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MAPPING THE LANDSCAPE OF SUSTAINABLE FINANCE: A SYSTEMATIC AND BIBLIOMETRIC REVIEW

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Abstract
The concept of sustainable finance has gained massive importance at both the academic and practitioner levels. The increasing regulatory requirements to implement sustainable finance within the financial framework are becoming more stringent. This study aims to assess the evolution of sustainable finance as a field of interest over the period ranging from 2010 to 2024. For this purpose, a systematic review and bibliometric analysis have been performed following the SPAR-4-SLR protocol, in which 867 articles were selected from the Scopus database and systematically reviewed through performance analysis and science mapping employing R package and the VOSviewer. The findings resulted in four major themes in sustainable finance, primarily focused on sustainable development, sustainable finance, climate change, environmental policy, and green finance.
Keywords: Sustainable Finance, SPAR-4-SLR, Bibliometric Analysis, VOSviewer, R-package, Science Mapping, Performance Analysis, Scopus.

1. INTRODUCTION

The world's population is expected to surge to 9.9 billion in the next 30 years, which will place excessive pressure on urbanization, 3/4 of the world's population will be residing in cities by 2050, resulting in resource scarcity (Pearson, Newton & Roberts, 2014). One of the greatest hurdles to creating and maintaining long-term economic and societal stability is the lack of financial capital, which is crucial for achieving a sustainable future (Lin, 2023). The conception of sustainable development gained worldwide recognition at the 1972 United Nations Conference on Human Environment (García et al., 2024; Larosa et al., 2025). The Brundtland Commission's support for SD led to its incorporation as a key component of the global development agenda at the 1992 Rio Earth Summit (Long, Censoro & Rietig, 2023).

In the given context, the involvement of the financial sector cannot be ignored, the financial markets play an important role in terms of capital formation (Cunha, Meira, & Orsato, 2021). There is a necessity for sustainable ventures financed by green bonds, green banking, impact bonds, and socially responsible investment that can benefit all the stakeholders (Singhania, Chadha & Prasad, 2024). For the stated objectives, sustainable finance is regarded as an efficacious mechanism that is capable of strategically directing the flow of capital towards the articulated objectives. It can be characterized as a process that incorporates environmental, social, and governance considerations in the decision-making process regarding investments. It is pivotal in advancing sustainable initiatives (Setyowati, 2023). Consequently, the evolution from a burgeoning economy to a sustainable economy demands that a nation's governance provides sustainable financing, and the heightened acknowledgment of sustainable finance is intricately linked to the global consciousness surrounding the comprehensive sustainability agenda, with particular emphasis on climate-related and social dimensions (Ryszawska, 2018).

To ensure sustainable development, countries across the globe have allocated resources towards green initiatives to foster, innovate, and implement eco-friendly technologies aimed at protecting the environment and enhancing ecological performance. Investments with a sustainable trait have surged spectacularly in the international financial markets even though in the presence of market volatility during COVID-19 (UNCTAD, 2021). In the United States, net inflows to sustainable funds augmented considerably, striking a record-breaking $69.2 billion in 2021, $51.1 billion in 2020, and a projected $21.4 billion in 2019 (Hale, 2021). Remarkably,

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earlier studies have examined several aspects, with an emphasis on "financing" standpoints such as recycled materials, green bonds, climate finance, circular economy, and environmental finance (La Torre, 2024).

The degree to which sustainable finance products adhere environmental, social and governance factors varies substantially moreover, the lack of agreement suggests that defining sustainable financing is a difficult undertaking as of right now, financial institutions and international organizations have demonstrated a propensity to define terms according to their underlying purposes, leading to the development of diverse terminologies (Zairis, Liargovas & Apostolopoulos, 2024). Keeping in view the diversified nature of sustainable finance and its significance to achieve sustainable development different studies have been performed but conflicting evidence across studies often leaves ambiguity in findings, making it challenging to determine the actual impact or effectiveness of interventions or phenomena since the nature of sustainable finance is heterogeneous (CunhaThe degree to which sustainable finance products adhere to environmental, social, and governance factors varies substantially. Moreover, the lack of agreement suggests that defining sustainable financing is a difficult undertaking. As of right now, financial institutions and international organizations have demonstrated a propensity to define terms according to their underlying purposes, leading to the development of diverse terminologies (Zairis, Liargovas & Apostolopoulos, 2024). Keeping in view the diversified nature of sustainable finance and its significance in achieving sustainable development, different studies have been performed. However, conflicting evidence across studies often leaves ambiguity in findings, making it challenging to determine the actual impact or effectiveness of interventions or phenomena since the nature of sustainable finance is heterogeneous (Cunha et al., 2021).

This study has employed a systematic review along with bibliometric analysis to provide a wide-ranging and comprehensive permissive into the evolution of sustainable finance over the years. A systematic review offers an objective and evident method for synthesizing, examining, and evaluating the findings of various research studies on the given subject by using systematic scientific protocols (Pollock & Berge, 2018). Additionally, bibliometric analysis includes various quantitative techniques to evaluate, examine, and measure the spectrum of academic studies conducted over the years about the specific phenomena (Paul et al., 2021).

Sustainable finance is a swiftly evolving field that needs integration to gain more insights that can benefit all the potential stakeholders; different financing tools such as green bonds, impact funds, socially responsible investment, and climate financing are continually developing (Ziolo, Bak & Cheba, 2021). However, there is often a lack of consolidated knowledge about their effectiveness, risks, and best practices. Methodological limitations in sustainable finance research also hinder progress. Many studies lack rigorous controls, use small or region-specific samples, or do not account for varying economic cycles, reducing the reliability of findings. In the realm of sustainable finance, performing a systematic review is vital for addressing pertinent research deficiencies that hinder the inclusion of sustainability into the financial charter. There is a dearth of precision concerning the financial performance of sustainable funds over conventional ones, since certain studies concluded that sustainable funds can outperform conventional ones because of long-term value orientation and effective risk management, whereas some of the studies attributed this to limiting investment choices for the investors. A systematic review can explicate these inconsistencies, thus assisting investors and policymakers in making productive decisions regarding the financial viability of sustainable finance. By integrating the most current evidence, a systematic review can provide a more comprehensible understanding of the impact of sustainable finance products on people, planet, and profit.

There are diversified groups of stakeholders within the domain of sustainable finance such as retail investors, institutional investors, governmental and other regulatory bodies which have different targets and operate in varied contexts prior researches have been limited in terms of their scope focusing on specific group of interest thus limit the generalizability of research findings thus by assessing subgroups in the form of different themes a systematic review can provide the clarity about how different contextual facets may impact the implementation of sustainable finance mechanism. Furthermore, this field is witnessing swift changes either in the context of the emergence of new financial products or increasing regulatory pressure that may limit the utility of previous research. Therefore, by reassessing prior research in light of these deviations, a systematic review can assure that significance where the sustainable finance framework remains pertinent, empowering a transition toward more robust and environmentally responsible financial practices. Each of these gaps highlights the vigorous contribution of a systematic review and bibliometric analysis in developing a more articulated, meticulous, and executable body of knowledge.

This study presents a comprehensive and integrated literature review that is not confined to an explicit facet of sustainable financing. The combination of big data and artificial intelligence enhances the objectivity of the results through bibliometric analysis. To collect a substantial amount of bibliometric data, an initial bibliometric search was conducted on a scientific database using targeted keywords. Subsequently, the primary variables and their potential relationships were identified utilizing artificial intelligence in the form of several clusters (Hallinger & Kovačević, 2019). The research questions stated are designed to address the gaps revealed in the current literature:

RQ1. What is the pattern of sustainable finance research publications from 2010 to 2024?

RQ2. Which research journals have contributed the most to the sphere of sustainable finance?
RQ3. Which are the distinguished nations contributing to the research on sustainable finance?
RQ4. Which authors are most frequently mentioned concerning sustainable finance?
RQ5. What are the dominant research themes that have been investigated concerning sustainable finance?

2. METHODOLOGY

To conduct systematic reviews, a defined protocol function is vital because it reflects meticulous planning, consistency in implementation, and transparency that permits generalizability. However, there are few protocols available for the stated purpose, although the most commonly used protocol for systematic review has been PRISMA. There is a need to adopt a more scientific approach since the PRISMA protocol needs stronger evaluation criteria to resolve this limitation. Paul et al. (2021) introduced the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol. This study executes 'The Scientific Procedures and Rationales for Systematic Literature) Reviews (SPAR-4-SLR) process to conduct a systematic literature review. Figure 2.1 illustrates the framework of (SPAR-4-SLR), which comprises three main and six sub-stages. The three essential stages of SPAR-4-SLR are: assembling, which aims to identify the available literature about the field of interest; arranging, which involves organization and percolation of the literature; then lastly assessing, in which the researcher evaluates, synthesizes, and reports the findings through using an inquiring approach. SPAR-4-SLR provides an extensive inclusion and exclusion criterion, rigorous methodology, and transparency in terms of reporting.

2.1. Assembling

This stage involves acquiring relevant literature from recognized databases. According to Aria and Cuccurullo (2017), the two most commonly used databases for this purpose are Web of Science and Scopus. While Scopus covers more ground than Web of Science, it is considered a good fit. Additionally, competitive evaluation techniques, including journal ratings, metric analysis, and visualization tools, are utilized. Scopus indexes over 69 million records from more than 25,000 publications, including books, conference proceedings, and peer-reviewed journals (Hosseiniara, 2023; Asubiaro, 2023). The expert panel's recommendations and the relevant literature that was accessible were taken into consideration while choosing the keywords. For the specified aim, the Scopus database was employed using the following advanced search string:
'Sustainable Finance' OR 'Green Finance' OR 'Climate Finance' OR 'Carbon Finance' OR 'Environmental Finance' OR 'Impact Finance' OR 'Socially Responsible Finance' OR 'ESG Finance' OR 'Sustainable Investing' OR 'Impact Investing' OR 'Green Bonds'

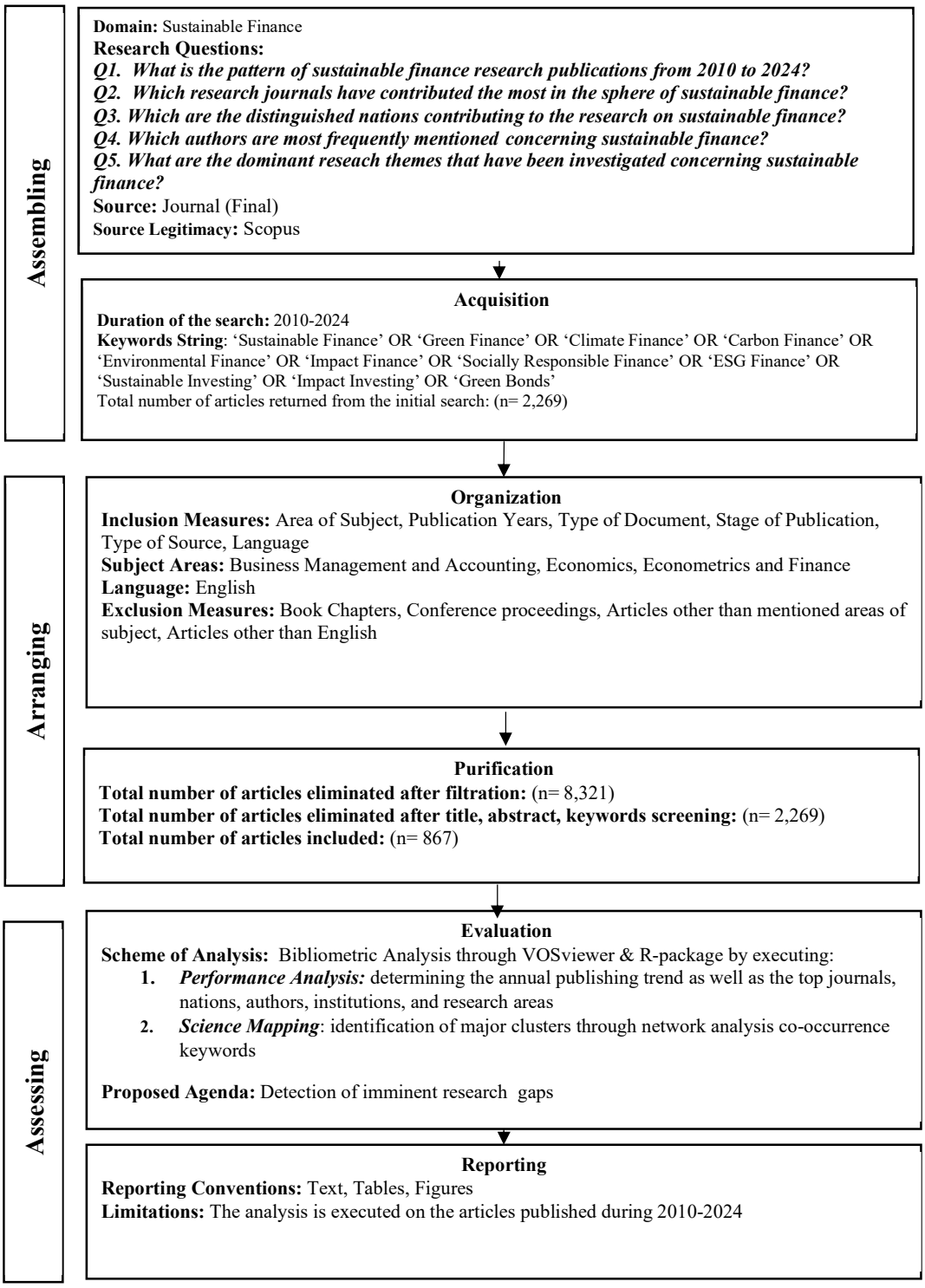
2.2. Arranging

The second stage involves the organization and filtration of literature obtained through the assembling stage, where an exclusion and inclusion criterion will be implemented. For this study, the inclusion criteria included the number of years for publication, document type, subject areas, publication stage, source type, and language version. The articles were selected for the period 2010-2024. Articles that were published in the English language were finalized. Non-journal material, such as book chapters, published books, conference proceedings, and articles other than in the English language, was excluded. The initial search resulted in a sample of 2,269 articles after applying the mentioned criterion; a total of 867 articles were selected for the evaluation and synthesis purposes.

2.3. Assessing

To assess and synthesize the sample of 867 articles systematic review and bibliometric analysis were performed. To conduct a bibliometric analysis, the study has used VOSviewer and R-package software, both are acknowledged as powerful tools for bibliometric analysis. Performance analysis and scientific mapping are commonly used approaches for the visualization of bibliometric data. Both methodologies are directed towards the analysis and comprehension of the frameworks, patterns, and interconnections inherent in available literature. Performance analysis aims at determining the output and impact of research entities such as authors, institutions, nations, or journals. This often incorporates the assessment of metrics, including publication frequencies, number of citations, etc. (Paul et al., 2021). In contrast, scientific mapping involves the examination of the interrelations, frameworks, and evolution of research domains. It augments in explicating the relationships between various concepts, authors, institutions, countries, publication sources, and can describe the intellectual framework of a discipline (Noyons, 2001).

Figure 2.1 Systematic Literature Review (SPAR-4-SLR) Protocol



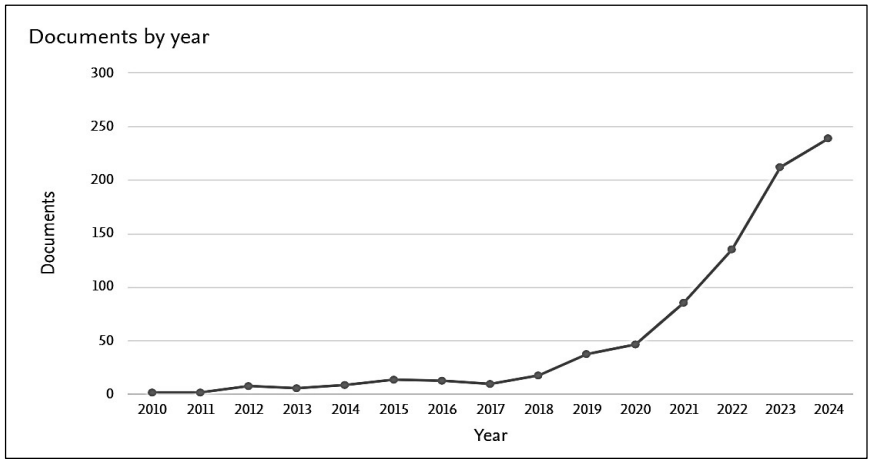
3. PERFORMANCE ANALYSIS

In bibliometric analysis, performance analysis refers to the systematic evaluation of literature and trends within the specific field of interest through employing different quantitative metrics, it helps to identify significant publications, prominent authors and research areas thus providing insights about the evolvement of field of interest over the period (Melega et al., 2022). Performance analysis technique helps to integrate various evaluation metrics that can provide insights about the effectiveness, trends, impact, and notable contributors in the specific field of interest. For this purpose, two commonly used software programs are VOSViewer and R-studio that help to visualize the data (Hanifa et al., 2023).

3.1. Publication Trend During 2010-2024

Figure 3.1 depicts the publication pattern for the years 2010-2024. It can be seen that over the years, there has been a surge in research publications, which highlights its academic importance. The financial markets witnessed tremendous growth, reaching the value of more than $500 billion. The efforts continue and resulted in mainstream adaptation of ESG metrics, notable initiatives such as Sustainability Accounting Standards Board, Sustainability Standard Board, Principles for Socially Responsible Investment further augmented the importance of ESG adaptation and timely disclosure moreover, United Nations Sustainable Development Goals Agenda 2030, European Union Sustainable Finance Action Plan further increased the need of academic research to understand the implications and limitations of the mentioned framework.

Figure 3.1: Publication Trend Over the Years 2010-2024 (Source: Scopus)



3.2. Notable Countries Production During 2010-2024

Table 3.1 depicts the information of the most cited nations for the research publication in sustainable finance during 2010-2024. China ranks at the top, both with total citations of 3,010, followed by New Zealand (1,669) and the USA (1,374). However, in terms of research publications, China has the highest number (i.e., 465 followed by the USA (252) and the UK (220). At present, China has made substantial advancements in the growth of green finance. China ranked first globally in terms of stock size at the end of 2021, with a green loan balance of 15.9 trillion yuan, that shows an increase of 33% year over year, it's carbon peaking and carbon noninvolvement targets are prominently aided by green credit funds, which are invested in carbon emission reduction initiatives. The growth of sustainable finance in the USA witnessed the revenue of USD 136.2 billion in 2023, which is predicted to reach USD 618.0 billion by 2030 (Grand View Research, 2023). Green Finance Strategy," market signals, long-term policy frameworks, and the judicious distribution of public funds may all successfully encourage private sector investment. In the ensuing period, the UK government has undertaken significant initiatives to fulfill this objective (Mobilising green investment, 2023). In the context of New Zealand, the government announced a significant climate financing amounting to NZ$1.3 billion for 2022–2025 to increase resilience and adaptation to the effects of climate change and encourage lower carbon emissions (Ministry of Foreign Affairs and Trade, 2023). Figures 3.2 and 3.3 show the countries' production and top-cited countries for sustainable finance research during 2010-2024.

Table 3.1: Most Cited Countries in the Realm of Sustainable Finance During 2010-2024

Country	TC	Average Article Citations
China	3010	21.30
New Zealand	1669	556.30
Usa	1374	25.40
United Kingdom	1277	23.20
Australia	1116	36.00
Italy	1073	20.20
Germany	974	21.20
Spain	616	20.50
Netherlands	544	41.80
India	316	7.30

Figure 3.2: Top Countries for Sustainable Finance Research Publications During 2010-2024

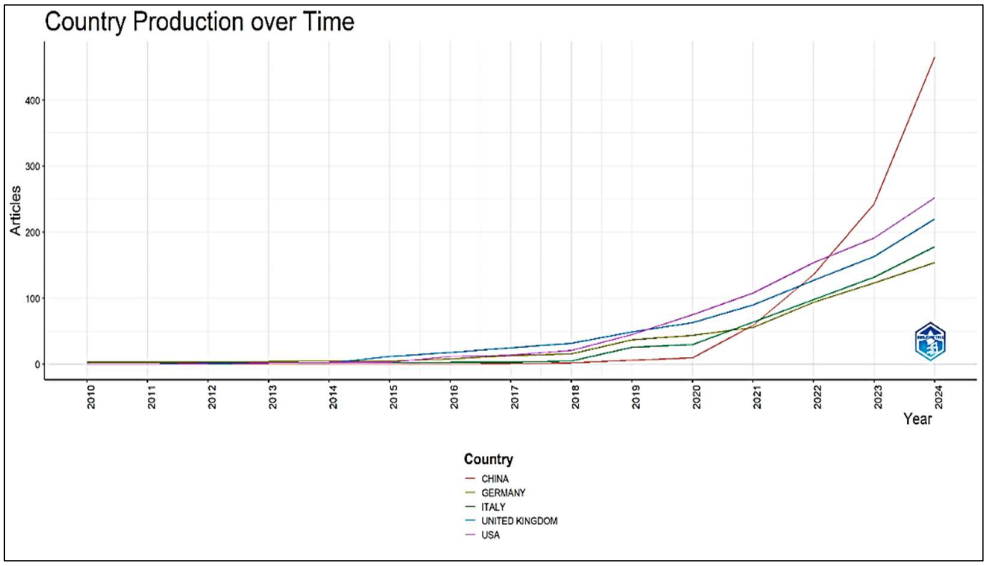
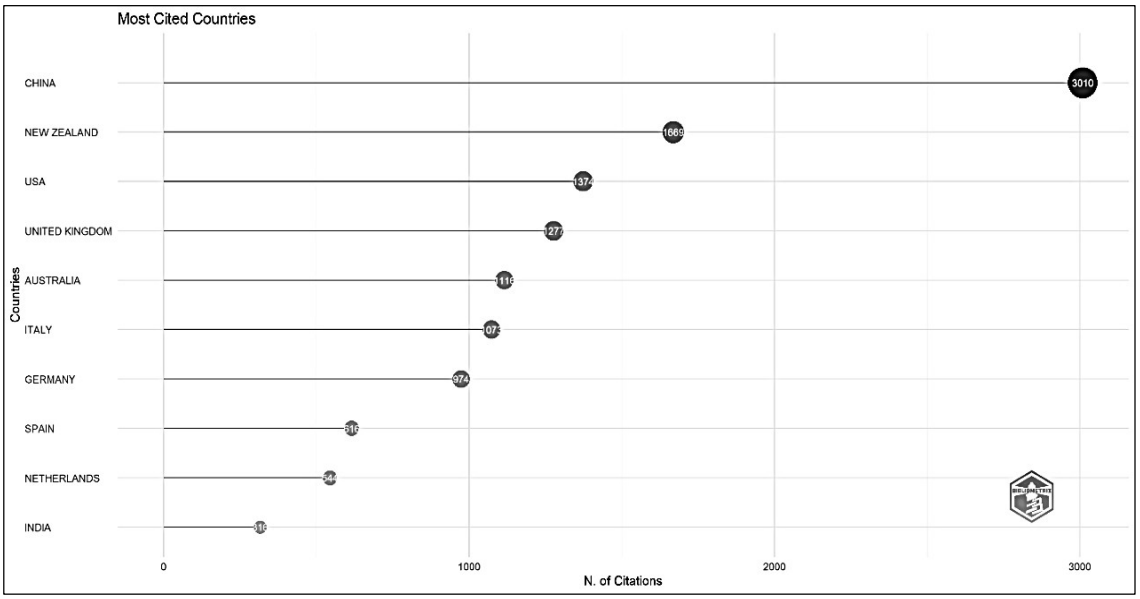


Figure 3.3: Top Cited Countries for Sustainable Finance Research Publications During 2010-2024



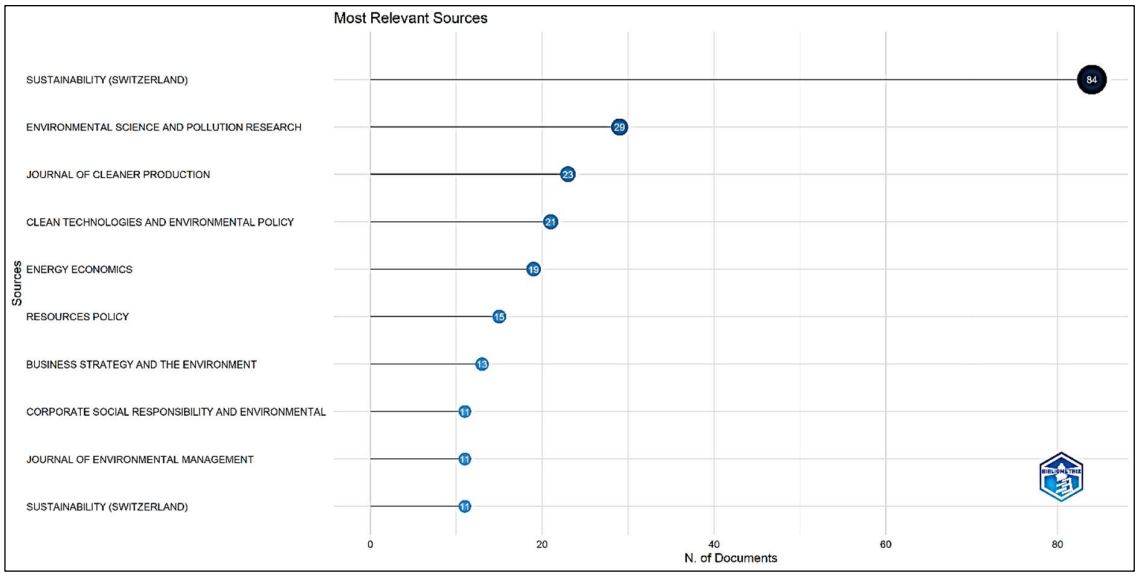
3.3. Top Contributing Journals for Sustainable Finance During 2010-2024

A bibliometric summary of journals in the domains of sustainability, environmental science, and climate policy is shown in Table 3.2, highlighting their production and scholarly influence. Since 2019, Sustainability (Switzerland) has had the greatest h-index (22) and total citations (1833), demonstrating a substantial impact and substantial scholarly production (84 articles). With a noteworthy h-index of 12 and a high total citation count of 793, the Journal of Cleaner Production comes in second, demonstrating its influence since 2018. In contrast to their shorter publication windows, several journals, such as Technological Forecasting and Social Change and Environmental Science and Pollution Research, have significant citation success. With encouraging m-index values, more recent arrivals like Business Strategy and the Environment and Corporate Social Responsibility and Environmental Management indicate significant productivity and effect in a comparatively short amount of time. Overall, the table shows how various publications, with differing levels of importance and specialization, advance knowledge in their respective fields. Figure 3.4 shows the top contributing journal in terms of total research articles produced in the domain of sustainable finance during 2010-2024.

Table 3.2: Most Impactful Journals in the field of Sustainable Finance 2010-2024

Source	h_index	g_index	m_index	TC	NP	PY_start
Sustainability (Switzerland)	22	41	3.667	1833	84	2019
Journal of Cleaner Production	12	23	1.714	793	23	2018
Energy Economics	11	19	2.75	556	19	2021
Technological Forecasting and Social Change	10	11	1.667	889	11	2019
Environmental Science and Pollution Research	9	16	1.5	289	29	2019
Business Strategy and The Environment	8	13	2	268	13	2021
Climate Policy	8	10	0.727	260	10	2014
Resources Policy	8	15	1.6	305	15	2020
Wiley Interdisciplinary Reviews: Climate Change	7	9	0.7	207	9	2015
Corporate Social Responsibility and Environmental Management	6	11	1.5	167	11	2021

Figure 3.4: Top Contributing Journals with Highest Number of Research Articles During 2010-2024

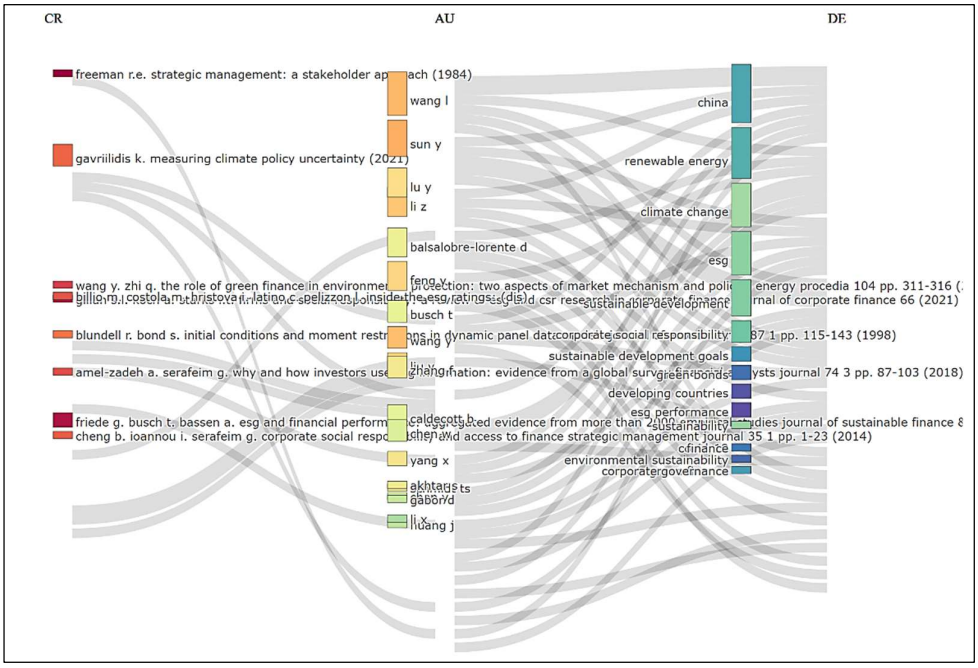


3.4. Three-Field Plot

Figure 3.5 illustrates a triadic visualization that effectively encapsulates the intricate relationships among significant cited references, distinguished authors, and essential research themes or keywords within a particular academic field, presumably associated with sustainability, environmental policy, and Environmental, Social, and

Governance (ESG) matters. Landmark publications such as Freeman's "Strategic Management: A Stakeholder Approach (1984)" and Gavriilidis's "Measuring Climate Policy Uncertainty (2021)" act as critical references that inform the scholarly pursuits of influential authors like Wang L., Sun Y., and Balsalobre-Lorente D., whose research encompasses a broad array of vital topics. The prevailing research themes, encompassing "climate change," "renewable energy," "sustainable development," and "ESG," mirror contemporary priorities and challenges inherent in confronting global sustainability and environmental governance. The robust interconnections among these three dimensions underscore a cohesive scholarly ecosystem wherein seminal past research continues to inform the current investigations of prominent authors in addressing urgent societal and environmental issues. This visualization accentuates the connotation of interdisciplinary methodologies in resolving global challenges through an amalgamation of theoretical underpinnings and empirical inquiry.

Figure 3.5: Three-Field Plot



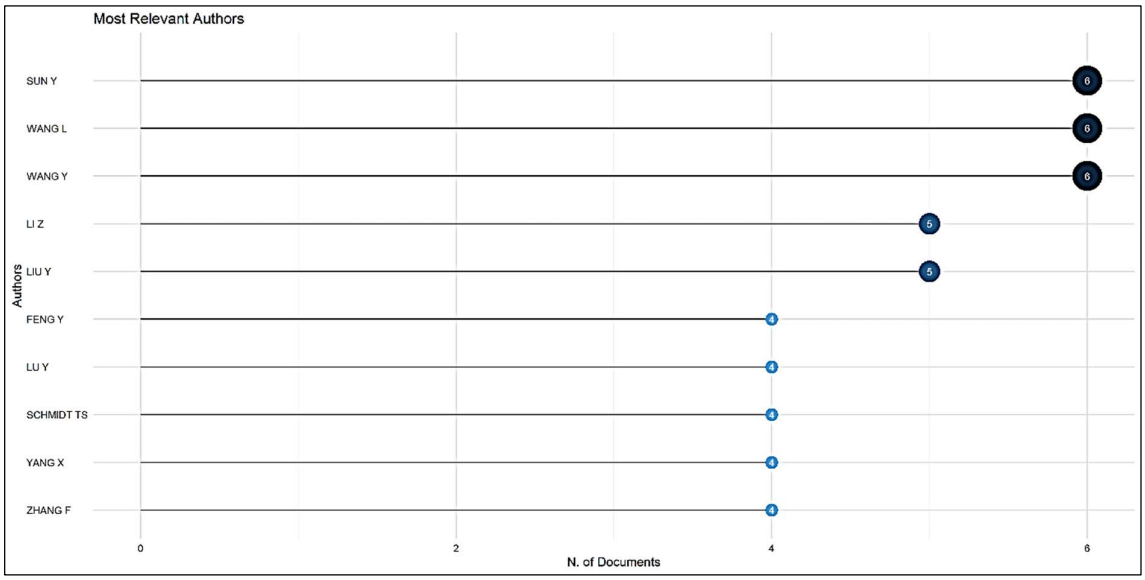
3.5. Most Relevant Authors in the Domain of Sustainable Finance During 2010-2024

Table 3.3 displays the contributions from various authors based on the number of articles and their fractionalized contributions. Sun. Y, Wang. L and Wang. Y are among the top three authors with the highest number of articles (i.e., 06, followed by Li. Z and Liu. Y (05). However, their fractionalized contribution differs; Wang. Y ranked top at 1.59, followed by Wang. L (1.53), and Sun. Y (0.92). This implies that Sun. Y, collaborated extensively, but Wang. Y and Wang. L was most probably contributing to works with fewer co-authors. Likewise, Li. Z and Liu. Y each has five publications, signifying relatively stable individual and team efforts with fractionalized contributions of 1.40 and 1.37, respectively. Zhang. F stands out with the prevalent fractionalized contribution (1.83), showing strong individual contributions, while Feng. Y has the lowest fractionalized contribution (0.93). Schmidt.T.S (1.06), Yang. X (1.23), and Lu. Y (1.33) contributed (04) articles. On the whole, authors such as Wang, Y and Zhang, F emerge as notable contributors with substantial individual impact, whereas others like Sun, Y and Feng, Y exhibit a stronger affiliation with collaborative research endeavors.

Table 3.3: No of Documents by Relevant Authors

Authors	Articles	Articles Fractionalized
Sun Y	6	0.92
Wang L	6	1.53
Wang Y	6	1.59
Li Z	5	1.40
Liu Y	5	1.37
Feng Y	4	0.93
Lu Y	4	1.33
Schmidt TS	4	1.06
Yang X	4	1.23
Zhang F	4	1.83

Figure 3.6: No of Documents by Relevant Authors



3.6. Most Cited Articles in the Domain of Sustainable Finance (2010-2024)

Table 3.4 shows the most cited articles in the context of sustainable finance during 2010-2024. Yu et al., (2021) ***examined the hurdles that restrict the potential of green innovation capabilities of enterprises in the context of China by making a comparative analysis amid private owned enterprises and state owned enterprises; the findings concluded that*** private owned enterprises are more open to challenges related to financing constraints as compared to state-owned enterprises, which ultimately impact their capabilities to incorporate green technologies, there shall be effective policies to promote green finance to minimize the constraints the risk associated with climatic change must be addressed by the enterprises in the context of their investment and financing decisions.

Shen et al. (2021) reconnoitered the effect of natural resources rent, green investment, financial development, and energy consumption on carbon emissions in thirty regions of China for the time ranged 1995 to 2017, the study employed sophisticated data analysis econometric techniques such as cross-sectional enlarged autoregressive distributed lags model (CS-ARDL) which is capable to take into considerations the aspects of cross-section dependence and heterogeneous parameters, the empirical findings suggested the facets such as carbon emissions, natural resources rent, green investment, financial development, and energy consumption, were co-integrated in the long-run.

Hoang et al. (2021) studied the effect of the COVID-19 pandemic on the energy industry in the context of encountered challenges and prospects for renewable energy expansion strategies. It highlights the necessity for short-term practical policies and long-term action plans to attain sustainable energy goals, the study executed a review methodology to gauge the substantial consequences of the pandemic on present and future sustainable energy tactics, the findings highlight the significance of collective research in dealing the legitimacy concerns in

the context of pandemic aftershocks, encouraging for more comprehensibility and replicability in research for the energy sector.

Cornett, Erhemjamts, & Tehranian (2016) investigated the association between corporate social responsibility (CSR) and the financial performance of banks, specifically in the presence of a financial crisis. GMM regression was used as a data analysis technique. The findings reveal that large banks increased their CSR activities after the financial crisis, thus positively correlated with their financial performance.

Le, Abakah & Tiwari (2021) investigated the transmission of volatility among various financial instruments. It employed the methodologies established by Diebold-Yilmaz and Barunik-Krehlik. The emphasis was on Fintech innovations, green bonds, and cryptocurrencies, it underscored the substantial relationship observed amid technological assets and conventional equities when involved in short-term trading, which intensifies risks as compared to long-term asset retention. Gold and oil were acknowledged as proficient hedging vehicles. On the other hand, the amalgamation of Fintech and equities was found to be ineffective. KFTX emerged as a primary aspect of shocks distressing Bitcoin and other financial instruments. Particularly, green bonds witnessed shocks from gold during COVID-19.

Ran et al. (2022) examined the impact of climate policy uncertainty on firm-level total factor productivity in the context of China, the findings suggested that climate policy uncertainty negatively impacts firm-level total factor productivity, particularly in mining, energy, and manufacturing sectors. Non state owned enterprises were more vulnerable to climate policy uncertainty as compared to state owned enterprises due to insufficient capital and limited information access however those enterprises which were labor and capital intensive witnessed more fluctuations in terms of total factor productivity as the presence of climate policy uncertainty constraint R&D investment which ultimately hinder firms' productivity.

Gabor (2021) discussed the effect of COVID-19 on financial practices and emphasized the significance of public and private partnerships for long term infrastructure finance, the findings suggest that de-risking approaches shield investors from several financial risks moreover the effective role of central bank is essential to ensure financial stability thus public-private partnerships shall be encouraged to augment the attainment of sustainable development goals. Siew (2015) studied the criteria and methodologies of sustainability reporting tools and highlighted the issues related to standardization and comparability. Moreover, the study concluded that corporations may use the term 'green washing' as a manipulative tool in terms of reporting to overshadow the thorough assessment of firms' sustainability performance.

Table 3.4: Most Cited Articles Globally for Sustainable Finance (2010-2024)

Paper	Total Citations	TC per Year	Normalized TC
Yu C-H, 2021, Energy Policy	618	154.50	0.2327
Shen Y, 2021, Sci Total Environ	491	122.75	0.1848
Hoang at, 2021, Energy Policy	331	82.75	0.1246
Cornett Mm, 2016, J Bank Finance	276	30.67	0.1039
Le Tn-L, 2021, Technol Forecast Soc Change	253	63.25	0.0953
Ren X, 2022, Energy Econ	233	77.67	0.0877
Gabor D, 2021, Dev Change	233	58.25	0.0877
Siew Ryj, 2015, J Environ Manage	221	22.10	0.0832

3.7. Cluster Mapping Using Keyword Co-occurrences

The assessment of literature evolution requires an objective assessment that can ensure the rationality of the scientific production in the context of a particular field (Pessin et al., 2023). Science mapping is a pervasive technique in bibliometric analysis that permits researchers to divulge the configuration of particular phenomena and classify major themes (Chen, Tsang & Wu, 2023). This study has employed a network evaluation based on a keyword co-occurrence bibliometric technique to ascertain the foremost clusters that define the scholarly configuration of sustainable finance research for the period 2010-2024. The findings from the network analysis based on keyword co-occurrences in addition to recent literature, resulted in four major themes.

Sustainable Finance as a Way Towards Sustainable Development

The accomplishment of SDGs cannot be detached from one another; thus, they are positively interrelated and long-term economic development as these are positively interrelated with each other. Economic development is greatly dependent upon social and environmental progress (Sukiyono et al., 2024). Environmental, Social, and Governance (ESG) pledges frequently appear to be perfunctory within bond agreements, the emergence of sustainability as a new avenue of financial activities can be attributed with market demand instead of regulatory efforts, thus the absence of regulatory framework hinders the productive use of sustainable finance products (Lupo-Pasini, 2022). Kumar, Taneja & Özen (2025) studied the impact of green bonds in promoting sustainable development by channeling low-carbon financing. The findings suggest that the green bonds issuance has a

significant impact on regulatory policy formation, moreover, the role of investors' sentiments is also evident in attaining sustainable development, as their eco-friendly traits may promote sustainable initiatives intensely.

3.8. Renewable Energy and Investments

Shinwari et al., (2022) examined the facets that impact investments in renewable energy in the context of China, the findings suggested that negative relationship between market volatility and investment in renewable energy, nevertheless, energy efficiency, economic performance, technological innovations were found to have substantial influence on investment in the context of renewable energy. The negative impact of natural resource volatility gains more statistical support as long as the relationship between economic performance and investment in renewable energy ceases to be significant, once a particular threshold level is reached, the beneficial effects of economic performance and the detrimental effects of natural resource volatility on investment in renewable energy changes its significance. Karasmanaki (2023) suggested that the factors that impact individuals' intentions to invest in renewable energy keep changing. In particular, however, the willingness is substantially affected by the information sources that shape their attitude positively, such as the media and digital information avenues. Solangi & Magazzino (2025) studied the financial dimensions of renewable energy transition in the context of China, the central focus of the study was on the impact of the climate combating strategy to achieve sustainable development goals. the findings suggest that subsidies, grants, and green financing strategies, public and private sector collaborations, are the foremost ways to augment renewable energy transformation.

3.9. Efficacy of Green Finance in Combating Climate Change

The mitigation strategies to combat climate change may bring financial instability, particularly in low-income countries that witness high exchange rate volatility. For this purpose, policymakers in underdeveloped countries are required to come up with such policies that can attract investors towards environmentally friendly portfolios (Löscher & Kaltenbrunner, 2022). **Green finance is necessary to augment environmental innovation, long-term economic growth, and sustainable development, as it can be beneficial to minimize environmental pollution and combat the negative consequences of climate change, and** it can positively moderate the relationship between innovation and climate change (Zhang et al., 2022). Xu at al., (2025) examined the role of green finance innovations to reduce carbon emissions in the context of China, the findings concluded that the industrial innovation synergy is vital to witness green financing benefits for carbon-intensive sectors. Other factors such as geographical location, marketization degree, enterprise equity nature, and pollution were found to have an asymmetric impact on carbon emissions.

3.10. Importance of Environmental Policy to Minimize Carbon Emissions

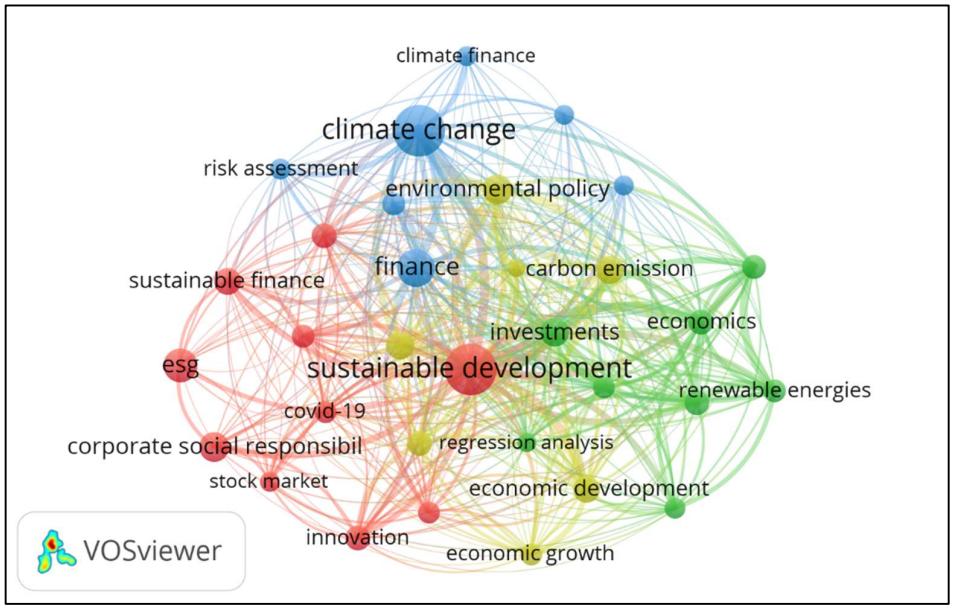
Environmental governance policy synergy (EGPS) is crucial in reducing carbon emissions by enhancing the effectiveness of initiatives such as environmental information transparency and low-carbon urban development, leveraging technological innovations and refining industrial configurations (Lu, Wang & Liu, 2023). Environmental regulations limit local carbon emissions, thereby supporting in the diminution of carbon dioxide levels, these regulations may unintentionally lead to amplified emissions in neighboring regions, emphasizing the inevitability for consistent policies to competently report the interactions of regional carbon emissions and to improve the inclusive framework of environmental governance (Song et al., 2022). Xiao (2025) found that the role of circular economy cannot be negated to combat effectively with environmental issues; the study also identified some of the key challenges in the way to minimize carbon emissions, such as a lack of a regulatory and policy framework to employ effective waste management, financial and investment limitations.

Table 3.5: Comparison of the Identified Clusters

Clusters	Similarities	Differences	References
Sustainable Finance as a Way Towards Sustainable Development	• Signifies the importance of ESG Facets (environmental, social, and governance) in investment decisions • Focuses on long-term value orientation • Acknowledge the need to employ the Sustainable Development Goals as a criterion to assess sustainable development	• Focuses on the agriculture sector in the context of local economic development • Emphasized the execution of a competent and standardized regulatory framework to govern sustainable finance	Sukiyono et al., 2024). (Lupo-Pasini, 2022). Kumar, Taneja, & Ozen, (2025)
Renewable Energy and Investments	• The focus of the studies was on investment in the **renewable energy** sector.	• Focused on rational as well as attitudinal facets in the context of renewable energy adaptation, such as the	Shinwari et al., (2022)

	• Inspects the factors that impact the renewable energy sector expansion • Acknowledged the renewable energy sector as a vital component for decarbonization strategies. • The findings backed SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action)	volatility of resources, GDP, and societal factors	Karasmanaki (2023) Solangi & Magazzino (2025)
Efficacy of Green Finance in Combating Climate Change	• The focus of the studies remains on the impact of finance in the context of climate and sustainability aspects. • Addresses the need to execute proper economic planning to combat climate change • The contexts of the studies remain developing and emerging nations.	• The findings emphasized the importance of green finance and technological innovations for long-term sustainable solutions • The regulatory initiatives shall be based on technology-friendly economic policies • Major revisions are needed to incorporate in macroeconomic aspects that can support debt sustainability	*Löscher & Kaltenbrunner, (2022)* Zhang et al., (2022) Xu et al., (2025)
Importance of Environmental Policy to Minimize Carbon Emissions	• The findings advocate the effectiveness of robust environmental policies to mitigate carbon emissions • The findings are notably based on regional data obtained in the context of China • Emphasized the strong regional cooperation between regions to attain sustainable goals.	• The focus of the studies was on **longitudinal dynamics** and the **interaction between neighboring regions,** as well as on the integration of various policy frameworks and governance practices to detect nonlinear impact on emissions and spillover effects.	Lu, Wang & Liu (2023) Song et al., (2022) Xiao (2025)

Figure 3.7: Netwrok Analysis using Keyword Co-Occurrence in the Domain of Sustainable Finance 2010-24



4. CONCLUSION

The foremost function of finance is to ensure the productive use of available funds; in the context of sustainability, the importance of the financial sector triggers transformational change that requires substantial investment to support climate-friendly initiatives and promote a circular economy. The notion of sustainable finance is still evolving, having received attention from academicians and policymakers globally. However, the scope of sustainable finance is immensely fragmented; therefore, this study has employed a systematic literature review along with bibliometric analysis to scientifically uncover the domain of sustainable finance. The SPAR-4-SLR protocol is followed, in which 867 articles are systematically reviewed for the period ranging from 2010 to 2024. Performance analysis and science mapping have been conducted using the R package and VOSviewer software. The keyword co-occurrence reveals four main themes based on sustainable development, sustainable finance, climate change, green finance, environmental policy, and carbon emissions. The study's findings provide insightful information that can be useful for policymakers, investors, and corporations to incorporate sustainable finance into financial decisions and regulations.

5. PRACTICAL IMPLICATIONS

The systematic literature review provides important practical implications for society. There is a growing interest in investors' engagement in renewable energy, which indicates the significance of individuals' attitudinal shift towards a carbon-free economy. This suggests that to empower individuals to make substantial contributions, there is a need to increase knowledge, financial inclusion, and community-level engagement. Furthermore, corporations should be held liable for their conduct and should not be misled by merely using the label of 'greenwashing.' Synchronized environmental policies surpass disseminated ones in efficacy; hence, there is a necessity for a mutually constructed unified governance framework that can foster the social behavior required for sustainable development. Additionally, the findings of the systematic literature review hold important managerial implications. Firstly, corporations must recognize that incorporating ES facets into their business conduct is no longer a choice; it has become a regulatory and ethical obligation. Evident tools, such as green bonds and industrial-innovation green renewable synergies, can help reduce carbon emissions and enable corporations to respond in a climate-friendly manner, enhancing the trust of major stakeholders and attracting capital from socially responsible investors.

6. LIMITATIONS

There may be certain limitations to the study that can be addressed by the subsequent research, such as future researches may increase the time frame for the assessment of the literature. Some other databases, such as Web of Science, along with Scopus, can be used for a more coherent appraisal of the given literature.

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