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Climate Finance Research Trends: A Bibliometric Analysis of International Publications from 2010 to 2025

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ABSTRAK

Tujuan utama penelitian ini adalah untuk mengidentifikasi ruang lingkup penelitian di bidang pendanaan iklim melalui analisis bibliometrik terhadap literatur internasional mengenai pendanaan iklim dengan menggunakan artikel ilmiah yang terindeks dalam basis data Scopus dari tahun 2010 hingga 2025. Makalah ini menggunakan teknik kuantitatif pemetaan ilmiah bersama dengan teknik visualisasi menggunakan VOSviewer untuk menganalisis produksi penelitian di bidang pendanaan iklim, tren kolaborasi, struktur kutipan, dan evolusi tematik. Studi ini menunjukkan peningkatan laju produksi penelitian di bidang keuangan iklim setelah tercapainya beberapa tonggak penting dalam kebijakan global terkait perubahan iklim dan keberlanjutan. Studi ini menemukan bahwa analisis jaringan kolaborasi menunjukkan adanya kolaborasi berkualitas tinggi di antara negara-negara dan lembaga-lembaga kunci di negara-negara maju; namun, negara-negara berkembang semakin berkontribusi dalam beberapa tahun terakhir. Studi ini menunjukkan tren kutipan yang mengidentifikasi kutipan kunci yang menjadi dasar penelitian di bidang keuangan iklim, termasuk aspek-aspek seperti pembangunan berkelanjutan, instrumen keuangan iklim, dan kebijakan. Akhirnya, penelitian ini juga menunjukkan evolusi kata kunci penelitian yang menandakan transisi dari isu-isu terkait tata kelola dan mitigasi ke tema-tema baru dalam penelitian keuangan iklim, seperti adaptasi, keadilan iklim, dan inovasi pembiayaan hijau.

Kata Kunci: *Pendanaan Iklim, Analisis Bibliometrik, VOSviewer, Pembangunan Berkelanjutan, Scopus*

ABSTRACT

The main objective of this research is to identify the research space in the field of climate finance through bibliometric analysis of international literature on climate finance using scientific articles indexed in Scopus databases from 2010 to 2025. This paper uses the quantitative technique of scientific mapping along with the visualization techniques using VOSviewer to analyze the research production in the field of climate finance, collaboration trends, citation structure, and thematic evolution. This study shows an increased rate of research production in climate finance research after some key milestones reached in the global policies regarding climate change and sustainability. This study finds that co-authorship network analysis demonstrates the presence of high-quality collaboration among key countries and institutions in developed economies; however, developing nations are increasingly contributing in recent years. It shows the citation trend that identifies key citations forming the basis of research in the field of climate finance including aspects such as sustainable development, climate finance instruments, and policy. Finally, this research also shows the evolution of research keywords indicating transition from governance and mitigation-related issues to new themes in climate finance research such as adaptation, climate justice, and green financing innovations.

Keywords: *Climate Finance, Bibliometric Analysis, VOSviewer, Sustainable Development, Scopus*

INTRODUCTION

The increasing consequences of climate change have made environmental issues central economic and financial problems at the international level. The rising temperature levels, extreme weather conditions, and environmental degradation have emphasized the need for funding to address these issues effectively (Steckel et al., 2017). In this regard, the role of climate finance has become a key aspect of directing funds towards a sustainable future. Climate finance is defined as the flow of investments, sourced either locally, nationally, or internationally, that aims to facilitate activities related to climate change (Clark et al., 2018). This issue has received considerable attention

in recent years from both scholars and policymakers. The growth of climate finance is largely attributed to international initiatives like the Paris Agreement, which stresses the importance of aligning financial flows towards low-emission and climate-resilient development goals (Galaz et al., 2018). In line with this agreement, there has been an influx of studies related to the use of financial tools like green bonds, carbon price mechanisms, climate funds, and sustainable investments. Such financial tools are meant not only for risk management but also for capitalizing on the growing potential of new green markets. It is for this reason that the scholarship on climate finance has become a multidisciplinary area of study involving economists, financiers, environmental scientists, and policymakers alike (Bhandary et al., 2021).

Besides the policy-led impetus, it is notable that climate-related hazards are being perceived by the corporate world as material financial hazards. Investors, commercial banks, and corporations are incorporating ESG factors into their decision-making process, which will further increase the need for climate-based financial research (Buchner et al., 2011). The issues of climate disclosure, sustainable portfolio management, and transition finance have taken center stage in the academic world. It is evident that there is a paradigm shift occurring in the financial world, where sustainability aspects cannot be ignored when considering value creation (Buchner et al., 2014). Although significant progress has been made towards climate finance research, there is still an evident level of fragmentation and dynamism within the research. The different areas that the various researchers focus on when addressing climate finance include such issues as adaptation finance for developing countries or mitigation finance for the developed world.

In addition, the existing gaps in the allocation of funding and financial assistance illustrate that the issue is far from being resolved since there is still a certain inequality between the developed and developing countries. Thus, there arises a need for conducting research that will be aimed at mapping out the research field. In addition to this, the growing number of scholarly articles related to climate finance poses problems when it comes to summarizing existing research. Conventional literature reviews might not be able to encompass the evolving complexity of such a fast-growing discipline. Through the application of bibliometrics, scholars will be able to identify trends regarding collaboration, key contributors, popular papers, and clusters within the topic that influence climate finance research. This method not only benefits academic studies but is also important when formulating policies and setting future research agendas.

Despite the fact that climate finance is one of the most investigated research topics, little is known about the international research trends, intellectual structures, and thematic developments of the topic between 2010 and 2025. The majority of the existing researches examine some aspects or discuss climate finance within a particular geographical region while ignoring the global picture of how the topic was developing in terms of research during this period. There is also no clear idea who were the major contributors to the topic, how they were cooperating with each other, and what research fronts existed. This information gap does not allow formulating strategic agendas for further investigation of the topic. This study aims to analyze the research trends in climate finance by conducting a comprehensive bibliometric analysis of international publications indexed in Scopus from 2010 to 2025.

RESEARCH METHODS

This research utilizes a quantitative bibliometric method to examine the evolution of research in the area of climate finance between the years 2010 and 2025. Bibliometrics is well known to be an effective way to explore scientific knowledge domains, detect emerging trends in research, and investigate the intellectual structure of a certain discipline (Donthu et al., 2021). The information used in this study was gathered from the Scopus database, which is arguably one of the largest sources of scholarly literature. The search string used included specific keywords (such as climate finance, green finance, sustainable finance, etc.) as well as relevant synonyms, applied to the title, abstract, and keywords fields. Only articles and reviews written in English were considered, published during the chosen period. Duplicates, unrelated documents, and missing records were eliminated after the cleaning stage, and the data was exported in suitable file formats (e.g., CSV or RIS files). The analysis was carried out through the use of the software known as VOSviewer. This is a software tool used to create and visualize bibliometric networks. Different forms of analyses were performed during this study, including co-authorship analysis to study the collaboration trends within the authors, citation analysis to highlight influential works and authors, and finally, keyword co-occurrence analysis to study the themes within the research.

RESULTS AND DISCUSSION

A. Co-Authorship Analysis

In this part, the co-authorship analysis is presented to analyze the patterns of collaboration among the authors in the field of climate finance. Network visualization using VOSviewer helps in analyzing the connections among authors, institutions, and countries responsible for shaping the literature. The role of co-authorship analysis is vital in knowing the collaborative process through which knowledge creation takes place. It helps in identifying dominant research networks, key players in the field, and international collaborations. Through the network map developed from this analysis, one will be able to identify collaborative clusters of authors within the field of climate finance.

The co-authorship network map created through VOSviewer reveals the collaboration network amongst the scholars studying the phenomenon of climate finance. The image shows the relationship between various scholars according to their collaborations in the form of publications, where nodes show different individuals while links show the co-authoring connection. The size of the nodes shows the level of contribution or influence by the scholars while the different color tones represent various clusters showing collaboration amongst different scholars who are engaged in working closely within one research group.

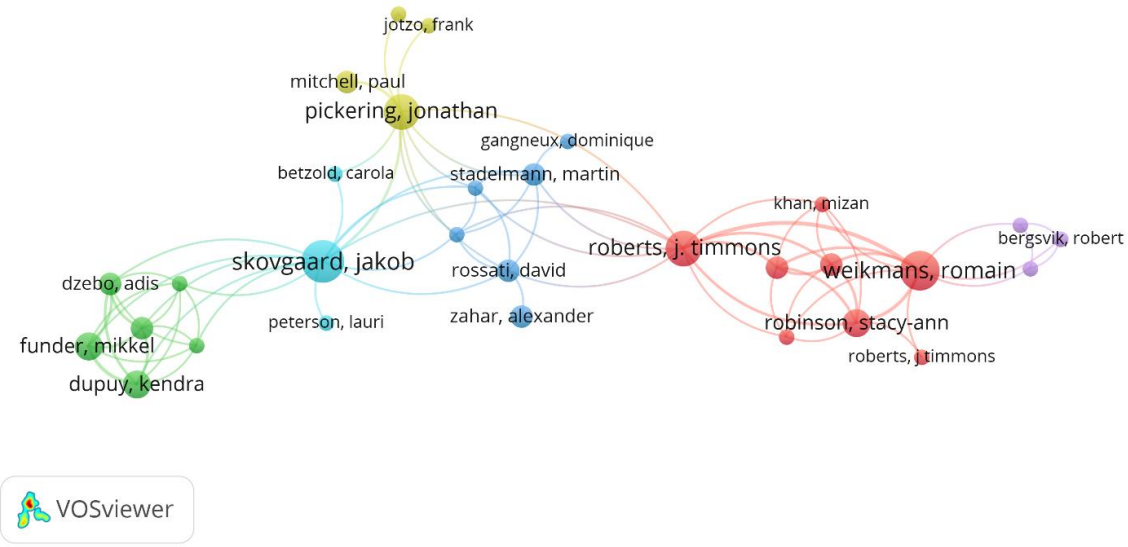

Figure 1. Author Visualization

Source: Data Analysis

There are quite a number of distinct clusters that represent distinct groups of researchers who collaborate closely through common papers. For example, there is a green cluster on the left hand side of the map which includes authors such as Funder, Mikkel and Dupuy, Kendra. This clearly represents a distinct group of researchers working together on particular aspects of climate finance. There is also another distinct group in the form of blue and yellow clusters which include authors such as Skovgaard, Jakob and Pickering, Jonathan. These researchers seem to have collaborated in order to produce important research for governance or policy making purposes. On the contrary, the emergence of bridge nodes like Roberts, J. Timmons and Weikmans, Romain shows that there are several connectors between different groups or clusters. Bridge nodes refer to those nodes which can be found in the middle, connecting various clusters through which information exchange takes place. This shows that although the area may have been fragmented into various clusters, there are several researchers who play a vital role in bringing different perspectives together. The small and unconnected clusters point out new research fields.

The co-authorship network between institutions that has been created by means of VOSviewer reveals the pattern of collaboration between the most influential institutions that have made significant contributions to the body of research in climate finance. In the graph below, nodes represent institutions, while the connections between the nodes demonstrate their collaborations through publications. The size of the node denotes the contribution of the particular institution to the dataset, while the connections reveal the intensity of collaboration.

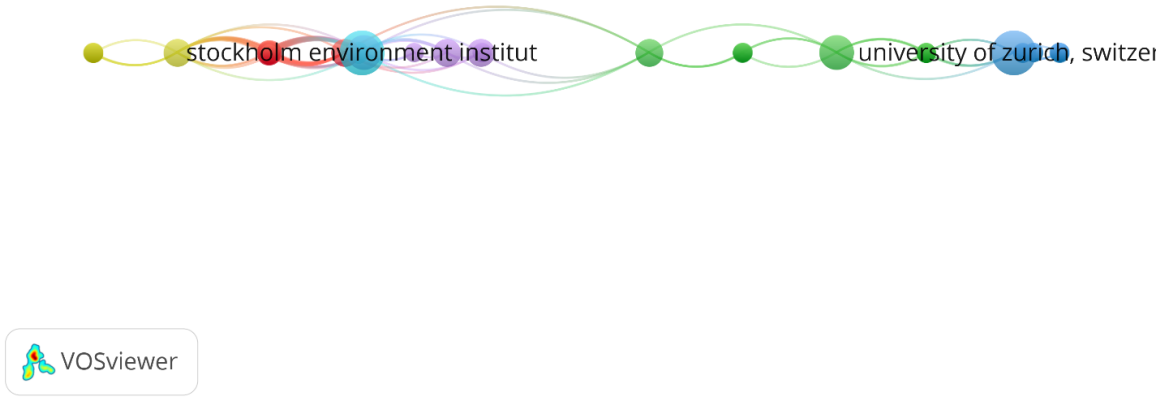

Figure 2. Institution Visualization

Source: Data Analysis

The map shows the prominence of institutions like the Stockholm Environment Institute, which is depicted as one of the most visible and interconnected nodes in the graph. This placement implies that this institution acts as one of the major hubs for climate finance studies, with many connections to other institutions. Likewise, the inclusion of the University of Zurich as one of the largest and most connected nodes implies its substantial contribution to the field. The connection between these two institutions demonstrates extensive international cooperation, especially among European researchers conducting climate finance research. Also, the linear nature of the network and its centralization to some extent point to institutional collaboration in climate finance being primarily among a few dominant institutions. The existence of intermediary nodes between dominant institutions demonstrates the function of smaller institutions in creating links between these collaborations and helping share information. However, the sparse nature of nodes outside the key links might also suggest that institutional collaboration is yet to be diverse worldwide.

The country level co-authorship network, generated by VOSviewer, is an example of a visualization that shows how research in climate finance is carried out internationally. Here, each node denotes a country while the lines between nodes denote collaborations among researchers in climate finance based on co-authorship of papers. Node size is an indication of the importance and productivity of the country, while the color groups are clusters of countries collaborating with each other.

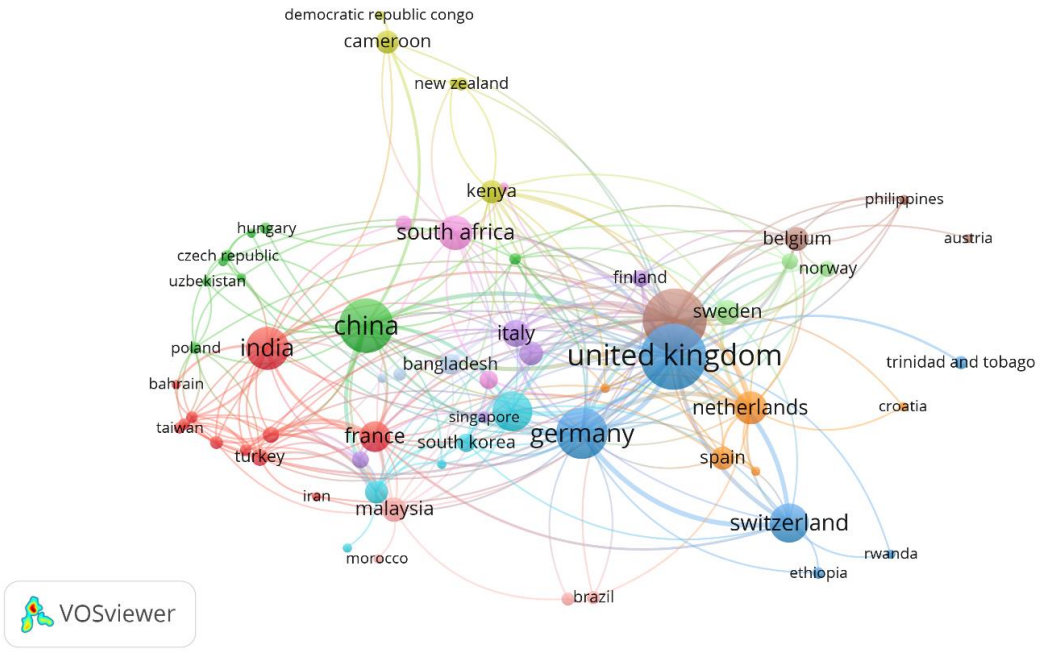

Figure 3. Country Visualization

Source: Data Analysis

The network shows that some countries serve as important hubs within climate finance studies including the United Kingdom, Germany, China, and possibly the United States, which have been found to occupy important central positions in the network, marked by their larger node size and greater number of connections. For example, the United Kingdom stands out as one of the most prominent nodes in the network because of its important contributions and collaborations with other countries. In addition, Germany and China are among the highly connected countries, implying their important role in collaborative research within and beyond their borders. Moreover, the clustering shows the pattern of collaboration within regions and between regions. Several European countries, including Sweden, the Netherlands, Switzerland, and Belgium, have clustered tightly together in an interconnected manner, demonstrating high levels of cooperation among these countries. On the other hand, the involvement of emerging nations like India, South Africa, and Malaysia within the network also proves that these countries are increasingly engaging in the field of climate finance studies. Thus, the linkage between developed and developing countries is also an indicator of increased collaboration at the global level in combating climate change. Nevertheless, certain countries are found to be on the periphery of collaboration networks.

Citation Analysis

Citation analysis focuses on assessing the intellectual influence and impact of the publications in the area of climate finance. Citation analysis helps identify some of the most influential papers and researchers which played an important role in developing the climate finance field.

Table 1. Top Cited Literature

Number of Citations	Author'(s)	Title
472	(Giglio et al., 2021)	Climate Finance
418	(Stroebel & Wurgler, 2021)	What do you think about climate finance?
418	(Soergel et al., 2021)	A sustainable development pathway for climate action within the UN 2030 Agenda
362	(Banga, 2019)	The green bond market: a potential source of climate finance for developing countries
345	(Akomea-Frimpong et al., 2022)	A review of studies on green finance of banks, research gaps and future directions
312	(Hong et al., 2020)	Climate finance
291	(Khan et al., 2022)	Does green finance really deliver what is expected? An empirical perspective
270	(Robiou du Pont et al., 2017)	Equitable mitigation to achieve the Paris Agreement goals
269	(D'Orazio & Popoyan, 2019)	Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies?
257	(Venturini, 2022)	Climate change, risk factors and stock returns: A review of the literature

Source: Scopus, 2026

Keyword Co-Occurrence Analysis

The keyword co-occurrence analysis aims to investigate the conceptual structure and theme development in the literature on climate finance research. By analyzing the keyword frequency and co-occurrence in the data set, this chapter highlights the major themes and topics of research and the relationship between different fields of study. The analysis is done by using the VOSviewer software, and it results in the creation of maps showing clusters of keywords, thereby identifying different research streams in the literature on climate finance research.

Figure 4 below depicts the keyword co-occurrence network created with the use of VOSviewer. As is seen from the image, a network of keywords used in climate finance research is shown depending on the keyword occurrence rates in the analyzed set of data. The nodes in the network stand for keywords, while their connections show how many times one keyword appears along with another one in the articles. The node sizes depend on how important/often the keywords were used, whereas the colors symbolize thematic clusters.

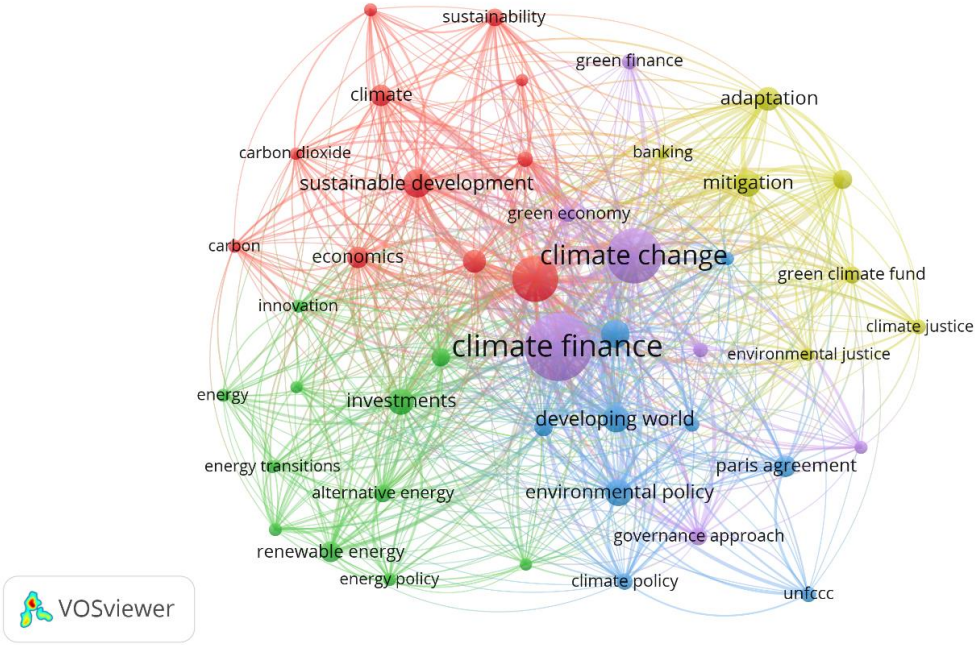

Figure 4. Network Visualization

Source: Data Analysis

This visualization clearly shows that the terms "climate finance" and "climate change" play central roles within the network due to their prominent node sizes and connections with other keyword clusters. Their centrality in the visualization demonstrates the importance of these two topics in forming the basis of the research field. The connection between these two keywords highlights the multidisciplinary aspect of climate finance, which involves financial policies in relation to environmental concerns. The significance of keywords like "sustainable development" and "economics" also shows that this field is firmly established in the discussion of sustainability and economics. The red cluster is one of the most salient ones and it revolves around issues regarding sustainability and environment. Important keywords such as "sustainable development", "carbon", "carbon dioxide" and "climate" underscore studies that are concerned with environmental impacts and emissions reduction. The presence of an environment-centered cluster is evidence of the importance of environmental science in climate finance research, especially concerning the reasons behind climate change and its ramifications. The inclusion of economic related terms in this cluster suggests the interplay between the two.

The next important cluster, highlighted in green, is related to the topics of energy and investments. The terms like "renewable energy," "energy policy," "energy transitions," and "investments" indicate that financing for the transition to a low-carbon economy plays an important role in the research. In other words, the cluster emphasizes that financial tools are critical for the development of renewable energy sources and the global transition to new energy sources. The blue cluster focuses on governance, policy, and international framework, which includes terms like "environmental policy," "climate policy," "governance approach," and mentions of the Paris Agreement and UNFCCC. Such a cluster reflects the fact that a large part of the existing literature deals with issues related to climate finance in terms of regulations and institutions. Another factor

which reflects the relevance of such an area is the inclusion of "developing world" in this cluster, thereby emphasizing the importance of climate finance policies in developing countries.

Yellow Cluster focuses on climate finance topics involving adaptation, mitigation, and climate justice. Key terms like "adaptation," "mitigation," "green climate fund," and "climate justice" illustrate an increased focus on the use of fair and inclusive strategies in climate finance. The focus here shows the move towards the adoption of both adaptation and mitigation measures. This change is indicative of the evolution of climate finance research and its integration of social elements, including questions of equity and inclusion in dealing with climate problems worldwide.

The visualization of the overlay map that shows the occurrence of keywords uses the VOSviewer software. The nodes in this diagram represent keywords, and the edges show their relationship of co-occurrences in the literature. Different from the typical map visualization of networks, the overlay map is characterized by the use of the color code for representing the publication years on average for the keywords, with darker colors denoting older themes, whereas lighter colors denote new themes.

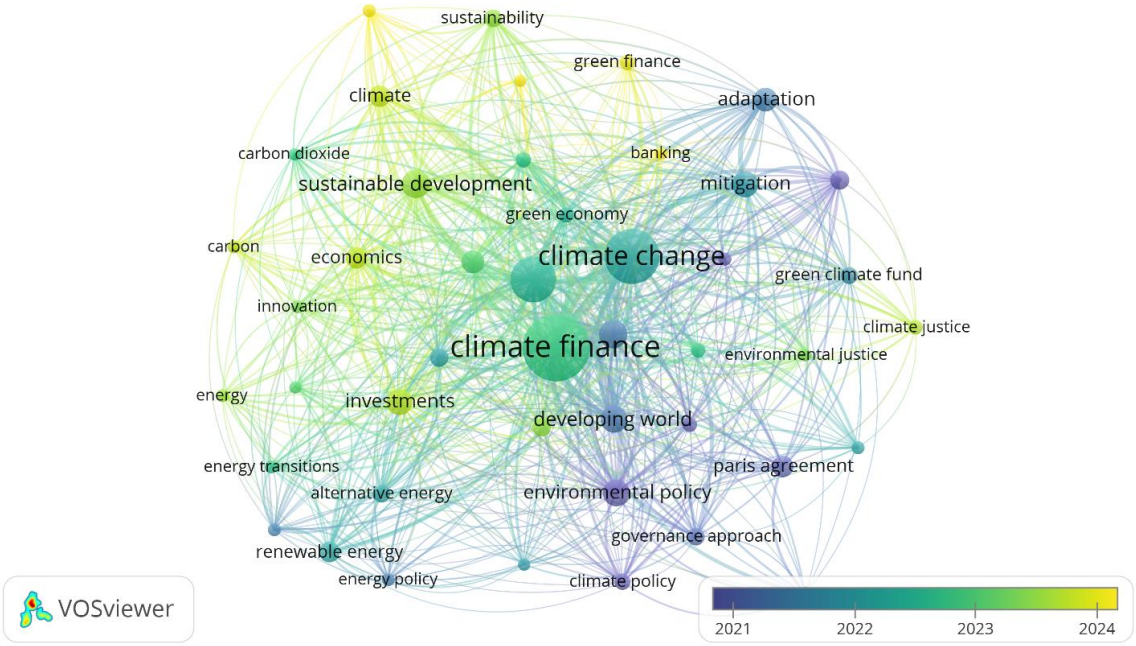

Figure 5. Overlay Visualization

Source: Data Analysis

In this visualization, keywords like "climate finance" and "climate change" are shown to be highly relevant across the whole spectrum of years, demonstrating that they continue to be very important concepts in research on this issue. At the same time, it should be noted that such keywords belong mainly to the middle range of shades used to visualize keywords on the map, which may imply that despite being relevant and consistently discussed by researchers, they do not represent new trends in the field. In turn, keywords related to "environmental policy," "governance approach," and various agreements like the Paris agreement belong mainly to darker shades of colors, implying that they were established as crucial issues much earlier. Newer topics can be observed in lighter colors, for example, "adaptation," "climate justice," and "green climate fund."

The fact that there has been increased attention paid to adaptation issues indicates an acknowledgment of the need for a response to climate vulnerabilities in developing countries. Similarly, climate justice has been rising as a concept, which is indicative of discussions surrounding justice, accountability, and fair distribution of finances when dealing with climate change across the world. Additionally, from the overlay map, it is clear that there have been increased discussions of economics and technology within the context of climate financing research. The use of keywords such as “green finance,” “green economy,” and “innovation” has increased recently, thus showing the rise of these areas of interest in climate financing research.

Density map of keyword co-occurrence produced by VOSviewer is a representation of the density of research topics covered in climate finance literature. In this graph, denser sections of keywords are represented by brighter colors (yellow), while those that occur less frequently or do not have strong interconnections are displayed using dark colors (green to blue). This density map makes it easy to distinguish the major topics covered from those that are given relatively little attention.

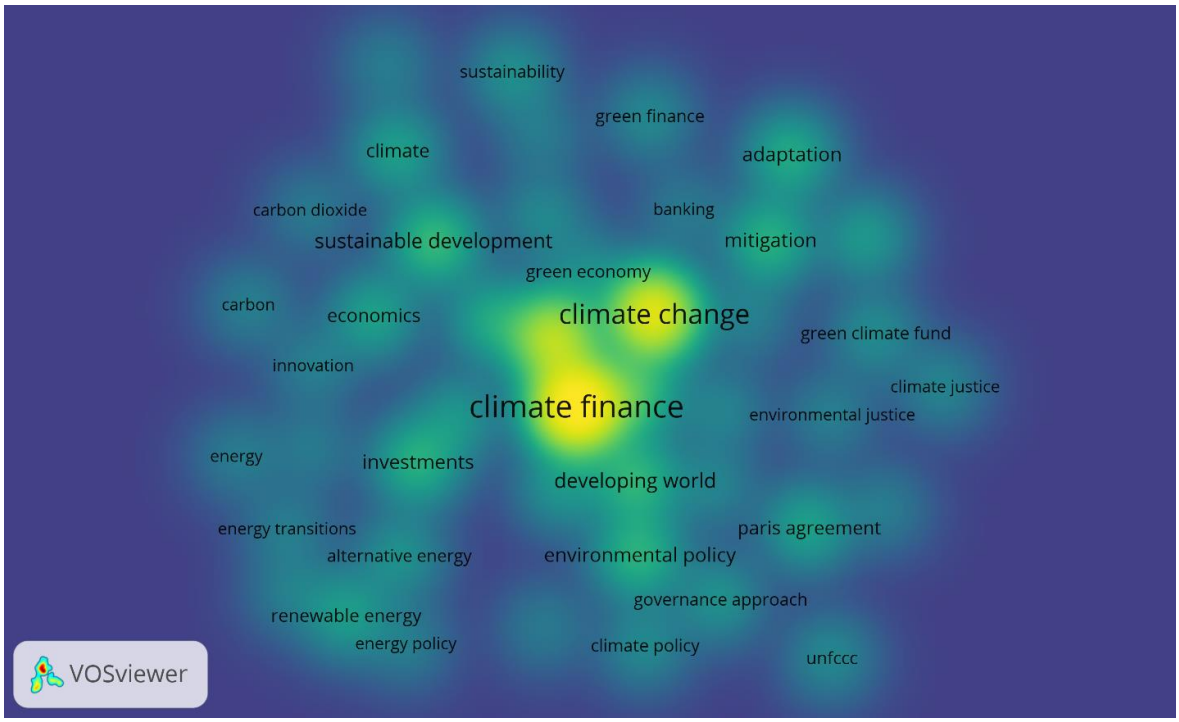

Figure 6. Density Visualization

Source: Data Analysis

From the graph above, it is clear that "climate finance" and "climate change" are the two key concepts with a high number of connections among all others, as depicted from the bright yellow cluster of keywords that occupy the center part of the visualization. This clustering of keywords reflects the fact that these two themes are the central ideas of the research field, forming the focal point around which other topics revolve. The clusters of keywords close to those in the center include terms such as "sustainable development," "green economy," and "developing world." On the other hand, terms in the outer rings of lower density, such as “renewable energy,” “energy policy,” “climate justice,” and terms related to frameworks such as “Paris Agreement” and “UNFCCC,” occur with relatively low frequency, implying that even though these issues are crucial, they are

somehow specialized, or not as extensively discussed in relation to the central themes of research. In essence, there appears to be an opportunity to expand research into the areas mentioned.

Discussion

The results of this bibliometric study show that climate finance has become an increasingly interdisciplinary and fast-growing field of study from 2010 to 2025. The recurring relevance of terms like climate finance and climate change in all networks shows that the field is firmly embedded within solving global environmental problems via financial means. This correlates with the overarching agenda set forth by international instruments like the Paris Agreement, which focuses on making the financial system compatible with climate objectives. The trend of increasing publication volume and complexity of theme relationships implies that climate finance has progressed beyond being a fringe subject matter and has become a vital component of sustainability and development studies. From a collaborative standpoint, the co-authorship study shows that climate finance knowledge creation is highly clustered within particular networks of scholars and organizations, mostly based in advanced countries such as Europe. The Stockholm Environment Institute and University of Zurich, as well as nations such as the UK and Germany, exert considerable influence on the research agenda. Nevertheless, the contribution from emerging players such as China, India, and South Africa reveals a growing trend towards diversity in engagement. This situation suggests an evolving process of collaboration on a worldwide scale despite the imbalance between research capabilities and funding opportunities in developing countries.

In addition to this, the citation analysis demonstrates how the presence of an established intellectual structure is evident within the realm. There are a number of publications and authors that have been very instrumental and are often used as important sources of reference when undertaking research on aspects such as climate policy, climate finance, and sustainable investment. It could be noted that there is a tendency towards theoretical consolidation since most of the references revolve around a few core publications, but this may pose challenges in terms of diversity and inclusiveness. In light of thematic development, it is evident from the analysis of keyword co-occurrences and overlays that there has been a distinct trend in the evolving focus of the literature. Early works largely focused on topics such as policies, governance, and mitigation measures, and were often associated with organizations like the UNFCCC. In contrast, newer works have broadened the focus and now incorporate subjects like adaptation, climate justice, and innovation in green finance. This shows that climate finance scholars recognize not only the environmental dimension of climate change but also its economic and social components, including questions related to equality and vulnerability. The density plot illustrates the existence of a strong core-periphery pattern in the research field. Although the core areas like climate finance and sustainable development have received a lot of attention from researchers, peripheral areas like financing of renewable energy, climate justice, and innovation technologies still lack adequate recognition. It is therefore imperative to conduct further research on the unexplored areas.

CONCLUSION

The study offers an extensive analysis of the bibliometric profile of climate finance studies published between 2010 and 2025, noting their increasing number, thematic structure, and collaborative efforts. The results show that climate finance has become a

pivotal topic in today's research with an interdisciplinary approach and is highly affected by global policy initiatives like the Paris Agreement. Although the research area is characterized by leading organizations and nations, the involvement of emerging countries seems to be on the rise, signaling a more inclusive trend. The study also reflects a change in research interests, moving from policy and mitigation strategies to adaptation, climate justice, and innovative finance mechanisms. In addition to an existing core of research studies, further areas for exploration can still be discovered.

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