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Research Article

Climate Risk Finance: A Bibliometric Analysis of Global Research Trends

Ulfa Muttoharoh[1*], Revanda Satria Buana[2]

[1-2] Semarang State University, Indonesia
* Corresponding Author: ulfamuttoharoh@students.unnes.ac.id[1]

Abstract: Climate risk finance has emerged as an increasingly important field of research along with the growing urgency to address climate change and its impacts on the global financial system. Climate change poses real risks to the stability of the international economy and financial systems. Climate risk finance represents an approach that encompasses various financial instruments in supporting climate change mitigation and adaptation. Although the term climate risk finance has not been widely used explicitly as a single keyword, the concept that integrates climate risk and financing is reflected in related keywords such as climate risk, climate finance, and climate change. This study employs a bibliometric analysis method using the Scopus database, supported by analytical tools such as VOSviewer and R Studio, to explore the development of research on climate risk finance. The study identifies publication patterns, international collaborations, and emerging themes within the related literature. The findings show that the publication rate on climate risk finance is relatively moderate each year, but has experienced growth in the last decade. The evolving understanding in this field is expected to strengthen the resilience of financial systems and support sustainable strategies to address long-term climate risks.

Keywords: Bibliometric Analysis; Climate Finance; Climate Risk Finance; Climate Risk; Financial Stability.

1. Introduction

Climate change has become one of the most pressing global challenges for the international community (Shang & Jin, 2023). The acceleration of global warming and the intensification of extreme weather events have elevated concerns about the potential consequences for ecosystems, human society, and long-term economic growth. Scientific evidence shows that climate change is progressing at an alarming rate, with its impacts spreading across geographical boundaries and affecting both developed and developing nations. At the same time, the magnitude of the threat it poses to all forms of natural life remains highly uncertain and unpredictable (Nobanee, et al., 2022). In recent years, extreme summer heat has occurred in many countries or regions across the Northern Hemisphere, with numerous areas recording the highest temperatures in history. This disrupts agricultural productivity, energy systems, and public health infrastructure. Such environmental disturbances highlight not only the ecological dimension of climate change but also its profound economic and social implications. Beyond its environmental impacts, the negative externalities of climate change have drawn significant attention from regulators and financial institutions (Zhao, Yao, & Huang, 2025). Climate change directly affects both economic stability and the global financial system. Therefore, the global financial system is required to adapt in managing increasingly complex climate risks.

In the financial context, climate-related risks are generally categorized into two types: physical risks and transition risks. Both physical and transition risks act as risk drivers for climate-related financial risks (Sari, 2024). When financial risks are driven by global market volatility, climate change, technological disruptions, and geopolitical uncertainties, they generate complex challenges for both economic stability and environmental sustainability

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(Yang, Sultan, Ibrahim, Xakimov, & Zhang, 2025). These two forms of risk not only affect asset values and trigger market volatility but may also increase non-performing loans and, ultimately, threaten the stability of financial institutions. This condition underscores the close interrelation between climate risks and financial stability, thereby necessitating appropriate financial instruments to mitigate the adverse impacts of climate change.

This is where the financial sector plays a crucial role as an instrument to help address negative impacts, including serving as a key supporter of climate change mitigation and adaptation. A variety of innovative financial mechanisms have emerged, ranging from green bonds and climate risk insurance to multilateral financing instruments designed to strengthen economic resilience. Through these instruments, financing can flow into sustainable projects that not only reduce emissions but also enhance the adaptive capacity of communities and economic systems in the face of climate change. Accordingly, the interconnection between climate risks and climate finance gives rise to an important concept known as climate risk finance. In a broader context, climate risk finance has become both the most necessary and the most effective instrument for addressing global climate challenges. Therefore, climate finance occupies a central position as a primary mechanism for reducing climate change risks while simultaneously safeguarding the sustainability of economic development.

However, although the concept of financing climate risks is becoming increasingly relevant, the term climate risk finance has unfortunately not yet been widely adopted as a standalone keyword in academic literature. Instead, similar ideas are often reflected in more general terms such as climate change, climate risk, and climate finance. Climate risk primarily focuses on the impacts of climate change on economic stability and the financial system, whereas climate finance emphasizes funding mechanisms for mitigation and adaptation to climate change. Although these two domains are closely interrelated, they are still rarely integrated explicitly within a single comprehensive analysis.

2. Literature Review

Climate change poses an increasing threat to financial stability and undermines infrastructure, thereby weakening national resilience. Climate risks not only affect ecosystems and the environment but also have broad economic and social consequences (Suciati, 2025). These risks heighten the likelihood of climate-related disasters such as floods, storms, droughts, wildfires, landslides, and extreme weather events, all of which are expected to be significantly exacerbated by climate change. Climate risks are not limited to the environmental impacts of climate change but are also closely linked to economic and financial issues. The impacts of climate risks on the financial system are generally classified into two categories based on their underlying drivers (Yang & Geng, 2025). Physical risks refer to financial impacts caused by climate change events such as extreme weather, storms, droughts, and floods that reduce asset values (Chabot & Bertrand, 2023). Transition risks, on the other hand, are associated with regulatory changes, technological shifts, and the reallocation of investments toward low-carbon assets (Gaies, 2025). One of the primary objectives and functions of climate finance is to channel funds to countries or regions that need to reduce carbon emissions, implement mitigation measures, and adapt to climate change.

Since the adoption of the Paris Agreement in 2015, various countries have implemented a range of measures to achieve climate governance. In the past decade, the number of publications related to climate change and finance has increased. However, until now, only a few studies have directly combined the issues of climate risk and finance in a single study. Although the concept of climate risk finance is becoming increasingly relevant, the term has unfortunately not yet been widely used as a standalone keyword in academic literature. Most research discusses the fields of climate risk and climate finance separately, either from the perspective of climate risk or from that of climate finance. In addition, the idea of climate risk finance can also be reflected in more general terms such as climate change, climate risk, and climate finance.

3. Proposed Method

Initially, a search was carried out in the Scopus database and the evaluation of the obtained documents was divided into three phases (Figure 1): (Phase 1) definition of search criteria to identify records in the Scopus database and refinement of retrieved records (data collection phase); (Phase 2) the documents were exported to the VOSviewer Software for bibliometric analysis of publications, authors, countries, institutions journals, and areas (data visualization phase); and (Phase 3) data analysis to identify the main themes discussed in research developed about climate risk finance in Indonesia.research developed about climate risk finance in Indonesia.

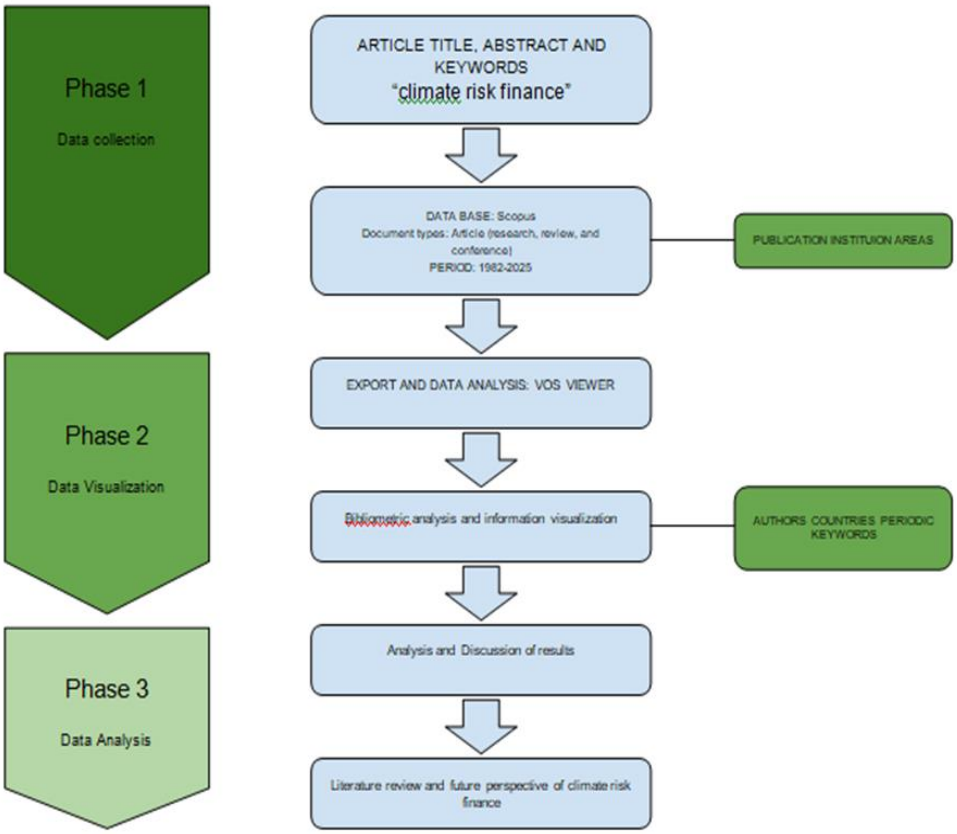

Figure 1. Methodology phases applied to the present work.

This study used bibliographic information from the Scopus article database between 2019 and 2024 (Figure 1). The sampling technique employed in this study was total sampling. The variables examined included publication titles, authors, abstracts, keywords, year of publication, publishing journals, publication types, and affiliations.

The search results were then downloaded using the Scopus export tool in .csv format and synchronized with Mendeley Desktop. Descriptive analyses (e.g., annual number of publications, number of publications by author, publishing journals) were processed using Microsoft Excel. Topic trend maps were generated with VOSviewer version 1.6.20 in .csv format. The mapping was conducted using keyword co-occurrence analysis as the unit of analysis, including network visualization of keyword mapping and keyword density (hotspots).

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4. Results and Discussion

Bibliometric analysis tools were employed in this study to provide insights into publication trends within the examined research field. The figure below presents an overview of the key information regarding research outputs spanning a considerable period. The database used covers a long range, extending from 1982 to 2026. The inclusion of data up to 2026 indicates the presence of articles still categorized as in press or pre-publication, thereby ensuring that the available information not only reflects well-established past literature but also incorporates the most recent studies that are soon to be published. This demonstrates that bibliometric analysis offers a more comprehensive perspective by capturing the latest research trends. The dataset comprises 769 publication sources and a total of 2,079 documents, with an annual publication growth rate of 1.59%, highlighting the field's consistent stability over time. The analysis involves 8,987 authors, with no single-authored documents identified, indicating a relatively high level of collaboration in this domain. Furthermore, the percentage of international co-authorship reaches 30.5%, with an average of 9.04 authors per document, suggesting that publications in this field are predominantly produced by large research teams.

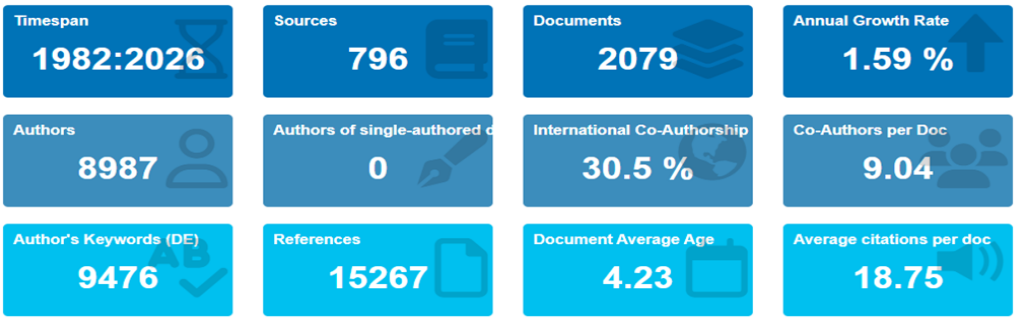

Figure 2. Main information overview (using R Studio).

This dataset also includes 9,476 distinct keywords provided by the authors to describe the focus of their studies. The number of keywords indicates the diversity of topics as well as the broad scope of issues being examined. Meanwhile, there are a total of 15,267 citations, with the average age of the documents being 4.23 years. This summary presents an overview of collaboration patterns, research impact, and the dynamics of development within the studied academic field.

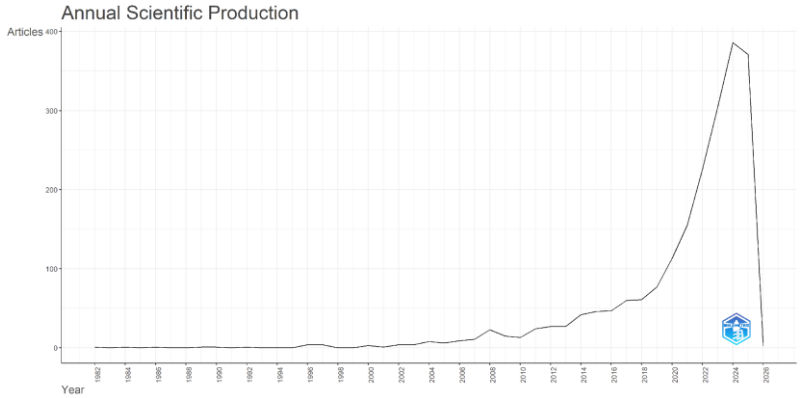

Figure 3. Annual Scientific Production (using R Studio).

The figure presents a graph of the Annual Scientific Production analysis, which shows the number of scientific publications released each year between 1982 and 2026. In the early part of the period, from 1982 until around 2000, the number of publications was relatively very low and stable, almost close to zero with only a few articles per year. This condition illustrates that during the first two decades, the research topic under analysis had not yet received significant attention from the scientific community. Entering the early 2000s through 2010, a slight increase began to appear, although still limited and with relatively slow growth. It was only after 2015 that a noticeable surge in publications occurred. The graph shows a gradual upward trend between 2018 and 2020, indicating a significant acceleration with a sharper rise in the number of publications. This suggests that more researchers were becoming interested in conducting studies in this field. The number of articles peaked in 2024, with nearly 400 publications, before slightly declining in 2025, although the figure remained relatively higher compared to previous periods. A sharp drop is evident in 2026, when the number of publications appears to return to nearly zero. However, this decline is not due to reduced research interest but rather because 2026 falls within a future projection. Thus, the graph demonstrates that research in this field has experienced exponential growth over the past decade, particularly after 2020, coinciding with the rising urgency of related issues at the global level. This finding highlights how the field has transformed from being relatively overlooked into a topic that is now receiving considerable attention in international academic literature.

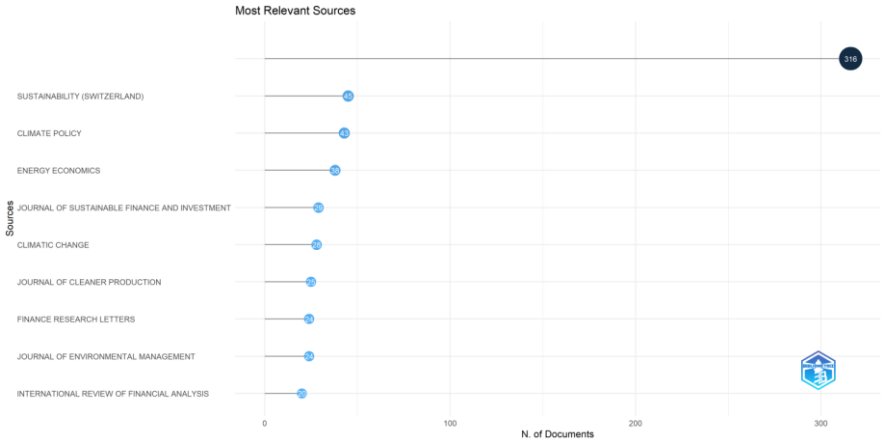

Figure 4. Most Relevant Sources (using R Studio).

This figure presents a bar chart illustrating the distribution of documents according to the most relevant scientific publication sources, sorted by the number of documents they have contributed. The left side of the vertical axis lists the publication sources, while the horizontal axis represents the number of documents. Each bar indicates the volume of documents published by a particular source, labeled with the corresponding number of documents. From the chart, several leading or top sources can be identified as the most frequently appearing.

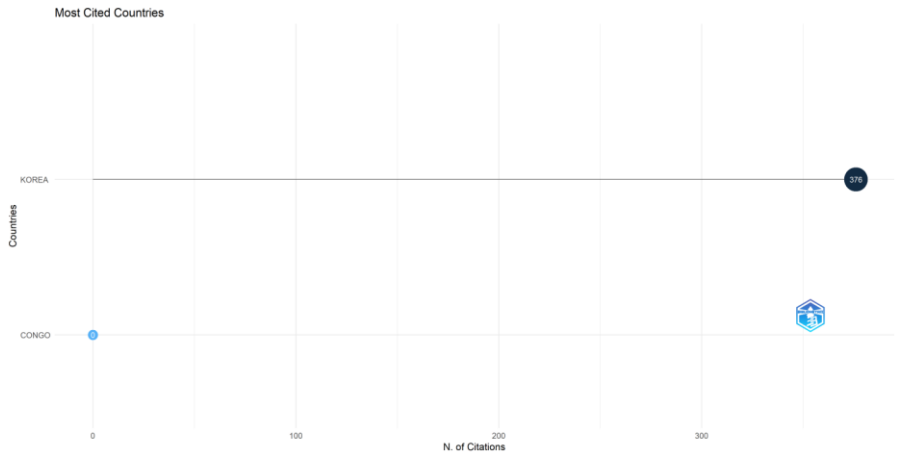

Figure 5. Most Cited Countries (using R Studio).

This figure is a bar chart illustrating the distribution of citation counts associated with the authors' countries of affiliation. In other words, the diagram demonstrates how frequently these countries are referenced through citations. The horizontal axis represents the number of citations (N. of Citations), while the vertical axis lists the names of the cited countries. In this chart, only two countries are explicitly labeled: KOREA and CONGO. Korea records a total of 376 citations, which is the highest in the diagram, indicating that it is the most frequently cited country. Meanwhile, Congo appears on the chart but shows zero citations, suggesting the absence of citation impact from this country in the dataset. For other countries, the chart does not display specific names, which may indicate either very low or unreported citation counts in this visualization. This pattern highlights a significant disparity in citation distribution across countries, with Korea standing out as a dominant contributor in terms of research impact, while other nations, such as Congo, register negligible or no influence in the context of the analyzed publications.

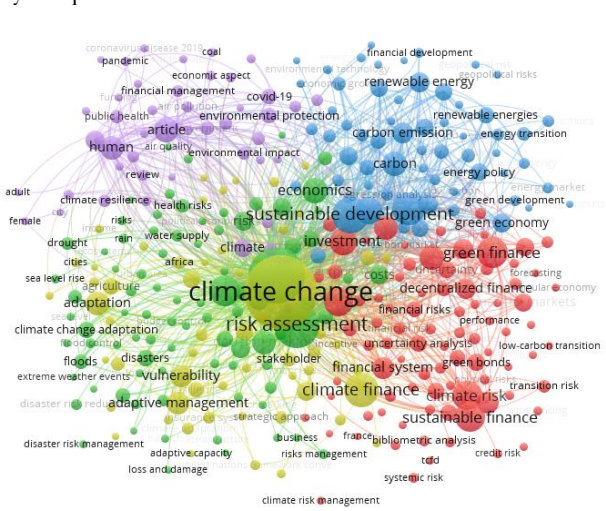

Figure 6. Network Visualization (using Vos Viewer)

The figure represents a network map that visualizes the co-occurrence of keywords obtained from publications related to the topics of climate change, climate finance, and climate risk. This visualization is based on co-occurrence analysis, where each circle or node represents a keyword, and the size of the circle indicates the frequency of that keyword's appearance in the documents. Meanwhile, the connecting lines between nodes illustrate the relationships or associations among keywords that often appear together in the same article. The map is color-coded red, yellow, green, blue, and purple to cluster related terms, with each color representing a group of research topics that share thematic proximity. The green cluster contains keywords such as economics, insurance, risk management, and risk assessment. This cluster reflects research focusing on risk management and economic aspects. The yellow cluster includes climate change, climate finance, vulnerability, and adaptive management. This

group generally represents studies that emphasize vulnerability and adaptation to climate change, including disaster risk mitigation and adaptive management strategies. The main concern in this cluster is how societies, regions, or specific sectors respond to the direct impacts of climate change, such as floods, droughts, or other natural disasters. The red cluster consists of keywords such as climate risk, sustainable finance, green finance, financial risks, and green bonds. This cluster highlights the role of the financial sector in addressing climate-related risks. Research in this group explores green financing mechanisms, sustainable financial instruments, and efforts to manage climate risks through capital markets, green bonds, and regulations related to transition risks. In doing so, this cluster underscores the strong connection between climate change and the stability of the global financial system. The blue cluster features keywords such as renewable energy, carbon emission, energy transition, and energy policy. The main theme here is the energy transition toward renewable energy sources and the reduction of carbon emissions. Studies within this cluster emphasize energy policies, environmentally friendly technologies, and decarbonization strategies as essential components of climate change mitigation. Finally, the purple cluster includes keywords such as COVID-19, pandemic, public health, environmental impact, air pollution, and climate. This cluster reflects a relatively new connection in the literature, namely how the COVID-19 pandemic has influenced the discourse on environmental health, air pollution, and its broader implications for sustainability and climate change adaptation. Altogether, this network map reveals the multidimensional nature of climate change research, spanning from economic and financial perspectives to energy transition and public health, showing how these diverse but interconnected themes shape the broader academic landscape.

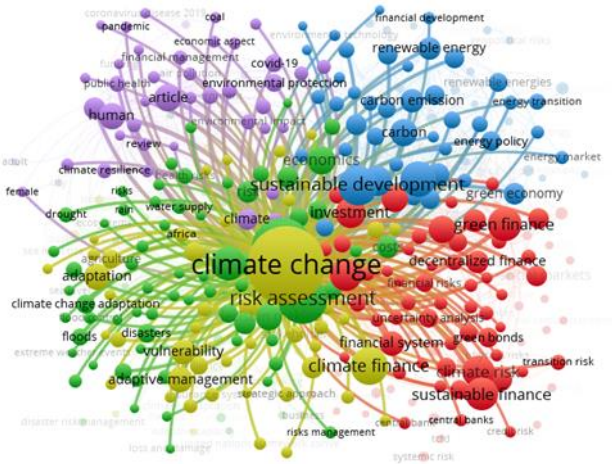

Figure 7. Network Visualization of Term Climate Risk Finance (using Vos Viewer).

This figure represents a detailed co-occurrence network map, which is used to illustrate the relationships between key terms or concepts within the scope of bibliometric research. The network is composed of nodes, representing terms or concepts, and edges, or connecting lines, which demonstrate the frequency of co-appearance of these terms within research articles or datasets. To facilitate interpretation, the map employs a color-coded clustering system that groups interrelated terms into distinct clusters, thereby enabling the identification of thematic concentrations within the broader research domain. The most prominent and central term in this network is climate change, represented by a large yellow node at the center of the map. This prominence indicates that research in the field is strongly centered around climate change and its associated concepts. Closely related terms such as climate risk, climate finance, risk assessment, sustainable development, and finance are also strongly connected to climate change, reflecting their frequent co-occurrence in studies addressing the broader discourse of climate change. The dense connections among these nodes highlight the interdisciplinary nature of the field, bridging environmental, financial, and policy-related themes. Interestingly, although this study specifically investigates climate risk finance as a mechanism for addressing climate-related risks through financing strategies, the term climate risk finance itself does not appear in the visualization. This absence suggests that relatively few, or possibly no, prior studies have employed climate risk finance as a standalone keyword in academic literature. Consequently, the trends in climate risk finance research must be

examined indirectly by analyzing the intersection of related keywords such as climate risk, climate finance, and climate change. By connecting these nodes, it becomes possible to understand how the concepts of climate risk and climate finance jointly interact within the broader discourse on climate change. Such an analysis underscores how financial mechanisms are increasingly positioned as crucial tools for mitigating and adapting to the risks associated with climate change. The interlinkages also reflect a growing recognition that climate-related challenges cannot be addressed solely from an environmental perspective, but rather require the integration of financial strategies and risk management approaches. Overall, the network highlights both the centrality of climate change in the research field and the emerging but underdeveloped space for climate risk finance. The absence of the latter as a distinct node reveals an important research gap and underscores the need for future studies to frame climate risk finance more explicitly as a scholarly keyword. Doing so would allow for clearer mapping of its position within the literature and a better understanding of its role in linking climate science, financial innovation, and risk governance in addressing global climate challenges

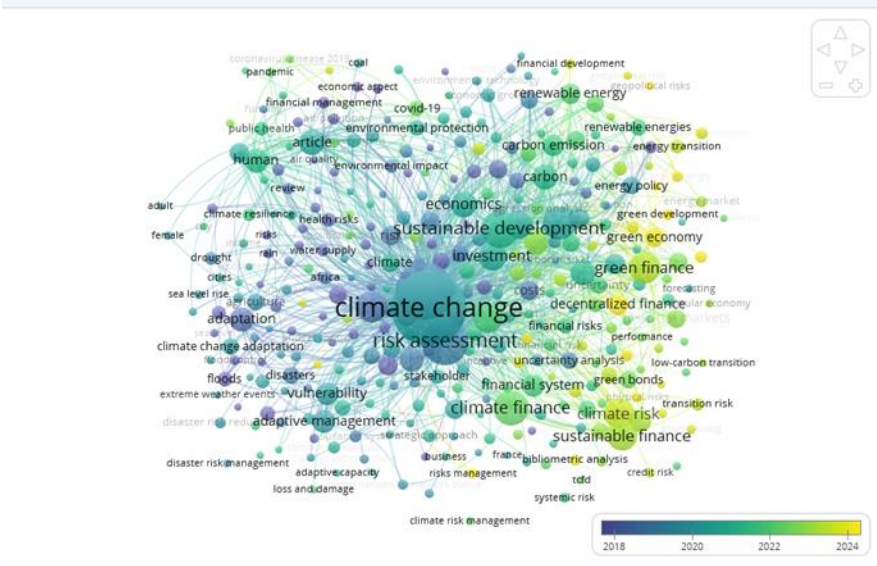

Figure 8. Overlay Visualization of Term Climate Risk Finance (using Vos Viewer)

The figure presented is the result of an overlay visualization of keyword analysis conducted using the VOSviewer software. This visualization depicts the research landscape related to climate change while emphasizing temporal developments based on the average year of publication. The colors of the circles represent the time of keyword emergence: dark blue indicates relatively early keywords (around 2018–2019), green represents keywords emerging in the mid-period (2020–2021), while yellow highlights newer keywords (2022–2024). The size of each circle reflects the frequency of keyword occurrence, while the lines connecting the circles indicate the relationships or co-occurrences of terms within the same documents. In general, the keyword "climate change" occupies the most dominant position, represented by the largest circle and connected to almost all other keywords. This shows that climate change serves as the central theme in the analyzed literature. Related keywords such as "risk assessment" and "sustainable development" also occupy strategic positions with larger sizes, indicating that these are recurring and significant themes in research. Meanwhile, more specific terms such as "climate finance," "sustainable finance," and "green finance" appear in yellow, suggesting that research on these topics has emerged more recently, particularly in the past three to four years. Tracing the color patterns reveals a shift in research focus from traditional issues to more contemporary themes. In the early phase (represented by blue), research largely concentrated on adaptation and vulnerability, with keywords such as adaptation, vulnerability, floods, drought, and disaster risk management. These issues reflect academic attention toward the physical impacts of climate change and mitigation efforts based on ecological measures and environmental policies. Moving into the green period (around 2020–2021), research attention shifted toward sustainable development and renewable energy, indicated by keywords such as sustainable development, renewable energy,

carbon emission, and energy transition. This stage highlights a strong connection with long-term mitigation strategies and the transformation of global energy systems. In the most recent phase (represented by yellow), research has increasingly focused on sustainable finance and climate-related risks within economic systems. Keywords such as climate finance, climate risk, sustainable finance, green bonds, financial risks, and transition risk illustrate how climate change is no longer viewed solely as an environmental issue but has also become a critical determinant in financial policies, investment decisions, and global economic stability. Thus, this overlay visualization map demonstrates the dynamic evolution of the literature: research that initially focused on physical impacts and adaptation (blue phase) expanded into sustainable development and energy (green phase), and has more recently shifted toward climate finance and financial risk management (yellow phase). This pattern reveals the future direction of research, which increasingly emphasizes the role of the financial sector in climate change mitigation and adaptation. These findings carry important academic and practical implications, highlighting that climate studies are now situated at the intersection of environmental science and economic-financial analysis, opening opportunities for further interdisciplinary research in the years to come.

5. Conclusions

The results of the bibliometric analysis indicate that research on climate change, climate finance, and climate risk has developed significantly and gained increasing attention over the past two decades. The data analyzed covers a long period from 1982 to 2026, with a trend of exponential publication growth since 2015, peaking in 2024. The high level of author collaboration, both at national and international levels, reflects the highly interdisciplinary and collaborative nature of this field of study. Keyword analysis shows that climate change serves as the central theme in the literature, closely linked to other concepts such as risk assessment, sustainable development, climate finance, and climate risk. The network visualization reveals five main clusters, ranging from risk management and economics, climate vulnerability and adaptation, sustainable finance, energy transition, to the intersection of public health and the COVID-19 pandemic. These findings highlight that climate change is not only an environmental issue but also closely connected to economic, social, health, and global financial stability aspects. Through overlay visualization, a shift in research focus is observed: from adaptation and vulnerability (early phase), to sustainable development and energy transition (intermediate phase), and finally to more contemporary issues concerning sustainable finance and financial risk management (current phase). This shift indicates the growing importance of the financial sector in supporting climate change mitigation and adaptation. Overall, this study emphasizes that the literature on climate change continues to evolve toward cross-disciplinary integration, particularly between environmental science and finance. Research gaps, such as the absence of the explicit use of the term climate risk finance as a primary keyword, present important opportunities for future investigation. Thus, these findings hold both academic and practical implications, especially in shaping policies, financial instruments, and collaborative strategies to comprehensively address the global challenges of climate change.

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