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Article

Revealing Sustainable Insights: Power BI Enhanced Bibliometric Analysis of ESG Initiatives and Climate-Related Financial Risks

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Abstract: ***Purpose***: Climate shift is a global contingency that elevates beyond national borders. Addressing this issue requires cooperation and coordinated solutions at international level. Climate shift may threaten financial Equilibrium, if climate-related financial risks (CRFR) become systematic. The research examines largely uncharted impact of "Environmental, Social, and Governance (ESG) initiatives" on "climate-related financial risk (CRFR)". ***Method***: Using a bibliometric analysis method, we selected 67 documents that met our criteria, emphasizing research published on ESG initiatives and CRFR within the criteria of "Business Management & Accounting, and Economics, Econometrics & Finance". For this we use the combination of key words "ESG" AND "Climate related financial Risk" The bibliometric analysis revealed that approximately 50% of existing research on this topic is concentrated in these subject areas. ***Finding***: While extensive literature establishes the relation between ESG factors and financial productivity, as well as the interplay between risks and return, but specific effect of ESG on CRFR remains untested. Climate-related Financial Risks (CRFR) is an emerging research domain with limited literature before 2018. Using bibliometric analysis of Scopus data (2018–2025) and Power BI visualizations, this study identifies a sharp rise in publications, growing from 6 in 2021 to 72 in 2024, while citations show a time lag, peaking between 2021 and 2023. European nations, notably Italy and the UK, dominate both publications and citations, with high-impact journals leading the discourse. A critical research gap exists in exploring the relationship between ESG (Environmental, Social, and Governance) initiatives and CRFR, presenting significant opportunities for future interdisciplinary research. ***Practical Implication:*** Researchers are encouraged to explore how ESG initiatives can be quantified to measure climate-related risks and to investigate specific impacts of these initiatives on CRFR. By doing so, this study aims to support evolving discourse on CRFR and inform policy and regulatory responses.

Keywords— "Climate shift", "Sustainable development", "ESG initiatives", "Climate related financial risks", "Business productivity", "Power BI", "Bibliometric"

INTRODUCTION

One of the leading issues of our era is climate shift, which has the potential to influence health and fitness of nearly everyone on planate. Furthermore, economy and financial system face significant overall risk due to climate shift. At this stage, everyone knows this fact, that it is high time to move further and take some advanced steps for sustainable development.

Background

Climate change represents one of the most significant global challenges of 21st century, influencing ecological stability, societal well-being and economic system. The transition toward a low carbon economy has introduced not only environmental implications bit also financial implication s too. In this context, climate-related financial risks (CRFR) have emerged as a central concern for investors, regulators, and financial institutions. ESG was first time came into the picture in year 2006, in "United Nations Principles for Responsible Investment (UNPRI) report".

ESG is an umbrella term which covers Environmental factors, Social factors and governance factors in it.

- The environmental factor covers the fact that the business should respect the environment and try to make an effort to protect and restore the environment.
- The Social factor of ESG covers the society around us, and the people who are associated with the organization in any form.
- Finally, the governance factor covers the fact that the business should run itself with all ethical standards and maintain and maintain integrity, transparency and accountability integrity transparency to society.

Gap in Literature

While we have enough literature to support establishing the relation between the ESG impact on financial productivity as well as the relation between risk and return is well defined by literature and financial theories, but the direct effect of ESG on CRFR has not yet been tested. Despite the global emphasis on ESG and its potential to guide capital towards greener practices, very limited scholarly attention has been paid to whether, ESG-driven strategies are related to the reduction in CRFR. The absence of focused bibliometric studies examining the link between ESG and CRFR further emphasizes this research gap.

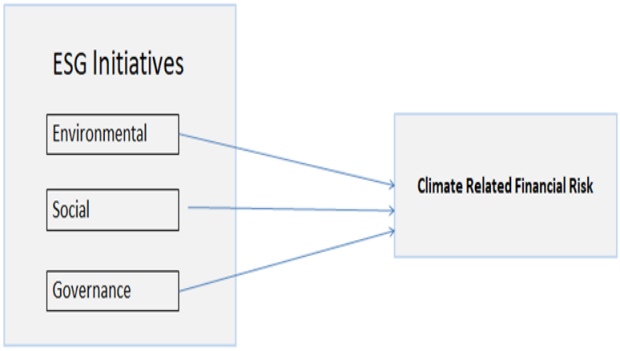
Research Question

To address the identified gap, this study guided by the following research questions.

- RQ1: What is the current landscape of research at the intersection of ESG initiatives and CRFR?
- RQ2: Which countries and authors are contributing most to this area of literature?
- RQ3: What are key areas, publication types and trends etc. in ESG-CRFR studies?

Novelty and Contribution

We have enough literature to support establishing the relation between the ESG impact on financial productivity as well as the relation between risk and return is well defined by literature and financial theories, but the effect of ESG on CRFR has not yet been tested. This study contributes to the ESG and CRFR literature by integrating bibliometric analysis with VOS Viewer along with Power bi, a visualization tools rarely used in prior bibliometric research. Unlike previous studied that generally explores ESG influence on corporate performance. This study uniquely maps the bibliometric structure; research trends and evolution of scholarly work and publication related to the ESG and CRFR. Theoretically. The study enriches the potential of ESG strategies to reduce CRFR financial risk mitigation potential, practically it provides stakeholder and regulator a data driven visual of the evolving research trends, identify knowledge gap and future research direction.



Structure of the Paper

The rest of the paper is structured as follow:

- **Section 2** presents the literature review highlighting foundational studies.
- **Section 3** outline the research methodology and data collection process.
- **Section 4** discuss the analysis using Power bi and Vos Viewer.
- **Section 5** concludes with key insights, implications and suggestion for future research.

LITERATURE REVIEW

1	Zhou, X. Y., Caldecott, B., Hoepner, A. G. F., & Wang, Y. (2022).	A systemic shift to sustainable lending demands industry-wide expertise, capacity, & management of risk. Without the necessary knowledge or proficiency in green finance, or the appropriate tools to evaluate environmental risks and possibilities, smaller regional Chinese banks may experience increased credit risk due to institutional pressure to indiscriminately expand green lending. However, green lending practices, as a form of stakeholder relationship, can enhance financial productivity when a sustainable competitive advantage is established.
2	Breitenstein, M., Nguyen, D. K., & Walther, T. (2021).	A series of studies examines the positive financial implications of Corporate Environmental Productivity (CEP). Additionally explores their negative financial outcomes on companies vulnerable to environmental risks. Even though majority of the research assessed market risk, but the blend of environment related concerns and financial risk is hardly explored. These environmental hazards ultimately lead to specific financial risks. The literature does not consistently differentiate between financial and non-financial risks. Financial risk refers to the negative impact on profitability.
3	Stolbov M.I. & Shchepeleva M.A.(2022).	Higher ESG rankings, whether overall or across the three pillars (Environmental, Social, Governance), generally improve financial system Equilibrium from both micro and macro-prudential perspectives. This is achieved by reducing the individual risks of financial organizations and their contribution to systemic risks.
4	Bell F. & Vuuren G.(2022)	The influence of climate risk drivers on corporations is observable across conventional risk categories like credit, liquidity, market, and operational risk. Transition risk, stemming from the movement to a low-carbon economy, has the potential to significantly impact financial risks due to its broad scope and coordinated implementation. Transition risks contribute to portfolio effects, influencing metrics such as value at risk (VaR).
5	Battiston S., Dafermos Y., & Monasterolo I. (2021).	Recently, Climate shift has been identified as a latest cause of risks for financial system. In the recent time, several central banks as well as financial advisor have suggested to the investors also to financial organisation to assess and evaluate their exposure to CRFR.
6	Galletta S. & Mazzù S.(2023)	The study finds that banks with lesser ESG controversies encounter reduce risk. Banks with less numbers of ESG disputes demonstrate their commitment to compliance with ESG plans, thereby reducing risk, as witnessed by lower risk-weighted assets.
7	Asni N. & Agustia D.(2022)	The study concludes that financial productivity, specifically "Return on equity (ROE)" and "Return on assets (ROA)" plays significant role in mediating the relations between green innovation (GI) and firm value (FV). This indicates that investors in the ASEAN region's are more interested in the economic incentives for companies who are implementing green innovation.

8	Lirou J.(2022)	The attention of society to enterprises is no longer limited to financial productivity but is further expanded to the aspects of ESG. The concept of responsible investment has gradually become a key factor for investors to consider when evaluating enterprises.
9	Oware K.M. & Mallikarjunappa T.(2022)	According to them there is statistically significant and positive relation between CSR expenditure and financial productivity metrics such as Tobin's Q and RO). Additionally, it shows a positive association where higher financial productivity (Tobin's Q and ROA) correlates with increased CSR spending. Moreover, this study finds that mandatory CSR reporting leads to an increase spending in CSR.
10	Rodella R. & DeGiacomo M.R.(2023)	Their study enhances understanding of how companies' efforts to address climate shift impact share price variability following the 2016 Brexit Referendum. The research indicates that financial markets reward companies that take material actions and adopt the top practices on environmental concern during ambiguous stages, compared to those companies that do not take such steps. These findings align with existing text, suggesting that industry environmental commitment serves as a stabilizing factor during challenging economic times.
11	Sabbaghi O.(2022)	Their study examines volatility risk among firms with highest ESG ratings through empirical analysis. They examined high impact of adverse news on the volatility of ESG firms as compared to positive news.
12	Iazzolino G., Bruni M.E., Veltri S., Morea D., & Baldissarro G. (2023).	Research findings indicate that ESG factors affect operational efficiency across sectors in varying ways. Some of them exhibit higher sensitivity to ESG factors compared to others. Moreover, for the most sensitive sectors, there are distinctive risk-return characteristics associated with ESG considerations.
13	Haywood L.K.(2022)	Emerging business risks are increasingly linked to sustainability issues, impacting long-term organizational productivity. This highlights that sustainability concern and risk should not be viewed as mutually exclusive.
14	Lokuwaduge C.S.D.S. & De Silva K.M.(2022)	Diverse interpretations of sustainability standards and frameworks can lead to heightened greenwashing risks, encompassing actions that overstate or misrepresent environmental credentials. ESG disclosure is seen as essential in mitigating greenwashing risks, given its growing importance in achieving sustainable and effective business productivity.
15	Nwaigwe, N. G., Ofoegbu, G. N., Dibia, N. O., & Nwaogwugwu, C. V. (2022).	According to them, Regression analysis findings indicate that there is favorable but non-significant relation between the firm's market values and sustainability disclosure. However, the quality of sustainability disclosure was found to have a negative association with market value.
16	Landi, G. C., Iandolo, F., Renzi, A., & Rey, A. (2022).	Despite ongoing debate, studies often use accounting-based measures to assess financial productivity, neglecting total risk as a proxy for market success. Orlitzky and Benjamin (2001) explore that CSP had a stronger negative impact on market risks than on accounting measures, highlighting the importance of managing both financial productivity and variability, especially in volatile markets.
18	Hoang T.(2018)	Sustainable investment encompasses a range of asset classes chosen with consideration for ESG factors. This investment plans aims to merge social and environmental benefits with financial benefits, addressing investors' social, ethical, sustainable, and economic interests. Under specific

		conditions, these indices can also attract foreign investment, encouraging international collaboration in domestic capital markets.
19	Chelawat, H., & Trivedi, I. V. (2016).	Better ESG productivity increase financial productivity. They use ROCE as well as market capitalization-based measures for the criteria of business productivity. Policymakers should necessitate sustainability reporting for all companies.
20	Arora, A., & Sharma, D. (2022).	Companies that disclose ESG practices are noted to enhance their reputation, boost investor confidence, optimize resource utilization, and maintain competitiveness. The ESG score correlates inversely with cost of debt, implying higher ESG scores are connected with lower borrowing costs, with the cost of debt serving as a risk metric. Among ESG scores, the social score demonstrates the highest significance for influencing the cost of debt.
21	Bodhanwala, S., & Bodhanwala, R. (2018).	According to their findings, there is a significant and favorable relation between a firm's profitability and sustainability. Firms are advised to align their strategies and economic objectives with environmental concerns, social causes, and governance principles. Emphasizing sustainability in policy decisions should positively impact profitability in the long run. High-rated ESG firms have notably lower leverage compared to low-rated ESG firms, suggesting that high-ranked ESG firms have better access to equity capital markets, thereby reducing their reliance on borrowed funds. Additionally, high-rated ESG firms show higher mean values in profit parameters, sales, and investment trends. Overall, there is a positive and significant relationship between a firm's profitability (measured by ROIC, ROE, ROA, and EPS) and its sustainability practices.
22	Michael T. Lee , Robyn L. Raschke (2023).	Stakeholder activism is exerting growing pressure on firms to adopt greener practices to improve both ESG (Environmental, Social, and Governance) productivity and financial outcomes. Stakeholders expect firms to demonstrate the legitimacy of their ESG actions and productivity in relation to financial productivity.
23	Wang, Y., Lin, Y., Fu, X., & Chen, S. (2023).	In the performance of China based listed companies, institutional ownership exhibits a markedly positive correlation with corporate ESG effectiveness. The researchers categorise institutional investors into 4 distinct categories on the basis of their investment horizons and business relations. Their results shows positive link between institutional ownership and ESG performance is primarily influenced by both long-term, pressure-insensitive investors and short-term, pressure-sensitive investors.
24	DeMenno, M. B. (2022).	Climate shift may threaten financial Equilibrium, “Climate-related financial risks” and a acknowledgment that such risks may be systemic. Climate stress testing has emerged as one of the most prevalent regulatory tools for addressing climate-related financial risks. Myriad governmental and intergovernmental organizations have called for the institutionalization of climate stress tests and a 2019 survey of central banks and regulators (n=33) found that 84% had already incorporated or planned to incorporate climate shift into stress tests within the next three years. emerged as one of the most prevalent regulatory tools for addressing climate-related financial risks. Myriad governmental and intergovernmental organizations have called for the institutionalization of climate stress tests and a 2019 survey of central banks and regulators (n=33) found that 84% had already incorporated or planned to incorporate climate shift into stress tests within the next three year.

25	Gosh, S., & Nath, S. (2023).	RBI Feb Bulletin, ESG disclosures are linked to improved stock returns and reduced volatility in stock prices. In the future, finance and green bonds will increasingly influence resource allocation.
26	Volz, U. (2022).	The economic and financial impacts due to climate shift have the potential to precipitate balance-of-payments or financial crises.
27	Wang, J., Hu, X., & Zhong, A. (2022).	Firms' reactions vary depending on their business operations and existing ESG productivity, which also highlights the diversity in the impact of mandatory disclosure requirements. The current ESG productivity of firms helps to mitigate the risk of negative price drift.
28	Bingler, J. A., Kraus, M., Leippold, M., & Webersinke, N. (2022).	Voluntary disclosures such as "Climate-related Financial Disclosures (TCFD)" are being praised as an effective measure for improved climate risk management.
29	Amzallag, A. (2022).	During significant climate-related financial disturbances, brown funds are expected to experience higher stress levels compared to green funds. These findings illuminate the interaction between systemic risk and climate shift in financial market. Highly diverse investment funds generally exhibit a significant and common vulnerability to climate-related financial shocks.
30	Friede, G., Busch, T., & Bassen, A. (2015).	In their research, they empirically examined approximately two thousand analysis and found that the correlation linking ESG execution and the economic productivity of companies remains scattered. However, the vast majority of these studies reported positive results between ESG investing and financial productivity. Their research collated evidence from over 2,000 studies and found that the correlation between ESG productivity and financial productivity of companies remains fragmented. Nevertheless, a significant number of the studies indicated positive outcomes between ESG investment/execution and financial productivity.
31	RBI Publication (July 2022),	As per the RBI Publication in July 2022, real estate entities (REs) are advised to assess both physical and transition risks under various climate scenarios. This includes modeling plausible scenarios, considering interconnections with other risks, and evaluating resilience to financial losses. The analysis should span different timeframes, incorporating future climate impacts and economic transitions relevant to business strategies. Given the uncertainties, forward-looking information complements historical data in scenario analysis, which also informs capital planning and adequacy assessments for REs.
32	KPMG, Impact of ESG Discloser (2019).	Corporate mow need to act on as ESG risks assessment and opportunities for their businesses as well as on proper ESG disclosures, to be prepared for these shifting demands. Direct as well as indirect urge on corporations and other enterprises to make more comprehensive ESG-related disclosures are escalating. Increased transparency is resulting in detail examination of companies' business and operational models, carbon footprints, and their vulnerability to climate shift.

RESEARCH METHODOLOGY AND DATA COLLECTION

The bibliometric analysis entails updating already existing bibliographical sources concerning the topic under study. It is a method that includes reading, and evaluating documents and bibliographic resources, to choose and gather information. Bibliometric analysis entails updating already-existing bibliographical sources in relation to the topic under study. It is a method that includes reading, evaluating documents and bibliographic resources, to choose and gather information.

The Bibliometric analysis executed in this learning is crucial in providing a advanced outlook to understand the literature development from conceptual uncertainty to theory evaluation and to clarify the important constructs and their connections (De Bakker et al., 2005). Furthermore, the development of the literature considers the number of alliances among scholars who create the research community to create and share information (Koseoglu, 2016)

Sample Criteria

Table1: Sample Criteria

Objective and Rational	This work analyses the distribution of ESG productivity studies for Climate related financial risk. The paper aims to investigate whether different sectors are seeing ESG from the eyes of CRFR.
Study design	This study employs bibliometric analysis to synthesize existing support from the literature through systematic steps. We have incorporated articles, book chapters, conference proceedings, and other relevant sources into our framework, which we sourced from electronic databases such as Scopus
Publication time frame	All years
Language	**All**

Using the criteria and following a systematic keyword filtration process, we assess the gap in the existing literature, as illustrated in Table 2 below.

Table 2: Analytical overview of Keywords as per June 2025

Key Words with in Subject Area "Business Management & Accounting", "Economics", "Econometrics & Finance"	**All field**	**Title, abstract, keywords**
	Total Result	**Total Result**
"ESG"	24344	7736
"Climate related Risk"	864	233
"Climate related financial Risk"	432	64
"ESG" AND "Climate related financial Risk"	195	2
"ESG" AND "Business Productivity"	12	0
"ESG" AND "Business Productivity" AND "Risk"	8	0
"Climate related financial Risk" AND "Business Productivity"	1	0

(Source: Developed by authors on the basis of Scopus Database)

Sample Design and rational

Based on the above table we selected 195 document results ALL ("Climate related financial Risk" AND "ESG") AND (LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "BUSI"))

In order to conduct a focused and meaningful bibliometric analysis, a total of 195 documents were selected using the combined search query "ESG" AND "Climate related financial Risk" within the subject domains of Business Management & Accounting, Economics, and Econometrics & Finance. This selection is based on several key considerations:

Firstly, the chosen query directly aligns with the core objective of the study, which seeks to explore the intersection between Environmental, Social, and Governance (ESG) practices and climate-related financial risks. While the keyword "ESG" alone retrieved 24,344 documents and "Climate related financial Risk" yielded 432 documents, the combination of both terms resulted in a refined list of 195 documents. This ensures relevance, thematic precision, and removes unrelated or overly broad literature.

Secondly, the relatively lower number of results (195) signifies the emerging nature and limited integration of these two critical topics in the current literature, which underscores the novelty and importance of this investigation. Notably, only 2 of these documents included both keywords explicitly in their titles, abstracts, or keyword sections, further highlighting a literature gap that this study aims to address.

DATA ANALYSIS

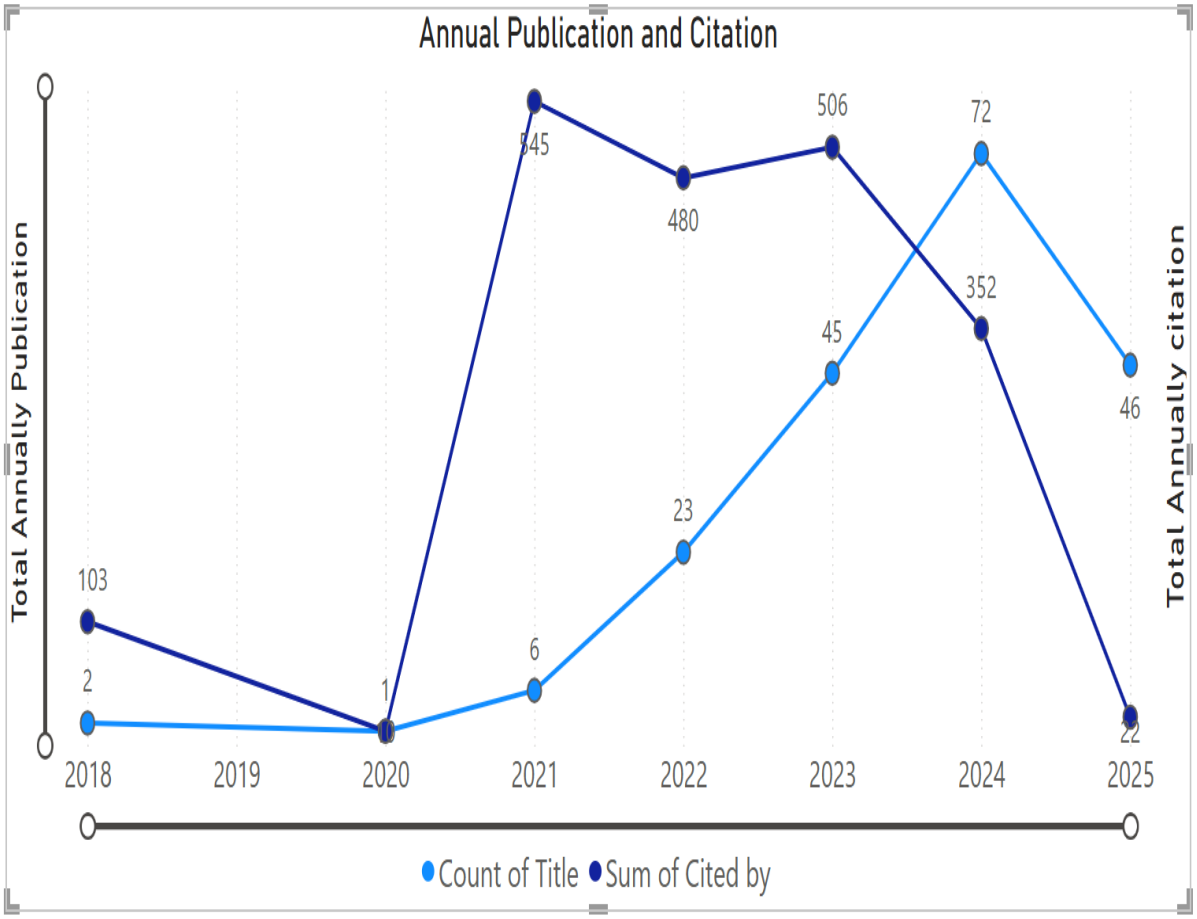
The bibliometric analysis was conducted using a combination of Power BI and VOS viewer to provide

comprehensive insights into the selected dataset. Power BI was utilized to generate key performance visuals such as Annual Scientific Production, Top Authors by Publications, and Top Keywords, offering a clear view of research trends, prolific contributors, and dominant themes. The Trend of Keywords Over Time further revealed the evolution of thematic focus across years, while the Collaboration Map by Country highlighted the global distribution and international partnerships in the research domain. Complementing these, VOSviewer was employed to construct sophisticated network diagrams including Keyword Co-occurrence, Co-authorship, and Co-citation Networks. These maps enabled the identification of thematic clusters, collaboration patterns among authors, and the intellectual structure of the field through frequently co-cited authors. Together, these visualizations offer a holistic understanding of the bibliographic landscape and research dynamics.

Key Visualizations Used in Bibliometric Analysis

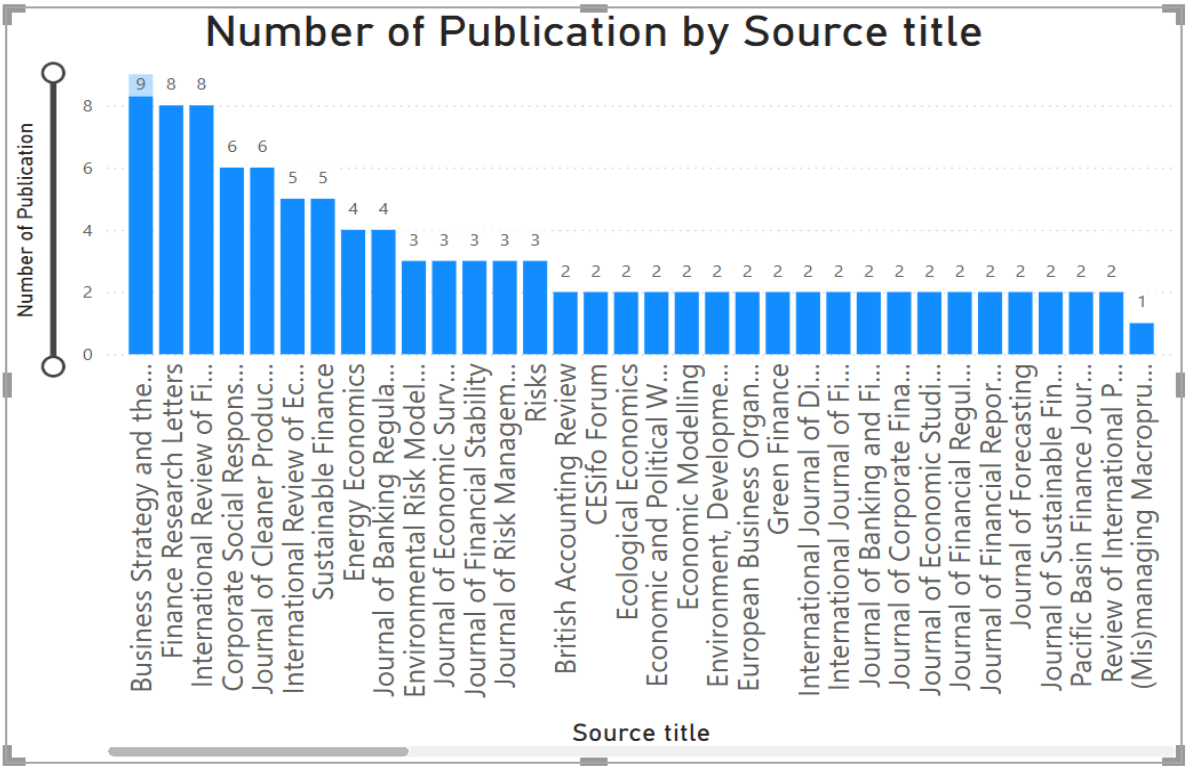
Fig. No.	Visualization Title	Type of Chart / Map	Purpose	Tool Used
4.1	Annual Trend of Publication & Citation	Line Chart	Show publication & Citation trends over time	Power BI
4.2	Research output by source title	Cluster Column Chart	Highlight Key journals for publications	Power BI
4.3.1	Co-authorship Network (Author Level)	Author Collaboration Network Map	Display collaboration patterns among authors	VOS viewer
4.3.2	**Co-authorship** Network (Countries Level)			VOS viewer
4.4	**Keyword Co-occurrence Network**	Clustered Network Map	Visualize thematic keyword relationships	VOS viewer
4.5	Bibliography Coupling	Co-citation Network Map	Identify key influential authors based on co-citations	VOS viewer
4.6	Global Footprint of Scholarly Research	Combo Chart (Column & Line)	Track evolution of research focus and emerging themes	Power BI
4.6.1	Collaboration Map by Country	Geographic Map (Choropleth / Bubble Map)	Show international collaborations in research	Power BI
4.6.2	Collaboration Map by Country	Geographic Map (Choropleth / Bubble Map)	Show international collaborations in research	Power BI

4.1. Annual Trend of Publication & Citation



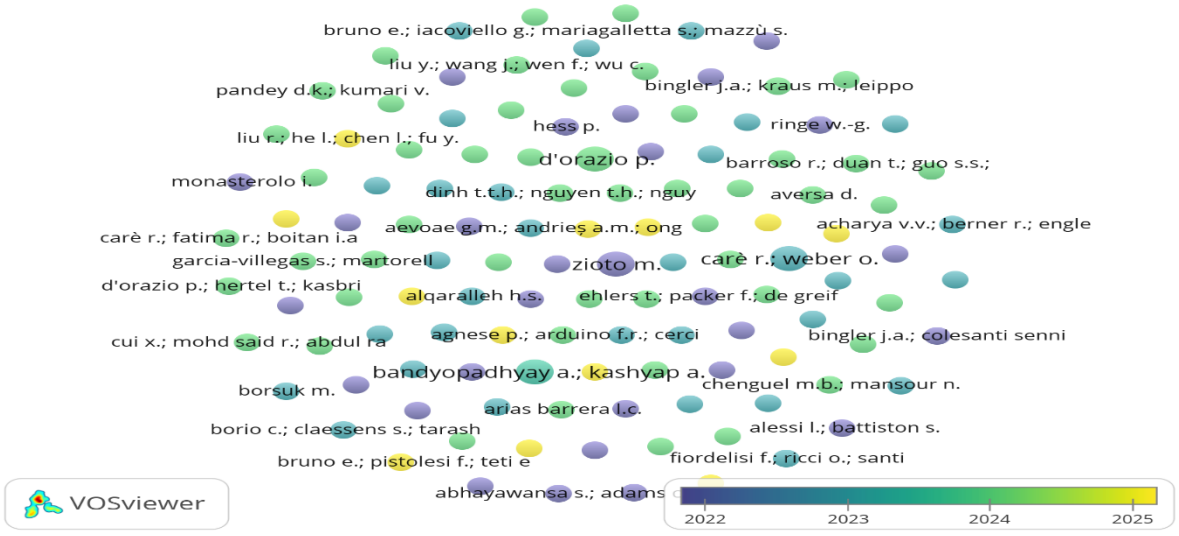
The chart titled **"Annual Publication and Citation"** is based on research data collected from the Scopus database (all years), which is available from 2018 onwards. It highlights the trends in publications and citations over the years 2018–2025. The number of publications was very low in the initial years, with only 2 titles in 2018, none in 2019, and 1 in 2020. From 2021 onward, there is a significant rise, reaching a peak of 72 publications in 2024 before slightly declining to 46 in 2025. Citations, on the other hand, show a contrasting pattern, starting at 103 in 2018 but dropping to zero in 2020. A remarkable surge is observed in 2021 with 845 citations, followed by 480 in 2022, 506 in 2023, and then a sharp decline to 352 in 2024 and 22 in 2025 (till June). This indicates that while publication volume increased after 2020, newer research outputs have not yet gathered substantial citations, resulting in a time lag. The spike in citations between 2021 and 2023 may reflect the influence of impactful studies published in earlier years.

Research output by source title



The chart **"Number of Publication by Source Title"**, prepared using the criterion of a minimum of 2 publications per source, shows that research output is concentrated in a few leading journals while also spanning a variety of sources. *Strategy and the ...* tops the list with 9 publications, followed by *Science Research Letters* and *International Review of Finance* with 8 each. Other significant journals, including *Corporate Social Responsibility* and *Journal of Cleaner Production*, have 6 publications, while many sources contribute 2–3. This distribution highlights the dominance of certain journals in the field while also reflecting the multidisciplinary nature of research across areas such as sustainability, economics, risk management, and corporate finance. This chart is helpful as it provides a clear overview of the distribution of research publications across different journals, allowing the identification of key sources that dominate the field. By highlighting the journals with the highest number of publications, it helps researchers and institutions understand where significant contributions are being made and which platforms are most relevant for disseminating their work.

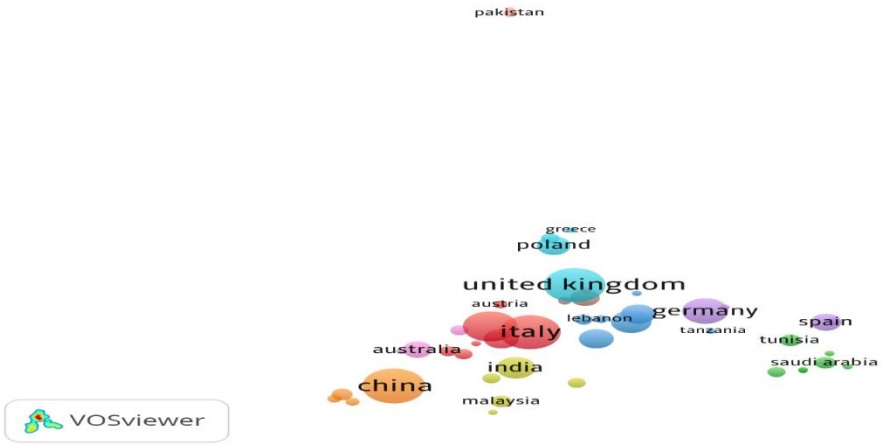
Co-authorship Analysis by Authors



The VOSviewer visualization illustrates the co-authorship network of researchers from 2022 to 2025, highlighting both established and emerging contributors in the field. Larger nodes, such as those representing **d'orazio p., zioto**

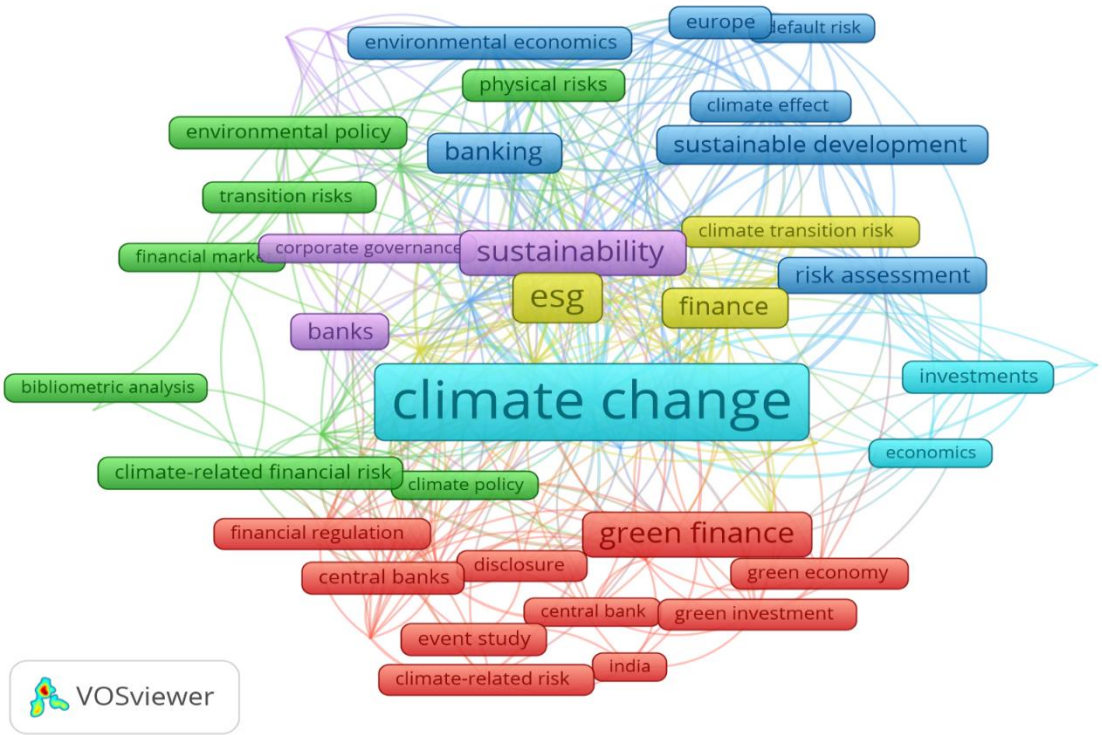
m., bandyopadhyay a., kashyap a., and **carè r.,** indicate authors with significant research output or influence. The color gradient from blue to yellow reflects the timeline of activity, with blue and green nodes representing authors active mainly during 2022–2023, while yellow nodes denote more recent contributions in 2024–2025. The clustering of nodes suggests strong collaborative groups or research teams, while the spread of authors indicates the global and multidisciplinary nature of the research domain. This network not only identifies key authors but also provides insights into evolving research trends and emerging collaborations.

Co-authorship Analysis by Countries



The visualization highlights that research output is dominated by countries such as the **United Kingdom, Italy, Germany, China, and India**, which form the core of global collaborations in the field. European nations lead the network, while Asian countries, particularly China and India, are also emerging as significant contributors. Smaller but notable contributions are seen from countries like Saudi Arabia, Malaysia, and Tunisia, reflecting a growing global interest. The clustering of countries indicates strong inter-country collaborations, whereas isolated nodes like Pakistan suggest limited collaborative research activity with other nations.

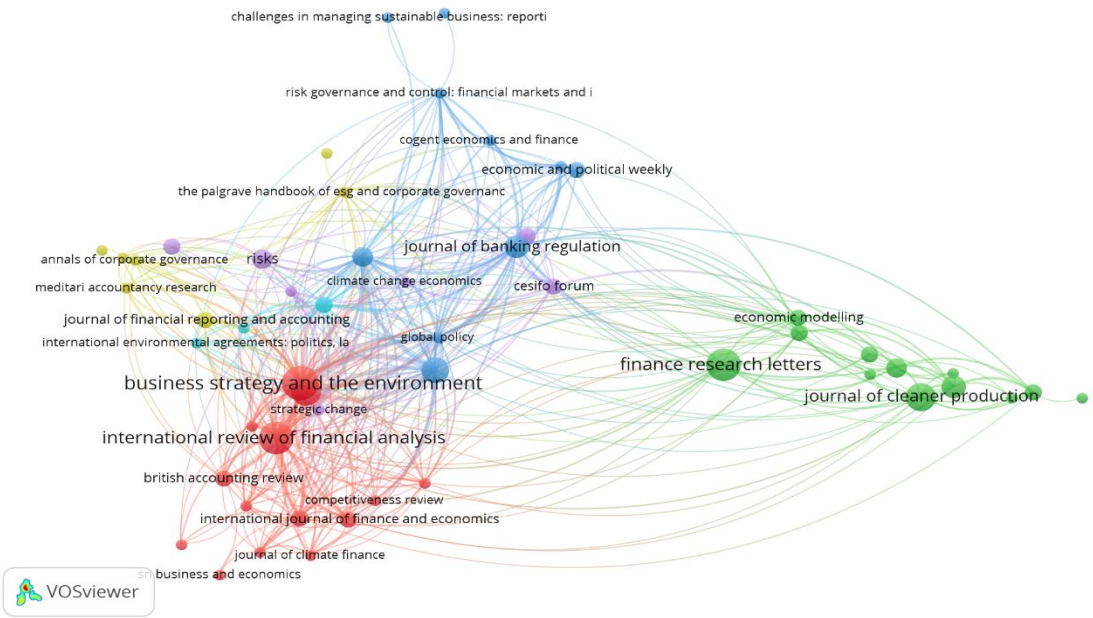
Co-occurance Analysis by all Key words



Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Central bank	bibliometric analysis	banking	China	banks	climate change
central banks	climate policy	climate effect	climate disclosure	corporate governance	economics
climate-related risk	climate-related financial risk	corporate social responsibility	climate policy uncertainty	emission control	environmental performance
decentralized finance	credit risk	default risk	climate risk	greenhouse gas	investments
disclosure	environmental policy	environment	climate transition risk	sustainability	performance
event study	financial market	environmental	climate-related financial risk		
financial regulation	green bonds	environmental economics	esg		
green economy	physical risks	environmental risk	finance		
green finance	sustainable development	europe	financial risks		
green investment	sustainable finance	risk assessment	financial stability		
india	transition risk	risk management	systemic risk		
macroprudential policy	transition risks	sustainable development			
monetary policy					

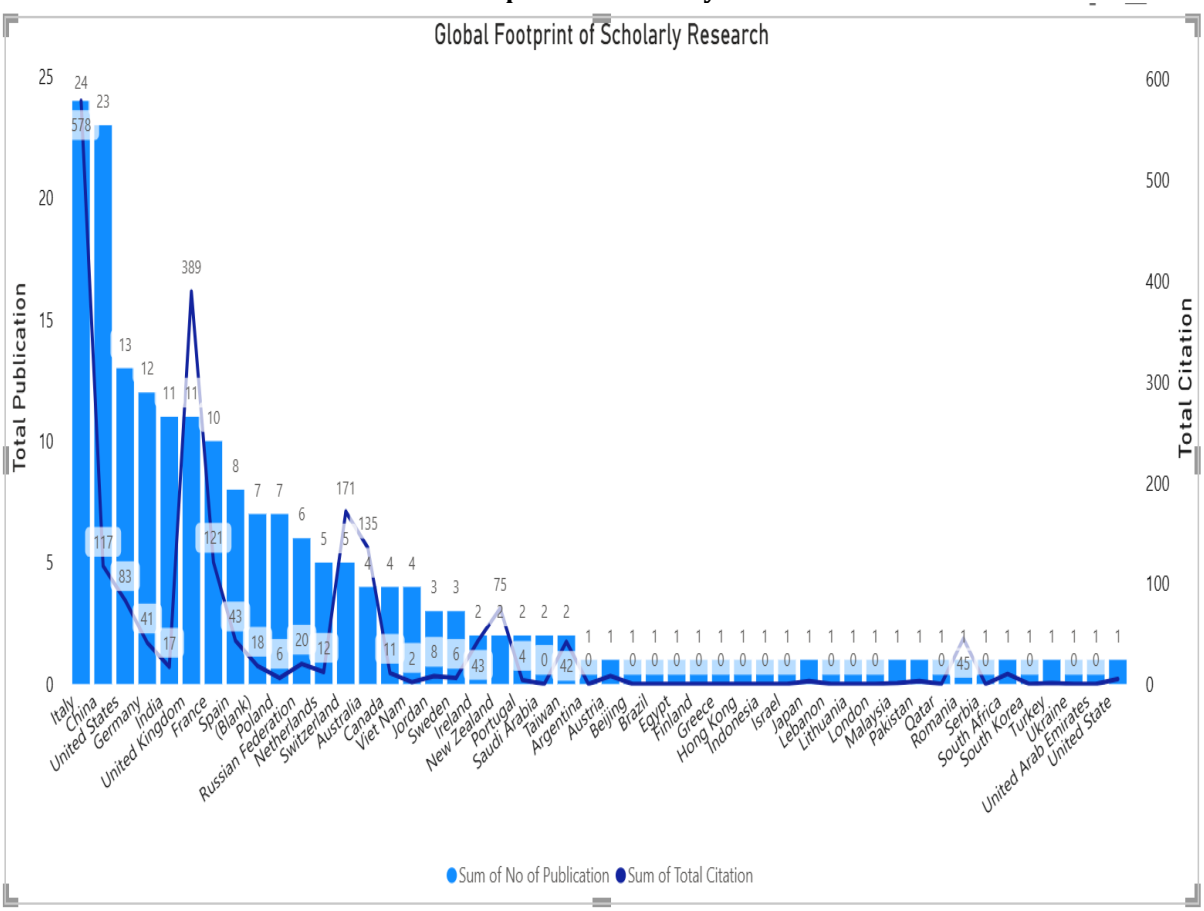
The visualization generated through VOSviewer presents a co-occurrence network of **58 keywords**, extracted based on a minimum occurrence threshold of **3**, from a total of **809 keywords**. The map identifies **six distinct clusters**, each represented by a unique color. These clusters group terms based on their thematic proximity and frequency of joint appearances in the literature. The co-occurrence analysis provides a clear visualization of the **interdisciplinary nature** of research on climate change and finance. It reflects growing academic interest in topics like green finance, ESG frameworks, financial risk assessment, and sustainable development. The structure and density of the network also highlight key **emerging themes** and **research gaps**.

Bibliographic coupling



The bibliographic coupling analysis, based on 54 sources and 120 documents, revealed several interconnected journal clusters. Prominent among these are *Business Strategy and the Environment* and *Journal of Cleaner Production*, which serve as key sources in sustainability and environmental finance. The red cluster emphasizes corporate strategy and financial analysis, while the green cluster focuses on environmental economics and sustainable production. A third cluster, in blue, includes journals on financial regulation and governance. The connections between these clusters reflect a growing interdisciplinary focus, where environmental sustainability, corporate governance, and financial performance are increasingly studied together—particularly under the lens of ESG and climate finance.

Global Footprint of Scholarly Research

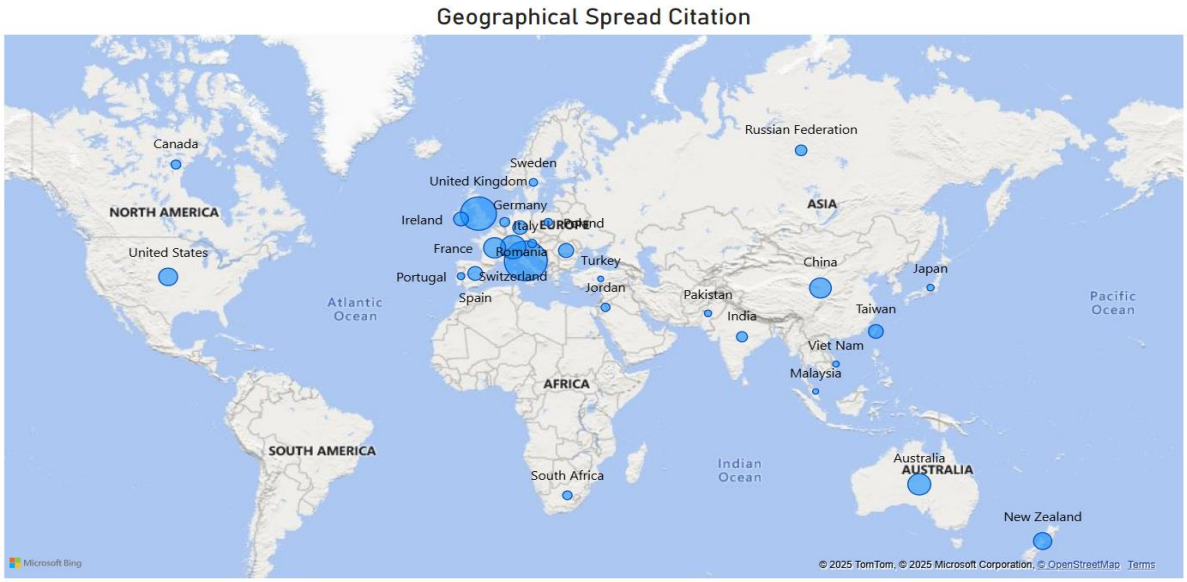


The analysis of the geographical distribution of publications and citations highlights notable disparities in research output and academic impact across countries. Italy leads with 25 publications and 578 citations, showcasing both high productivity and exceptional influence. The exceptionally high citation count for Italy may be attributed to collaborative research networks, publication in high-impact journals, and research topics of global relevance. China (24 publications, 117 citations) and the United States (23 publications, 83 citations) follow closely, while Germany (13 publications, 41 citations) and India (11 publications, 17 citations) emerge as significant contributors.

Interestingly, countries like Australia (6 publications, 171 citations) and Netherlands (7 publications, 135 citations) exhibit remarkable citation-to-publication ratios, reflecting the high quality and international relevance of their research outputs. Even with limited publications, South Africa (1 publication, 45 citations) and New Zealand (2 publications, 43 citations) demonstrate substantial academic impact.

India ranks among the top contributors, but its comparatively lower citation count highlights the need to focus on publishing in high-impact journals, engaging in international collaborations, and addressing globally relevant topics to enhance research visibility. European countries dominate both publication volume and influence, suggesting a concentration of scholarly excellence. Overall, the data underscores that research quality and global collaboration drive citation impact more effectively than sheer publication volume.

The map shows that research publications are concentrated in **Europe (Italy, Germany, Spain, and the UK)**, followed by **China, the United States, and India**. Australia and New Zealand also make notable contributions despite their geographical distance.



Citations are predominantly clustered in **European countries such as Italy, Netherlands, and the UK**, with **Australia and the United States** showing strong influence. This suggests that **European and Australian research outputs are highly impactful and widely referenced.**

CONCLUSION & SCOPE OF FUTURE RESEARCH

Climate-related Financial Risks (CRFR) is an emerging field that requires deeper and more extensive exploration. To understand the research landscape, a bibliometric analysis was conducted using data collected from the Scopus database, covering publications from 2018 onwards, as no significant literature existed before that period. The findings confirm that this field is still in its nascent stage and offers vast potential for exploration across multiple dimensions of sustainability and finance.

The analysis of publication and citation trends, conducted using Power BI, reveals a notable growth in interest after 2021. While there were only **6 publications in 2021**, the number rose sharply to **22 in 2022**, peaking further in 2024 with **72 publications**, indicating that researchers are increasingly recognizing the importance of CRFR. However, citation trends show a natural time lag, with impactful studies from earlier years driving citation surges between 2021 and 2023.

The study also highlights that existing literature is largely dominated by general articles, with **a critical gap in research exploring the intersection of ESG (Environmental, Social, and Governance) initiatives and climate-related financial risks.**

This gap presents significant opportunities for future studies to examine how ESG practices can mitigate or quantify risks associated with climate change and financial systems.

Geographical and source analysis underscores the dominance of European nations—particularly Italy, the UK, and Germany—alongside growing contributions from China and India. High-impact journals such as *Business Strategy and the Environment* and *Journal of Cleaner Production* emerge as key platforms for research dissemination. Countries like Italy and Australia stand out due to their exceptionally high citation counts, which can be attributed to international collaborations, publication in leading journals, and globally relevant research topics.

The keyword co-occurrence and bibliographic coupling analyses further reveal that the field is inherently interdisciplinary, intersecting themes like green finance, sustainable development, ESG frameworks, and financial risk assessment. However, the presence of emerging clusters suggests that significant thematic areas remain underexplored, offering avenues for innovative research.

In conclusion, this study emphasizes that while CRFR research is gaining momentum, there is an urgent need to focus on **the integration of ESG initiatives and climate-financial risk assessment.** Strengthening global collaboration, publishing in high-impact outlets, and addressing critical gaps will be essential for advancing this field and contributing to sustainable financial strategies in the face of climate change.

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