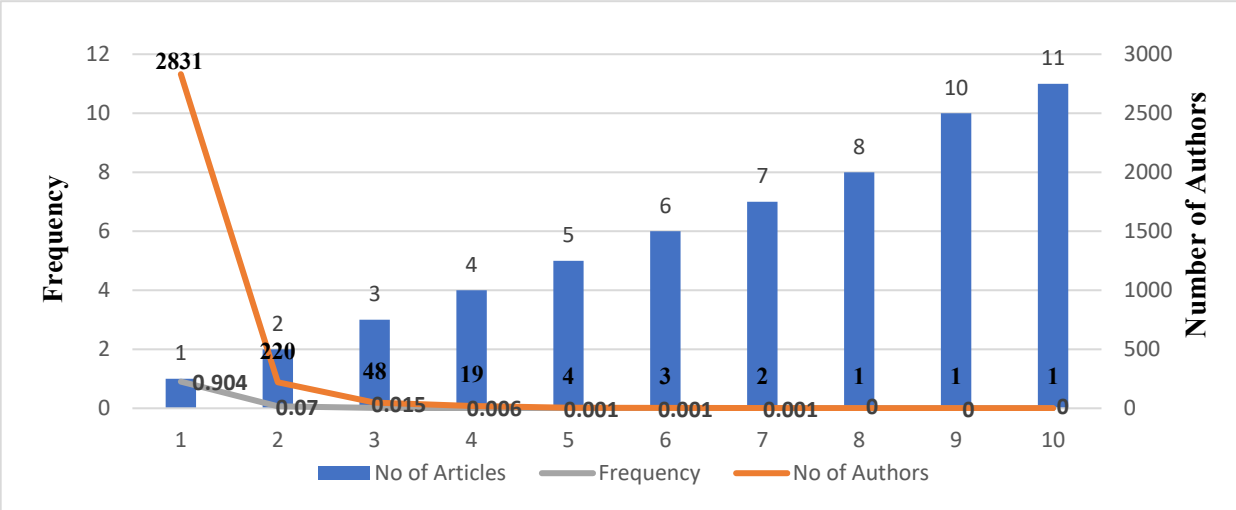


Fig. 6: Empirical Validation of Author Contribution Patterns through Lotka's Law

It shows a strong presence of writers who contributed only one publication, as 2,831 writers (94%) provided a sole contribution, far outweighing Lotka's expected figure of 60%. Those writers who have made two contributions number 220 writers (around 7%) by a tiny margin above what theory would expect. The frequency rapidly decreases as the number of publications per author increases, following the inverse square law. For example, only 48 writers have three publications, dropping further to a negligible 1 to 4 authors in the range of six to ten publications.

This indicates that the research domain is heavily supported by a large pool of occasional contributors, while a very small group of highly productive scholars drives the majority of multi-publication

outputs. The steep drop-off after one publication suggests that, although interest in the field is broad, sustained research engagement is concentrated among a small elite group of researchers aligning with the core assumptions of Lotka's Law but showing an even more pronounced skew toward single-publication authors.

Table 4: Ranking of Core Authors Using Tri-Criteria Evaluation: Publications, b) Citations, and c) h-Index

Author	Number of Articles (Rank)	Total Number of Citation (Rank)	h-index (Rank)
Tiwari Aviral Kumar	11(1)	292(7)	7(3)
Naeem Muhammad Abubakr	10(2)	650(1)	9(1)
Karim Sitara	8(3)	369(4)	8(2)
Uddin Gazi Salah	7(4)	374(3)	5(4)
Richardson Benjamin J.	7(5)	256(9)	5(5)
Sharma Gagan Deep	6(6)	342(5)	5(6)
Makarenko Inna	6(7)	74(14)	4(9)
Sinha Avik	5(8)	577(2)	5(7)
Abakah Emmanuel Joel Aikins	5(9)	181(10)	5(8)
Trinh Hai Hong	5(10)	127(12)	4(10)
Bouri Elie	4(11)	310(6)	4(11)
Cunha Felipe Arias Fogliano De Souza	4(12)	266(8)	4(12)
Volz Ulrich	4(13)	150(11)	4(13)
Guo Kun	4(14)	101(13)	4(14)
Plastun Alex	4(15)	62(15)	4(15)

Source: Scopus database

It is crucial to determine the most influential authors who have significantly contributed to the research domain. The table 4 quantifies authors' influence and productivity based on publication count, total citations, and h-index. In terms of publications, Tiwari Aviral Kumar ranks first with 11 articles, followed by Naeem Muhammad Abubakr with 10 articles and Karim Sitara with 8 articles. Regarding total citations, Naeem Muhammad Abubakr leads with 650 citations, followed by Sinha Avik with 577 citations and Uddin Gazi Salah with 374 citations. In terms of h-index, Naeem Muhammad Abubakr again occupies the top position with an h-index of 9, followed by Karim Sitara (h-index 8) and Tiwari Aviral Kumar (h-index 7). Overall, Naeem Muhammad Abubakr appears to be the most influential author, leading in both total citations and h-index, while also ranking second in publication count. Tiwari Aviral Kumar emerges as the most prolific in terms of publications, though his citation rank is relatively lower (7th).

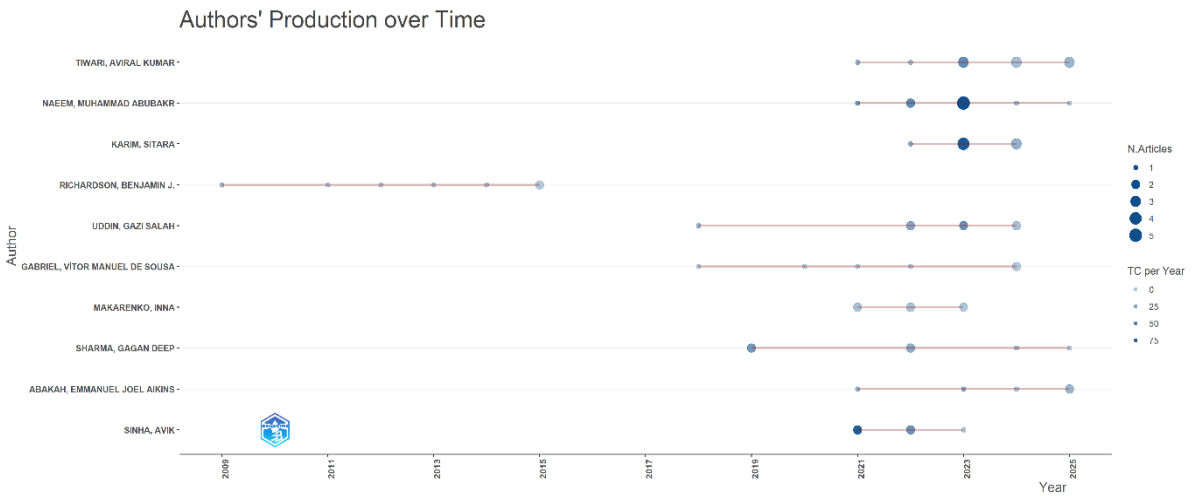


Fig: Top Authors production over time

Figure 6 illustrates the productivity curve of notable authors and this would give an understanding of the research activity trend in the community. The longest period of publication in this field is associated with Richardson Benjamin J. who started publishing in the field in 2009 and continues to produce regularly until 2015. Most recently, Tiwari Aviral Kumar and Naeem Muhammad Abubakr have added a lot of value between 2021 and 2025. In other researchers, such as Karim Sitara, Uddin Gazi Salah, and Sinha Avik, the surge of productivity is also evident in recent years, which is the evidence of increased popularity and interest in the research field. The calendar also brings to attention the introduction of new researchers, including Abakah Emmanuel Joel Aikins and Makarenko Inna who have recently come into the scene. The high productivity and citation impact that is witnessed among the scholars like Naeem Muhammad Abubakr and Tiwari Aviral Kumar indicates that they are currently guiding the research agenda on this field.

4.3 RQ3: Conceptual and Intellectual structures

Zipf's Law is a significant principle employed in researching how frequently keywords are used in scholarly papers. The principle is used in discovering frequently occurring as well as significant words in a particular field of scholarship. The law asserts that phrases that are more popular are going to rank lower in frequency lists. Various disciplines in scholarly writing apply this principle (Chao & Zipf, 1950). In this work, Zipf's Law applied in reviewing 1251 papers aims at addressing the research question **(RQ3): "What are the prevailing conceptual, intellectual, and social frameworks that define the literature on sustainable investing in financial markets?".** It originates from authors' patterns of keywords that happen to appear in association with each other in numerous publications. This is analyzed by means of co-word analysis. In addition, the intellectual framework is illustrated by means of co-citation analysis. The approach is premised upon that if a third source cites two publications simultaneously, then doubtless, there are similar themes or ideas in them (Small, 1973).

4.3.1 Keyword analysis

Fig. 7: Word clouds based on author's supplied keywords

Figure 7 illustrates a word cloud regarding sustainable investment and ESG investing. It indicates a dynamic research focus where significant themes such as "green finance," "sustainable finance," "ESG," and "sustainability" are particularly significant. They are keywords of the discipline, indicating how environmental, social, and governance aspects are integrated into financial choices and transition to low-carbon, responsible economies. New issues such as "green bonds," "climate change," and "renewable energy" exhibit more focus on new financial instruments and pressing environmental concerns. Topics such as "corporate governance," "socially responsible

investment," and "financial markets" reveal ESG research's diverse scope, ranging over market practices, rules, and firm behavior. Recent work also indicates how external events such as COVID-19 influence sustainable investing trends, as more investors become cognizant and policies evolve toward broader use. The emerging theme typology shows a multidisciplinary meeting point that aims at developing sustainable economic growth, financial stability, and social justice, and thus promotes continuity in research and innovation in ESG models (Rodriguez-Rojas et al., 2022; Maria et al., 2023; Khamitdkhanovich et al., 2025).

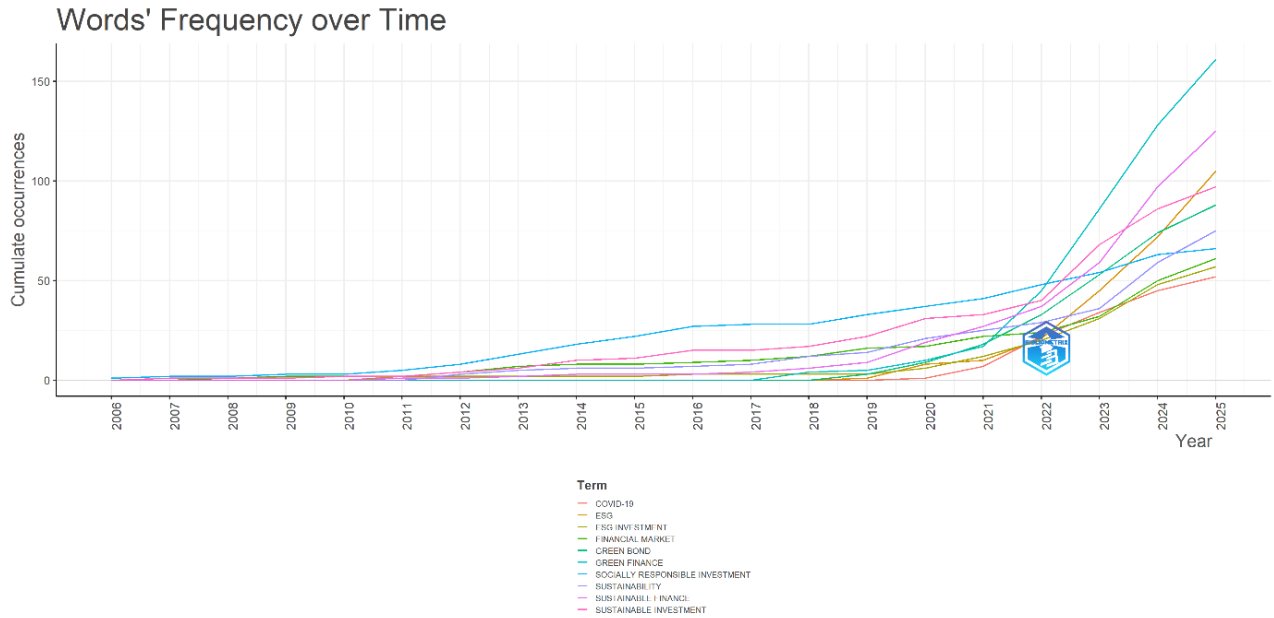


Fig. 8. Trend of Author's supplied keywords

Figure 8 demonstrates the cumulative frequency of the chosen keywords in 2006-2025, and it is evident that the use of sustainability-related financial terms in the academic literature is gradually increasing since the middle of the 2000s. First impressions were minimalistic and were mainly limited to theoretical accounts of socially responsible investing and of financial markets. The period between 2006 and 2015 was characterised by a consistent but insignificant rise, the indicator of the nascent phase of academic activity. Since 2016, the terms green finance, ESG, and sustainable investment have become more and more widespread, as the United Nations Sustainable Development Goals are being ratified worldwide and the policy-making continues to be more scrutinized in terms of the climate finance. The last five years (2020-2025) are marked by an intensive growth since it is confirmed by steep rise curves in sustainable finance, ESG investing, and green bonds, indicating their penetration into the global financial study. This change is specifically linked to the increased regulatory activity, investor demands toward increased transparency, and post-pandemic economic recovery plans. The introduction of COVID-19 as a term of relevance since 2020 further contextualized the rushed considerations of resilience and sustainability in finance. The observations also correspond with bibliometric evidence of previous research, which records a thematic change in the recent years to ESG consistent and sustainability-oriented finance (Ellili, 2022).

4.3.2 Co-word analysis

Co-occurrence analysis, a prominent bibliometric method for keyword analysis, identifies groups of frequently co-occurring terms that reveal thematic structures within research domains (Cobo et al., 2011). As Figure 9 shows, the co-word analysis reveals three thematic clusters that define the conceptual framework of the research on sustainable finance, thus providing the insight into the interrelationships, which can be created by the patterns of the key words co-occurrence (Purnomo et al., 2021).

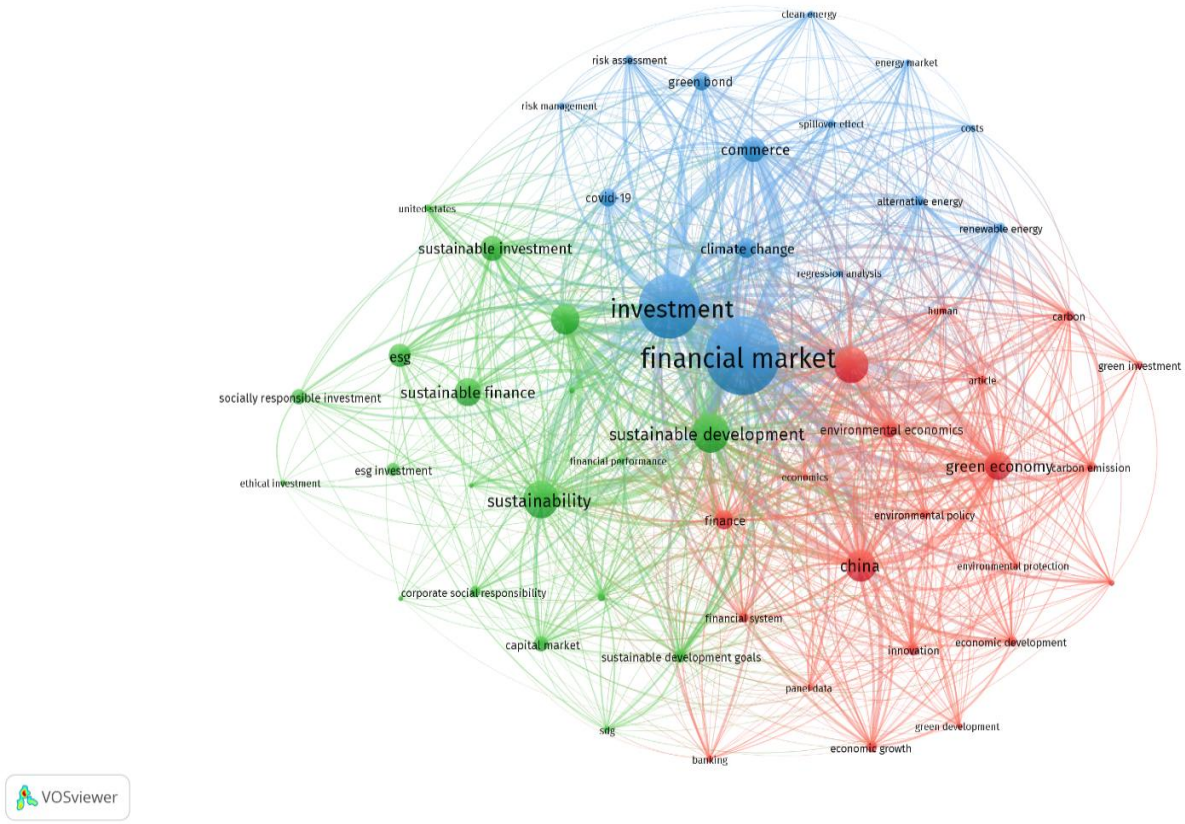


Fig. 9: Co-word analysis

Cluster 1 (Brown): Green Finance and Environmental-Economic Development

This cluster reflects the nexus between green finance, carbon emissions, environmental policy, and sustainable economic development. It examines how financial systems mobilize capital toward low-carbon innovation while internalizing environmental externalities. Empirical studies often panel-based assess policy effectiveness and innovation-driven growth (Zhang et al., 2023; Wang & Li, 2024). Overall, the cluster shows how financial architecture increasingly steers economies toward sustainability (Numan et al., 2023).

Cluster 2 (Green): Corporate Governance and Sustainable Investment Strategies

The second cluster focuses on how ESG, CSR, SRI, and governance structures shape sustainable investment behaviour and financial performance. Research highlights governance quality and transparency as key drivers of investor decisions and alignment with SDGs. Empirical evidence particularly from Europe shows the influence of regulatory reforms and disclosure mandates (Khan, 2019; Mohammad & Wasiuzzaman, 2021; Ming et al., 2024). The cluster underscores governance as a central mechanism linking corporate conduct with responsible capital allocation.

Cluster 3 (Blue): Climate Risk, Energy Markets, and Financial Innovation

The third cluster captures the emerging convergence of climate risk, renewable energy markets, and sustainable financial products such as green bonds. Studies analyse spillover effects, transition risks, and market responses to climate-related shocks, including COVID-19. The cluster demonstrates how financial innovation supports renewable energy deployment and climate-risk mitigation (Wang et al., 2022; Chen *et al.*, 2024). Overall, it signals the growing prominence of climate finance in shaping resilient and low-carbon financial markets.

4.3.3 Co-citation analysis

Co-citation analysis is a strong bibliometric method that is commonly used to define scholarly interrelations and intellectual structures in a specific research field, by measuring how frequently authors are cited collectively in scholarly literature (Small, 1973; Van Eck & Waltman, 2014). Figure 10 shows co-citation by author, which indicates three strong clusters that represent affiliated research communities and thematic areas that concern sustainable investment and ESG research related to financial market.

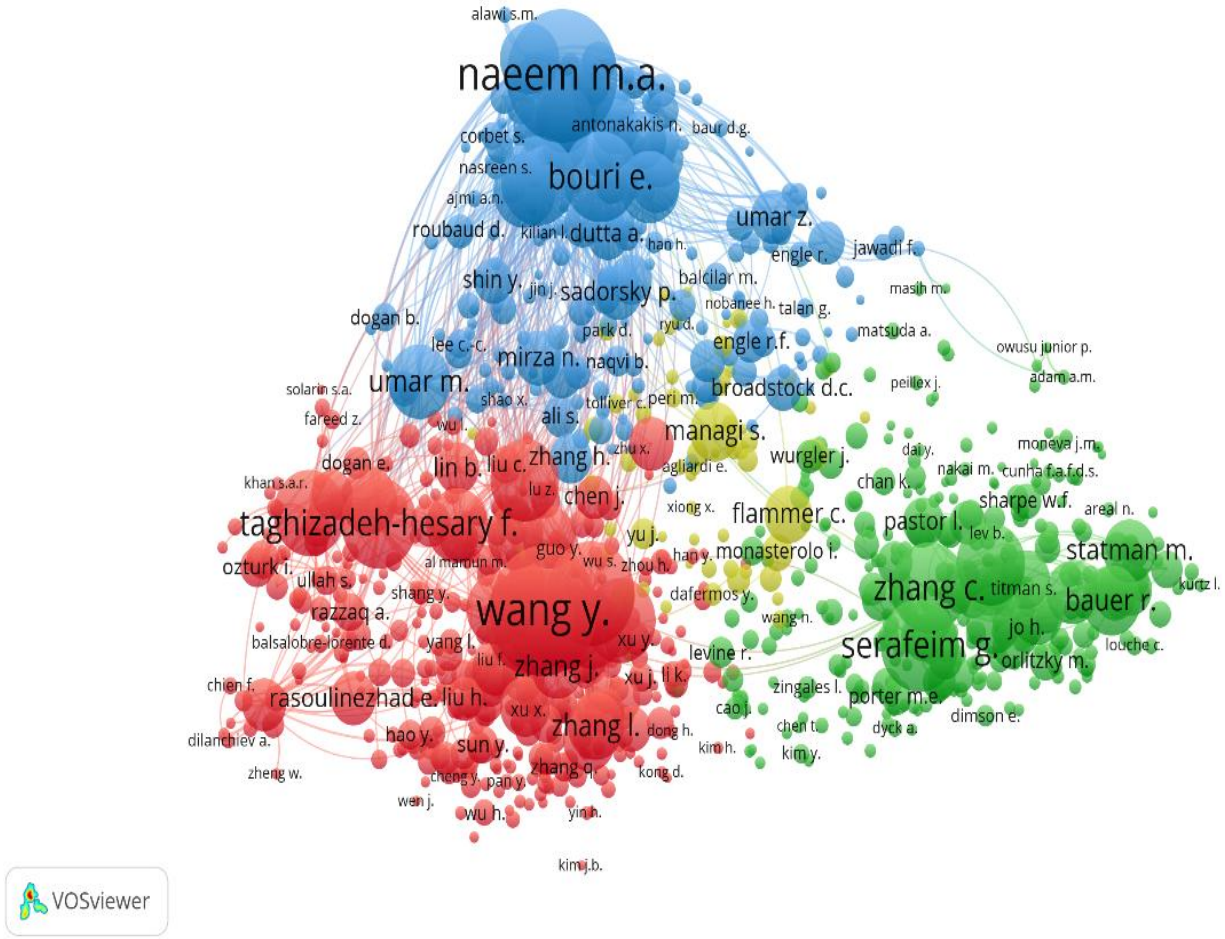


Fig. 10: Co-citation network

Cluster 1 (Red) mainly includes scholars such as Wang Y., Taghizadeh-Hesary F., and Rasoulinezhad E., who are co-cited many times due to their first efforts to introduce to the paradigm of green finance, carbon emission-reduction measures and development of sustainable investment frameworks. Their work indicates one critical task which is to tie the environmental policy to financial structures (Taghizadeh-Hesary & Yoshino, 2020; Wang et al., 2024).

Cluster 2 (Blue) comprises a small group of researchers such as Naeem M.A. and Bouri E. and focuses on the financial market volatility, the dynamics of the energy market, and the spillover effects that guide the empirical discussion of market risks and resilience in the ESG transformation domain (Naeem et al., 2020; Shahzad et al., 2021; Zhang & Umair, 2023).

Cluster 3 (Green) led by Serafeim G., Zhang C., and Statman M. boasts of very prominent academic work on corporate governance, ESG integration, and sustainable performance of investments. Their work has greatly contributed to the current knowledge of the institutional determinants and the governance structure which influence the financial and social results in the global capital markets (Serafeim, 2020).

The closeness and interconnections between clusters in the co-citation network not only highlight the importance of research impact and academic leadership but also pointing out the overlaps of thematic interest within the environmental, financial, and governance bodies. It highlights the emerging cross-disciplinary themes that will shape the ESG and green finance in the upcoming studies (Rodríguez-Rojas et al., 2022; Ahmad et al., 2025).

4.3.4 Co-Authorship Analysis

Co-authorship analysis is a salient bibliometric measure that is used to define and measure scientific relationships by recording collaborative works among authors, institutions and countries (Glänzel & Schubert, 2006; Zare-Farashbandi et al., 2014).

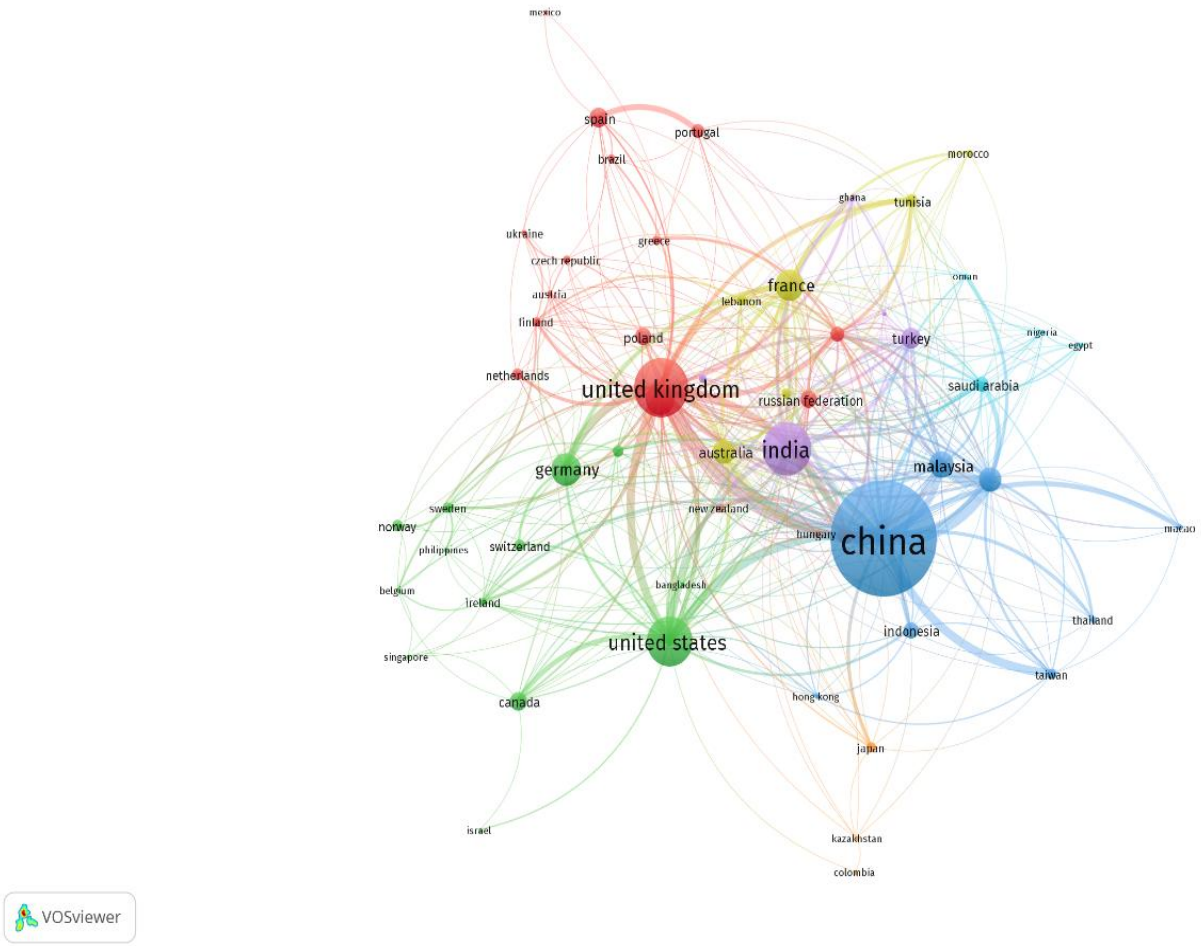


Fig. 11: Co-Authorship Analysis

Through such studies, research societies are able to identify leading authors, collaborative centers, and worldwide changes in research trends, therefore offering valuable proof of scholarly influence and knowledge diffusion (Glynatsi & Knight, 2021).

Figure 11 represents the international co-authorship network, which gives a general visual representation of the trends of collaboration in the area of study. China as the foremost hub, indicating its dominance in scholarly output and its role in facilitating global knowledge distribution. Similarly, the United Kingdom and the United States play significant roles, as evidenced by the larger dimensions of their nodes, pointing to their capability to connect diverse scientific communities in different parts of the world. The network graph further shows significant clustering along geographic distance and linguistic considerations like Europe, Asia, and North America blocs underlining the role of sociocultural factors in shaping collaborative dynamics. Countries like India, Pakistan, and Malaysia are marked by rising participation and strong connectivity, marking new regional leaders in scientific output and collaborations. These findings are supported by the literature in Q1 journals, which indicates that nodes with high concentration and closeness like China, the United Kingdom and the United States, act as research nodes, subsequently intensifying the visibility and citation impact of their joint creations (Glynatsi & Knight, 2021; Qiu et al., 2014). The co-authorship model illustrated in diagram 11 not only captures current science collaborations, it also indicates potential avenues of strengthening future international research collaborations, which result in both scholarly influence as well as global dissemination of knowledge.

4.3.5 Thematic map

The thematic map provides a comprehensive bibliometric interpretation of prevailing clusters of research in ESG investing and sustainable finance. This framework outlines thematic densities with regard to centrality, hence facilitating understanding of maturity as well as importance of major research domains (Cobo et al., 2011). Figure 12 classifies thematic map into four different quadrants;

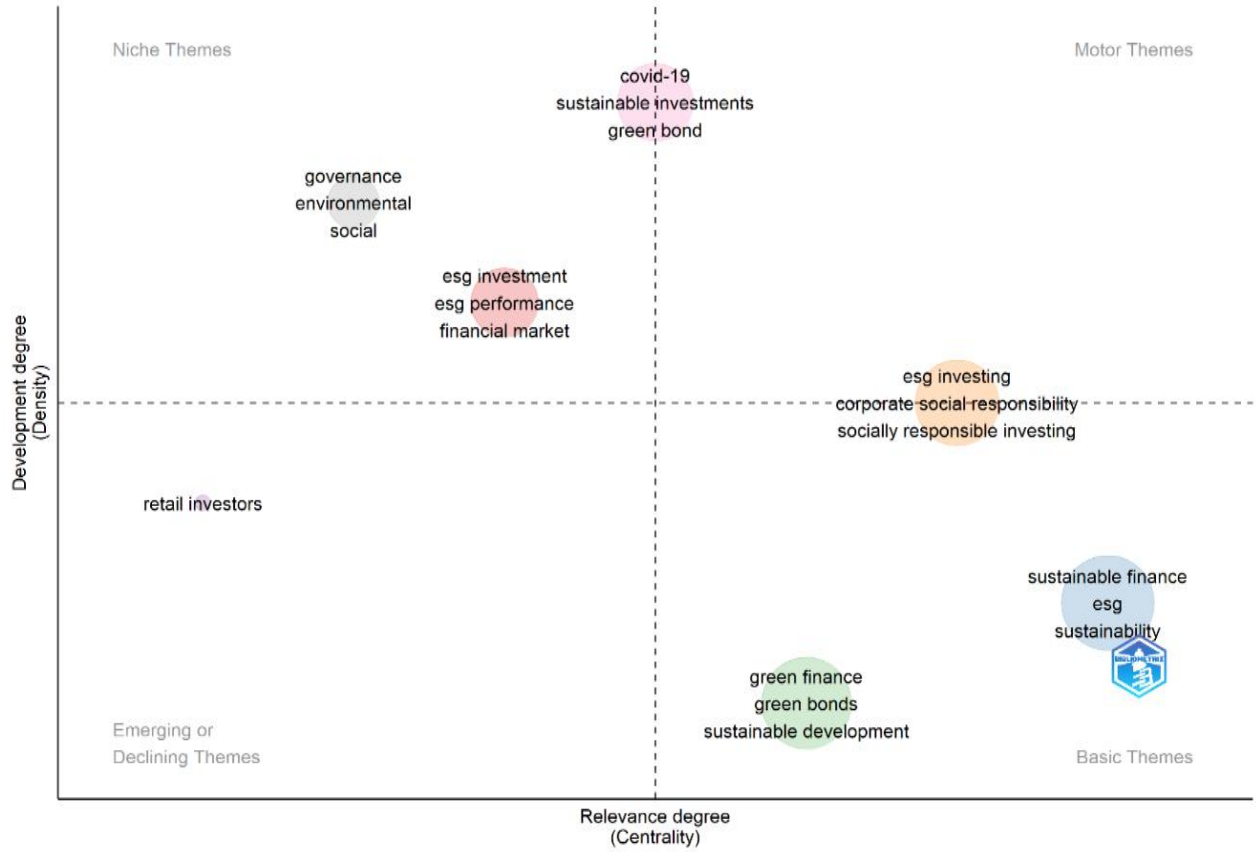


Fig. 12. Thematic map Figure 12 illustrates the thematic map into four Quadrants;

Quadrant 1: Motor Themes (High Density, High Centrality)

Motor theme quadrant is primarily characterized by terms such as "ESG investing, corporate social responsibility, and socially responsible investing" represent the most developed and influential domains, exhibiting both strong internal coherence and broad relevance across sustainable finance (Callon et al., 1983). These themes underscore the central role of ESG integration in contemporary investment analysis and link theoretical sustainability frameworks with practical financial decision-making (Eccles et al., 2014).

Quadrant 2: Niche Themes (High Density, Low Centrality)

The niche theme quadrant includes topics like *governance, environmental, social, financial market,* and *ESG investment* show advanced internal development but remain weakly connected to mainstream discourse (Van Eck & Waltman, 2014). Emerging topics including *COVID-19, sustainable investments,* and *green bonds* reflect rapidly expanding areas shaped by recent global disruptions (Gössling et al., 2020). These themes hold strong potential but require deeper integration into the core sustainable finance narrative.

Quadrant 3: Emerging or Declining Themes (Low Density, Low Centrality)

Themes like ***retail investors*** are conceptually underdeveloped and peripheral, indicating either an emerging or declining research trajectory. Their low density and centrality point to limited scholarly integration, yet their rise suggests increasing attention to individual investor behaviour in ESG markets (Riedl & Smeets, 2017). This quadrant reveals promising avenues for future research.

Quadrant 4: Basic Themes (Low Density, High Centrality)

In the quadrant of prominent themes, foundational concepts such as green *finance, green bonds, sustainable development, sustainable finance, ESG,* and *sustainability* display high centrality but modest internal development. They form the conceptual backbone of the field and anchor specialized ESG research, though still offering scope for theoretical deepening and empirical expansion (Stoicescu & Sima, 2024). These themes remain essential reference points in sustainable finance scholarship.

4.3.6 Bibliographic coupling

Bibliographic coupling is a bibliometric technique applied to measure the extent of similarity among

entities, such as countries, by calculating the number of common references in their published outputs, hence revealing collaborative as well as intellectual relations across different research fields (Perianes-Rodriguez et al., 2016; Van Eck & Waltman, 2014).

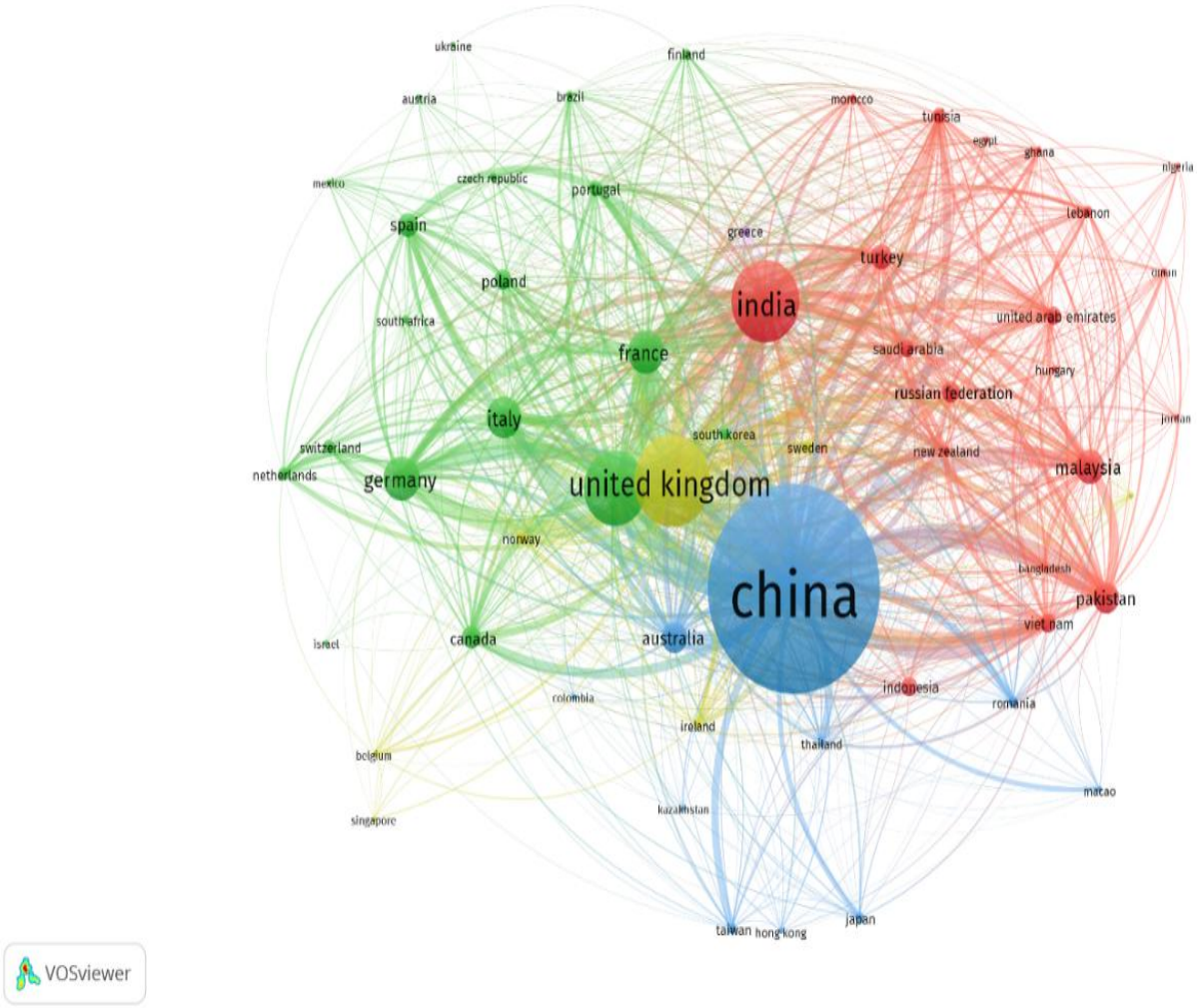


Fig. 13: Bibliographic Coupling

Figure 13 demonstrates the bibliographic coupling network of countries that uncovers four prominent clusters reflecting regional and thematic research affiliations. The overwhelming blue cluster, anchored by China, Japan, and Australia, indicates a strong coupling around topics such as green finance innovation and renewable energy studies, in which China plays a central role in East Asian sustainable finance scholarship. The green cluster centered by Germany, Italy, and France demonstrates Europe's collective involvement in environmental economics and sustainability studies motivated by policy concerns. An India, Turkey, and Malaysia-based red cluster signals a connection across South Asia and the Middle East, focusing on development finance and carbon emission cutback strategies. The yellow cluster around United Kingdom, United States, Canada, and Spain indicates a transatlantic–European collaborative effort that focuses on corporate governance, integration of ESG principles, and performance of sustainable investments. Interconnections among such clusters in complex patterns suggest a dynamic global scholarship network, in which local expertise converges upon key themes of sustainable finance, while geographical contiguity of United Kingdom both to Europe and Asia-based clusters highlights its role as a bridge in spreading research insights across scholarly communities.

4.4 RQ4: Trend Areas, Knowledge Gaps, and Future Directions

4.4.1 Trending topics

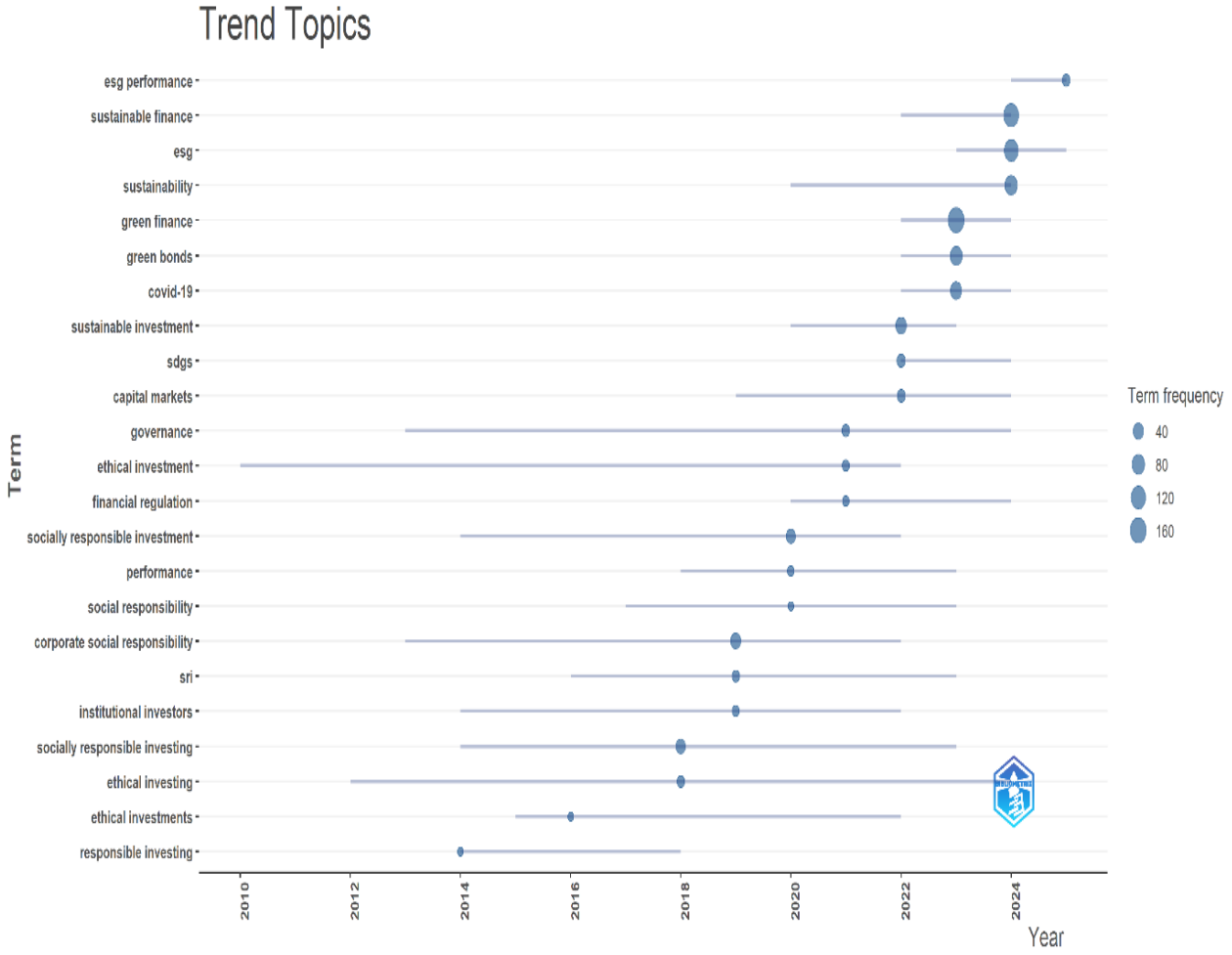


Fig. 14: Trends Across the Ages

This section provides an overview of the evolving thematic focus in the literature related to sustainability and financial markets, based on the cumulative keyword frequency extracted from Biblioshiny. Figure 14 demonstrates a clear upward trajectory in the usage of specific sustainability-linked terms over the 2005–2025 period. The analysis considered keywords with a minimum repetition threshold of seven, mapped annually. While early years show relatively low activity, a significant surge is observed from 2020 onward. Notably, keywords such as "*sustainable finance*", "*green finance*", and "*ESG*" have experienced a sharp rise, reflecting an academic shift toward responsible investing and climate-conscious financial strategies. The prominence of "*climate change*" and "*sustainable development*" post-2021 indicates growing interdisciplinary integration between environmental imperatives and financial decision-making. In contrast, terms like "*financial markets*" remain consistently referenced, signifying their foundational role. Importantly, "*COVID-19*" appears as a short-term but impactful keyword, suggesting its catalytic role in reorienting scholarly focus towards resilience and sustainability in finance. The overall focus on "Sustainable investment" in 2024 and 2025 highlights the direction of the market transformation and the increasing importance of sustainability in the capital allocation practices.

Countries Collaboration

Figure 15 illustrates the network of collaboration in the world in terms of research on sustainable investment and ESG integration based on co-authorship between different countries. The figure illustrates the very interconnected and widely spread network of research with China, the United States, and the major European states, such as the United Kingdom, Germany, and France, becoming key participants and the centers of collaboration.

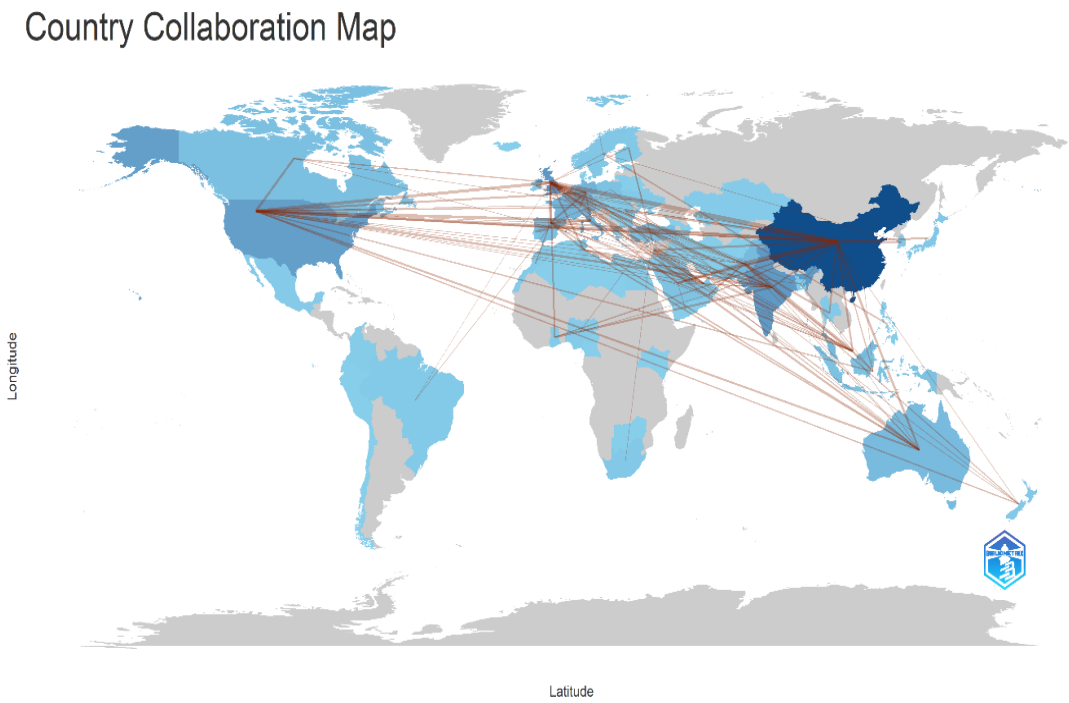


Fig. 15: Country Collaboration across the world

This darker tone in these areas does not only signify the increased research activity but also means the increased global interactions. The map also indicates that there are widespread cross-regional connections and strong collaborative flows between the Asian and Western economies suggesting the high degree of globalisation and multidisciplinary research in sustainable finance. The adoption of the emerging economies in the Asian continent, Africa, and South America, in particular, is a sign of the expansion of the ESG discourse beyond the conventional financial market, and an indication of the rising awareness of sustainable investment as a research agenda in the world.

The network architecture is a representation of the global intellectual effort of the scholars in handling sustainability issues and promoting the idea of ESG integration in financial markets. co-authorship pattern not only help to disseminate knowledge, but also confer the ability to co-establish common conceptual and methodological paradigms, which further accelerates the internationalization and development of the discipline.

4.4.2 Knowledge gaps

The bibliometric mapping reveals a large number of under researched areas in the field of sustainable investment, ethical investing, and ESG research that are relevant to financial markets. First, while core subjects such as ESG integration, sustainable development, as well as green finance, are well established, there is a lack of studies connecting them to retail investors' behavior. The thematic representation recognizes "retail investors" as a nascent yet thinly populated and marginally central theme, which calls for both empirical and theoretical models that explain the motivations, decision-making, as well as difficulties confronted by private investors in ESG strategy implementation.

Second, there are indications of geographic imbalances. Though China, Britain, and America are at the forefront in publication output and citing, non-Asian emerging economies remain underrepresented despite playing a more critical role in marketplaces of sustainable finance. Underrepresentation limits global usability of developed models and theories as much of what is discussed is conditioned by policy, regulatory, and market circumstances unique to leader economies.

Third, while green bonds, climate change, and COVID-19 have been at the forefront of recent writing, in niche/basic quadrants, with correspondingly low thematic density, it indicates that such themes remain under-integrated in the mainstream ESG narrative and that interlinkages of such themes with financial performance, risk consideration, and policy architecture remain under-examined.

Lastly, the extent of methodologies used is constrained. The prevalence of empirical event studies, regression studies, and bibliometric surveys indicates that there is a scarcity of work incorporating mixed-method studies, experiments, and elaborate econometric modeling that can offer more robust

observations of causality linkages in sustainable finance systems.

4.4.4 Future Research Directions

According to acknowledged shortcomings, future research should pursue the following directions:

1. **Retail Investor Engagement in ESG** - Develop behavioral finance models that incorporate psychological, socio-economic, and cultural determinants of ESG investment decisions among retail investors. Cross-country comparative studies could identify universal and context-specific drivers.
2. Inclusion of Emerging and Frontier Markets - Expand the geographic scope of research to include Africa, Latin America, and Southeast Asia. This would enrich the global understanding of sustainable finance practices and highlight innovative market mechanisms in developing economies.
3. Integration of Climate Risk and Resilience Metrics - Strengthen the link between climate-related risks (e.g., transition and physical risks) and financial market behavior by incorporating tools such as climate stress testing and scenario analysis into ESG valuation models.
4. Post-COVID-19 Sustainable Finance Models - Investigate how the pandemic-induced market disruptions have permanently reshaped sustainable finance strategies, particularly in areas like supply chain resilience, health-related ESG metrics, and crisis preparedness.
5. Innovative Financial Instruments - Explore the performance, adoption barriers, and impact of emerging instruments such as sustainability-linked loans, transition bonds, and blended finance vehicles, with a focus on their role in accelerating capital flows toward the Sustainable Development Goals (SDGs).
6. Interdisciplinary Approaches - Foster collaborations between finance, environmental science, behavioral economics, and data science to develop integrated frameworks that measure and forecast ESG impacts at micro and macro levels.

5. DISCUSSION

5.1 Purpose and Scope of the Discussion

The aim of the paper was to perform a thorough bibliometric mapping of sustainable investment related to financial market research literature in the 2005-2025 timeframe with an objective of tracking the conceptual shift of the field, which started with ethical investing, followed by socially responsible investing (SRI) and, finally, to the concept of environmental, social, and governance (ESG) integration. The current research incorporates performance measures, co-citation networks, keyword co-occurrence patterns, thematic evolution mapping and collaboration analysis to provide a comprehensive picture of how sustainable finance has progressed intellectually and institutionally. The debate is not limited to descriptive patterns but an effort to clarify how specific trends emerge, how they relate to the global policy and the market dynamics, and how it impacts theory, practice, and regulation. In a contribution to the modern discourse of sustainability-oriented finance, this section summarizes the intellectual framework of the discipline and finds gaps in thematic coverage, contextualizing their findings with a larger development of climate finance, responsible investing, and ESG-oriented making of financial decisions.

5.2 Thematic Interpretation of Key Findings

5.2.1 Research Growth and Global Patterns

The fact that the number of publications increasing over the last twenty years is evidence of the accelerating mainstreaming of sustainability issues in world finance. The sharp rise in output since 2015 has been accompanied by significant policy mile stones, including the United Nations Principles for Responsible Investment (UN PRI), the Paris Agreement, Task Force on Climate-Related Financial Disclosures (TCFD) guidelines, and the European Union Taxonomy which formalised ESG disclosure and exerted more regulatory pressure on financial systems. The countries with mature financial markets and sophisticated regulatory ecosystem like the United States, the United Kingdom, China, and various other large economies in the EU, control the research output because of their high-quality academic infrastructure and extensive involvement of institutional investors. There is still underrepresentation of emerging economies, which is unequal when it comes to the availability of ESG data, regulatory maturity, and funding of research. These discrepancies imply the need to seek capacity-building efforts, enhanced sustainability reporting, and cross-regional cooperation to democratise ESG knowledge production and decrease global research asymmetries.

5.2.2 Intellectual Structure and Thematic Evolution

The Co-citation and clustering analyses have identified three main intellectual streams namely, **(i)** green finance and environmental-economic

development; **(ii)** governance-based responsible investment and ESG performance; and **(iii)** climate risk, renewable energy, and sustainable financial innovation. These groups map the development of the field, as it was conceptualized in normative discussions of ethics and social responsibility, into models of ESG materiality, climate risk pricing, and financial system resilience, which have their analytic foundations.

The thematic map together with thematic evolution map reveals a clear developmental sequence in Sustainable finance.

Core Themes (Motor Themes) - ESG investing, corporate social responsibility (CSR) and SRI are fully formed high-impact ideas that establish the intellectual framework of sustainable finance and define the mainstream theory and practice of investment.

Niche Themes - Governance, environmental and social aspects, green bonds, and COVID-19-related sustainability changes are highly specialized but not very cross-domain connected research streams.

Niche Themes - Environmental and social aspects, governance, and green bonds, and COVID -19 related sustainability changes are well-established, but less integrated research streams with high specialization rates and low cross-domain connectivity.

Emerging or Declining Themes- The retail investor-oriented ESG conduct seems to be marginal and low-density, which points to an early-stage field that is beginning to pick up in sustainable investment studies.

Basic Themes- The pillars that support the development of specialized scholarship around ESG are foundational, i.e., green finance, sustainable development, ESG and sustainability, which are basic and high-centrality concepts.

The thematic evolution over time further highlights a clear progression in the field:

- **2005-2010:** initial ethical investment and CSR performance controversies.
- **2011-2016:** broadening of SRI systems, application of the stakeholder theory, and sustainability disclosure.
- **2017–2025:** the reign of ESG integration, climate finance, green bonds, and risk-based modelling.

Altogether, the given trend reflects the general tendencies of international capital markets, where ESG has shifted away, as a voluntary, values-based commitment, into a mandatory, risk-based indicator that is being integrated into investment requirements and regulatory systems.

5.2.3 Social, Managerial, and Market Perspectives

Although the literature focuses mostly on environmental and governance aspects, the research results show increasing, but still inadequate attention to social topics, such as labor rights, diversity, community impact, and social inclusion. The progress of ESG pillars has not been smooth; the S dimension seems to be conceptually weak in relation to the climate risk and governance systems. There are managerial views including investor sentiment, behavioural biases, and institutional stewardship, which are underutilized. These knowledge gaps suggest that, even though financial markets have created significant climate-modulated and governance-oriented ESG modelling, more comprehensive socio-economic transformation routes are not yet developed. Since sustainable investment is centralizing itself in SDG alignment and just-transition models, the need to incorporate the social and behavioural financial aspects is an essential field of focus in research in the future.

5.3 Implications

5.3.1 Practical Implications for Investors and Financial Institutions

The concepts of ESG integration, CSR, and SRI have the greatest conceptual maturity and applicability. Investors will use these observations to optimise portfolio screening, advance climate-risk modelling and incorporate governance-based risk reduction strategies. Themes like green bonds, climate-risk spillovers, and renewable energy finance offer an insight into future product-innovation and diversification of investments. The Quality of ESG reporting and related reporting levels become the key factors that should be considered by institutional investors who want to base the ratio of financial performance on sustainability goals.

5.3.2 Policy and Regulatory Implications

The fact that the majority of influential ESG studies are concentrated in well-developed regulatory frameworks suggests that there cannot be sustainable finance ecosystems without the policy-based momentum. These findings provide a number of insights to policymakers in developing economies: enhancing the sustainability of disclosure requirements, create, and strengthen national green finance taxonomies, and stimulating ESG-enabled capital markets. The collaboration networks demonstrate the advantages of the international research relationships and gives a hint that international organisations, including UNEP FI, PRI,

IOSCO, ought to encourage the harmonisation of the regulations across borders, exchange of knowledge, and capacity building.

5.3.3 Academic Implications

This research methodologically advances the field of sustainable finance by combining performance analysis with science mapping which makes the research a workable framework to map large-scale intellectual ecosystems. The results indicate that there are still gaps in unexplored areas like social sustainability, behavioural aspects of ESG adoption, cross-country ESG comparability, and retail investor participation. These research gaps offer sufficient opportunities to the future empirical, experimental, and mixed-method studies. Thematic structures also provide a plan of action on how to enhance theoretical integration in ethics, SRI, ESG and climate finance.

5.4 Limitations

Due to the exhaustive nature of the current research, several limitations still exist. The use of Scopus as the sole indexing can unintentionally omit relevant contributions in Web of Science, SSRN, or region-specific journals. Thematic clustering may be affected by inconsistencies in the use of the keywords, which is a common problem in the bibliometric analyses, even after careful data cleaning steps. The selected timeframe (2005-2025) covers most of the most important developments but might miss some of the most recent publications that have not had enough citation information. In addition, the results of science-mapping depend on threshold parameters and the clustering algorithms which determine granularity of the network generated. These limitations highlight the importance of methodological triangulation in future studies.

5.5 Final Synthesis

The paper provides an in-depth analysis of 20 years of sustainable investment literature, which discloses intellectual underpinnings, thematic pillars, and international development. It clarifies how sustainability has been transformed into an ethical and socially responsible investment as well as ESG research strand integrated bibliometric framework as a core determinant of financial decision-making. The multi-dimensional approach envisages modern demands of responsible, climate-resilient, and socially inclusive financial systems. To the scholars, the study presents a practical framework and a synthesized agenda, to the practitioners and policymakers, it gives them actionable information on thematic priorities, disclosure imperatives, investment patterns and regulatory opportunities. Together, the results establish sustainable finance as a crucial tool in promoting global sustainability goals.

6. CONCLUSION

6.1 Summary of Core Insights

The article provides a two-decade, science-mapped longitudinal study of sustainable investing literature, which demonstrates how the field of sustainable investment has shifted its focus toward ethical investing, SRI models, to advanced ESG-based financial systems. It shows how sustainability has been embedded in valuation models, risk-pricing mechanisms, and global investment strategies through the incorporation of performance indicators, Co-citation structures, thematic evolution, and collaboration networks. The findings unveil key gaps in the literature, such as geographic imbalance, inadequate social-sustainability integration, and lack of empirical connections between ESG models, which in turn promote conceptual clarity in the field of sustainable finance research.

6.2 Practical and Theoretical Contributions

The study can provide scholars with a methodological template that can be reused and a thematic taxonomy that can be further leveraged to conduct more sophisticated bibliometric studies in finance and sustainability. The findings highlight mature topics like ESG integration, governance, and climate-risk assessment, and emerging opportunities in green bonds, renewable energy finance, and behavioural ESG adoption that are of importance to investors and practitioners. The policymakers are alerted of the need to harmonise disclosure frameworks, capacity-building programmes, and international co-operation to hasten the adoption of sustainable finance.

6.3 Acknowledgement of Key Limitations

As mentioned earlier, single-database approach, variability of the keywords and citation-based limitations can be biased. Although such factors are downplayed, they still have to be taken into account to interpret the findings and plan further research.

6.4 Outlook and Pathways Forward

With the shift of financial markets towards climate-resilient, socially-based, and governance-enhanced investment models, sustainable finance will remain an important area of research and policy. The future research in the field must embrace cross-disciplinary views, merge bibliometric with experimental confirmation, and cover new themes like AI-based ESG analytics, biodiversity finance, and just-

transition investments. The continuous bibliometric tracking will assist the developing field by identifying new areas of research, enhancing international cooperation, and guiding policy and investment choices. The future of sustainable finance studies promises to transform financial systems across the world in a just, unambiguous, and sustainable way.

DECLARATIONS

Funding

The authors did not receive any financial support, grant, or funding from any public, commercial, or not-for-profit sectors for conducting this research.

Data availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Ethics Statements not Applicable

This article does not contain any studies with human participants performed by any of the authors.

Conflicts of Interest

The authors declare that they have no competing interests.

REFERENCES

Ahmad, V., Arora, M., Sayal, A., Kumar, R., & Kumar, P. (2025). Exploring trends in e-business and sustainable finance: an integrated analytical approach. Frontiers in Sustainable Cities, 7. https://doi.org/10.3389/frsc.2025.1549874

Amel-Zadeh, A., & Serafeim, G. (2018). Why and how investors use ESG information: Evidence from a global survey. Financial analyst journal, 74(3), 87-103. https://doi.org/10.2469/faj.v74.n3.2

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Arner, D. W., Buckley, R. P., Zetzsche, D. A., & Veidt, R. (2020). Sustainability, FinTech and financial inclusion. European Business Organization Law Review, 21(1), 7-35. https://doi.org/10.1007/s40804-020-00183-y

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. Quantitative science studies, 1(1), 377-386. https://doi.org/10.1162/qss_a_00019

Bradford, S. C. (1934). Sources of information on specific subjects. Engineering, 137, 85–86. https://doi.org/10.1177/016555158501000406

Broadstock, D. C., Chan, K., Cheng, L. T., & Wang, X. (2021). The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. Finance research letters, 38, 101716. https://doi.org/10.1016/j.frl.2020.101716

Brookes, B. C. (1969). Bradford's law and the bibliography of science. Nature, 224(5223).https://doi.org/10.1038/224953a0

Busch, T., Bauer, R., & Orlitzky, M. (2016). Sustainable development and financial markets: Old paths and new avenues. Business & Society, 55(3), 303-329. https://doi.org/10.1177/0007650315570701

Butlin, J. (1989). Our common future. By World commission on environment and development. (London, Oxford University Press, 1987, pp. 383£ 5.95.). https://doi.org/10.1002/jid.3380010208

Callon, M., Courtial, J. P., Turner, W. A., & Bauin, S. (1983). From translations to problematic networks: An introduction to co-word analysis. Social science information, 22(2), 191-235. https://doi.org/10.1177/053901883022002003

Capelle-Blancard, G., & Petit, A. (2019). Every little help? ESG news and stock market reaction. Journal of business ethics, 157(2), 543-565. https://doi.org/10.1007/s10551-017-3667-3

Chandran, R., & Chandran MC, S. (2024). Green finance and sustainability: mapping research development through bibliometric analysis. Discover Sustainability, 5(1), 339. https://doi.org/10.1007/s43621-024-00549-z

Chao, Y. R., & Zipf, G. K. (1950). Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology. Language, 26(3), 394. https://doi.org/10.2307/409735

Chen, F., Zeng, X., & Guo, X. (2024). Green finance, climate change, and green innovation: Evidence from China. Finance Research Letters, 63, 105283. https://doi.org/10.1016/j.frl.2024.105283

Chien, F., Anwar, A., Hsu, C. C., Sharif, A., Razzaq, A., & Sinha, A. (2021). The role of information and communication technology in encountering environmental degradation: proposing an SDG framework for the BRICS countries. Technology in society, 65, 101587.

https://doi.org/10.1016/j.techsoc.2021.101587
Chowdhury, S. B., DasGupta, R., Choudhury, B. K., & Sen, N. (2023). Evolving alliance between corporate environmental performance and financial performance: A bibliometric analysis and systematic literature review. Business and Society Review, 128(1), 95–131. https://doi.org/10.1111/basr.12301
Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science mapping software tools: Review, analysis, and cooperative study among tools. Journal of the American Society for Information Science and Technology, 62(7), 1382-1402. https://doi.org/10.1002/asi.21525
Crona, B., Eriksson, K., Lerpold, L., Malmström, M., Sanctuary, M., & Sandberg, J. (2021). Transforming toward sustainability through financial markets: Four challenges and how to turn them into opportunities. One Earth, 4(5), 599-601. https://doi.org/10.1016/j.oneear.2021.04.021
Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070
Drott, M. C. (1981). Bradford's law: Theory, empiricism and the gaps between. Library Trends, 30, 41–52.
Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. Management science, 60(11), 2835-2857. https://doi.org/10.1287/mnsc.2014.1984
Edmans, A. (2011). Does the stock market fully value intangibles? Employee satisfaction and equity prices. Journal of Financial economics, 101(3), 621-640. https://doi.org/10.1016/j.jfineco.2011.03.021
Ellili, N. O. D. (2022). Bibliometric analysis and systematic review of environmental, social, and governance disclosure papers: current topics and recommendations for future research. Environmental Research Communications, 4(9), 092001. https://doi.org/10.1088/2515-7620/ac8b67
Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. Journal of sustainable finance & investment, 5(4), 210-233. https://doi.org/10.1080/20430795.2015.1118917
Glänzel, W., & Schubert, A. (2006). Analysing scientific networks through Co-Authorship. In Kluwer Academic Publishers eBooks (pp. 257–276). https://doi.org/10.1007/1-4020-2755-9_12
Glynatsi, N. E., & Knight, V. A. (2021). A bibliometric study of research topics, collaboration, and centrality in the iterated prisoner's dilemma. Humanities and Social Sciences Communications, 8(1). https://doi.org/10.1057/s41599-021-00718-9
Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. Journal of sustainable tourism, 29(1), 1-20. https://doi.org/10.1080/09669582.2020.1758708
Han, J., & Gao, H. (2024). Green finance, social inclusion, and sustainable economic growth in OECD member countries. Humanities and Social Sciences Communications, 11(1), 1-8. https://doi.org/10.1057/s41599-024-02662-w
Hussain, S. M., Ahmad, N., & Ahmed, S. (2023). Applications of high-frequency data in finance: A bibliometric literature review. International Review of Financial Analysis, 89, 102790. https://doi.org/10.1016/j.irfa.2023.102790
Jaishree, & Dogga, S. M. (2025). Unveiling research trends on the nexus between green finance and sustainable development: a systematic bibliometric review. Discover Sustainability, 6(1), 577. https://doi.org/10.1007/s43621-025-01331-5
Khamitdkhanovich, N. A., Rajendran, M., Nailevich, I. R., & Krishnakumari, S. (2025). Green finance and ESG investing: Driving sustainable growth through innovation. AIP Conference Proceedings, 3306, 030025. https://doi.org/10.1063/5.0277720
Khan, M. (2019). Corporate governance, ESG, and stock returns around the world. Financial Analysts Journal, 75(4), 103-123. https://doi.org/10.1080/0015198X.2019.1654299
Kotsantonis, S., Pinney, C., & Serafeim, G. (2016). ESG integration in investment management: Myths and realities. Journal of Applied Corporate Finance, 28(2), 10–16. https://doi.org/10.1111/jacf.12169
Lee, C. C., & Lee, C. C. (2022). How does green finance affect green total factor productivity? Evidence from China. Energy economics, 107, 105863. https://doi.org/10.1016/j.eneco.2022.105863
Liu, J., & Peifer, J. L. (2022). A moral foundations framing approach: Retail investors' investment intention in ethical mutual funds. Business & Society, 61(7), 1804-1837. https://doi.org/10.1177/00076503211062186

Lotka, A. J. (1926). The frequency distribution of scientific productivity. Journal of the Washington academy of sciences, 16(12), 317-323. https://www.jstor.org/stable/24529203

Maria, M. R., Ballini, R., & Souza, R. F. (2023). Evolution of green finance: a bibliometric analysis through complex networks and machine learning. Sustainability, 15(2), 967. https://doi.org/10.3390/su15020967

Martini, A. (2021). Socially responsible investing: from the ethical origins to the sustainable development framework of the European Union. Environment, development and sustainability, 23(11), 16874-16890. https://doi.org/10.1007/s10668-021-01375-3

Marzuki, A., Nor, F. M., Ramli, N. A., Basah, M. Y. A., & Aziz, M. R. A. (2023). The influence of ESG, SRI, ethical, and impact investing activities on portfolio and financial performance—bibliometric analysis/mapping and clustering analysis. Journal of Risk and Financial Management, 16(7), 321. https://doi.org/10.3390/jrfm16070321

Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. Cogent Social Sciences, 5(1), 1653531. https://doi.org/10.1080/23311886.2019.1653531

Ming, K. L. Y., Vaicondam, Y., & Mustafa, A. M. A. A. (2024). ESG integration and financial performance: evidence from Malaysia's leading companies. International Journal of Energy Economics and Policy, 14(5), 487-494. https://doi.org/10.32479/ijeep.16706

Mohammad, W. M. W., & Wasiuzzaman, S. (2021). Environmental, Social and Governance (ESG) disclosure, competitive advantage and performance of firms in Malaysia. Cleaner Environmental Systems, 2, 100015. https://doi.org/10.1016/j.cesys.2021.100015

Morales, L., Soler-Domínguez, A., & Hanly, J. (2019). The power of ethical investment in the context of political uncertainty. Journal of Applied Economics, 22(1), 554-580. https://doi.org/10.1080/15140326.2019.1683264

Naeem, M. A., Farid, S., Balli, F., & Shahzad, S. J. H. (2020). Hedging the downside risk of commodities through cryptocurrencies. Applied Economics Letters, 28(2), 153–160. https://doi.org/10.1080/13504851.2020.1739609

Numan, U., Ma, B., Sadiq, M., Bedru, H. D., & Jiang, C. (2023). The role of green finance in mitigating environmental degradation: Empirical evidence and policy implications from complex economies. Journal of Cleaner Production, 400, 136693. https://doi.org/10.1016/j.jclepro.2023.136693

Oyewola, D. O., & Dada, E. G. (2022). Exploring machine learning: a scientometrics approach using bibliometrix and VOSviewer. SN Applied Sciences, 4(5). https://doi.org/10.1007/s42452-022-05027-7

Patel, S. K., & Jhalani, P. (2023). Formulation of variables of environmental taxation: a bibliometric analysis of Scopus database (2001–2022). Environment Development and Sustainability, 26(3), 7687–7714. https://doi.org/10.1007/s10668-023-03027-0

Perianes-Rodriguez, A., Waltman, L., & Van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. Journal of Informetrics, 10(4), 1178–1195. https://doi.org/10.1016/j.joi.2016.10.006

Purnomo, A., et al. (2021). Research patterns and trends in sustainable finance: A bibliometric analysis. Journal of Sustainable Finance & Investment, 11(3), 183-210. https://doi.org/10.1080/20430795.2020.1812807

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. Sustainability Science, 14(3), 681–695. https://doi.org/10.1007/s11625-018-0627-5

Qiu, J. P., Dong, K., & Yu, H. Q. (2014). Comparative study on structure and correlation among author co-occurrence networks in bibliometrics. Scientometrics, 101(2), 1345-1360. https://doi.org/10.1007/s11192-014-1315-6

Revelli, C., & Viviani, J. L. (2015). Financial performance of socially responsible investing (SRI): what have we learned? A meta-analysis. Business Ethics: A European Review, 24(2), 158-185. https://doi.org/10.1111/beer.12076

Riedl, A., & Smeets, P. (2017). Why do investors hold socially responsible mutual funds? the Journal of Finance, 72(6), 2505-2550. https://doi.org/10.1111/jofi.12547

Rodriguez-Rojas, M. D. P., Clemente-Almendros, J. A., El Zein, S. A., & Seguí-Amortegui, L. (2022). Taxonomy and tendencies in sustainable finance: A comprehensive literature analysis. Frontiers in Environmental Science, 10, 940526. https://doi.org/10.3389/fenvs.2022.940526

Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six

transformations to achieve the sustainable development goals. Nature sustainability, 2(9), 805-814. https://doi.org/10.1038/s41893-019-0352-9

Schramade, W. (2016). Integrating ESG into valuation models and investment decisions: the value-driver adjustment approach. Journal of Sustainable Finance & Investment, 6(2), 95-111. https://doi.org/10.1080/20430795.2016.1176425

Sciarelli, M., Cosimato, S., Landi, G., & Iandolo, F. (2021). Socially responsible investment strategies for the transition towards sustainable development: The importance of integrating and communicating ESG. The TQM Journal, 33(7), 39-56. https://doi.org/10.1108/TQM-08-2020-0180

Serafeim, G., & Yoon, A. (2022). Which corporate ESG news does the market react to? Financial Analysts Journal, 78(1), 59-78. ttps://doi.org/10.1080/0015198X.2021.1973879

Shahzad, S. J. H., Naeem, M. A., Peng, Z., & Bouri, E. (2021). Asymmetric volatility spillover among Chinese sectors during COVID-19. International Review of Financial Analysis, 75, 101754. https://doi.org/10.1016/j.irfa.2021.101754

Shen, Y., Su, Z. W., Malik, M. Y., Umar, M., Khan, Z., & Khan, M. (2021). Does green investment, financial development and natural resources rent limit carbon emissions? A provincial panel analysis of China. Science of the Total Environment, 755, 142538. https://doi.org/10.1016/j.scitotenv.2020.142538

Singh, V. K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. Scientometrics, 126(6), 5113–5142. https://doi.org/10.1007/s11192-021-03948-5

Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. Journal of the American Society for information Science, 24(4), 265-269. https://doi.org/10.1002/asi.4630240406

Sparkes, R., & Cowton, C. J. (2004). The maturing of socially responsible investment: A review of the developing link with corporate social responsibility. Journal of business ethics, 52(1), 45-57. https://doi.org/10.1023/B:BUSI.0000033106.43260.99

Stoicescu, V., & Sima, A. G. (2024, March). Sustainable Finance as the Catalyst for ESG-Driven Organizational Design. In International Conference on Business Excellence (pp. 457-480). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-78179-7_28

Strampelli, G. (2023). ESG, Sustainability Disclosure, and Institutional Investor Stewardship. Wash. & Lee L. Rev. Online, 81, 405. https://scholarlycommons.law.wlu.edu/wlulr-online/vol81/iss6/2

Sullivan, R., & Mackenzie, C. (2017). Responsible investment: Guide to ESG data providers and relevant trends. Journal of Applied Corporate Finance, 29(2), 110–117. https://doi.org/10.1111/jacf.12232

Taghizadeh-Hesary, F., & Yoshino, N. (2020). Sustainable solutions for green financing and investment in renewable energy projects. Energies, 13(4), 788. https://doi.org/10.3390/en13040788

Van Duuren, E., Plantinga, A., & Scholtens, B. (2016). ESG integration and the investment management process: Fundamental investing reinvented. Journal of business ethics, 138(3), 525-533. https://doi.org/10.1007/s10551-015-2610-8

Van Eck, N. J., & Waltman, L. (2014). CitNetExplorer: A new software tool for analyzing and visualizing citation networks. Journal of informetrics, 8(4), 802-823. https://doi.org/10.1016/j.joi.2014.07.006

Wang, Q. J., Wang, H. J., & Chang, C. P. (2022). Environmental performance, green finance and green innovation: what's the long-run relationships among variables? Energy Economics, 110, 106004. https://doi.org/10.1016/j.eneco.2022.106004

Wang, S., Shu, W., & Cui, L. (2024). Green finance policy and green economic transformation. International Review of Financial Analysis, 96, 103785. https://doi.org/10.1016/j.irfa.2024.103785

Wang, T., Liu, X., & Wang, H. (2022). Green bonds, financing constraints, and green innovation. Journal of Cleaner Production, 381, 135134. https://doi.org/10.1016/j.jclepro.2022.135134

Yang, Y., Su, X., & Yao, S. (2021). Nexus between green finance, fintech, and high-quality economic development: Empirical evidence from China. Resources Policy, 74, 102445. https://doi.org/10.1016/j.resourpol.2021.102445

Youngblood, M., & Lahti, D. (2018). A bibliometric analysis of the interdisciplinary field of cultural evolution. Palgrave Communications, 4(1). https://doi.org/10.1057/s41599-018-0175-8

Zare-Farashbandi, F., Geraei, E., & Siamaki, S. (2014). Study of co-authorship network of papers in the Journal of Research in Medical Sciences using social network analysis. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 19(1), 41. PMCID: PMC3963322

Zhang, Y., & Umair, M. (2023). Examining the interconnectedness of green finance: an analysis of dynamic spillover effects among green bonds, renewable energy, and carbon markets. Environmental Science and Pollution Research, 30(31), 77605–77621. https://doi.org/10.1007/s11356-023-27870-w

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. Organizational Research Methods, 18(3), 429–472. https://doi.org/10.1177/1094428114562629