



## Bibliometrics Analysis of Green Financing Research

Endang Pitaloka<sup>1\*</sup>, Edi Purwanto<sup>1</sup>, Yohanes Totok Suyoto<sup>1</sup>, Agustine Dwianika<sup>2</sup>, Delfi Anggreyani<sup>1</sup>

<sup>1</sup> Department of Management & Jaya Launch Pad, Universitas Pembangunan Jaya, South Tangerang 15413, Indonesia

<sup>2</sup> Department of Accounting & Jaya Launch Pad, Universitas Pembangunan Jaya, South Tangerang 15413, Indonesia

Corresponding Author Email: [oka@upj.ac.id](mailto:oka@upj.ac.id)

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### ABSTRACT

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*green financing trends, bibliometric analysis, environmental concerns, sustainable finance, thematic clusters*

The study investigates the trends and dynamics in green financing using bibliometric analysis techniques. Green financing has gained momentum due to its alignment with global environmental concerns and sustainability goals. It involves funding economic endeavors that offer ecological benefits, particularly in mitigating adverse impacts on environmental sustainability and global warming. The study explores various aspects of green financing research, including its publication trends, geographical distribution, prominent journals, leading institutions, authors, and thematic clusters. The methodology employs bibliometric analysis utilizing Scopus and VOSviewer tools to discern patterns and advancements in Green Financing. The research identifies key clusters of themes in green financing, such as alternative energy, carbon emissions, economic development, and sustainable investment. The study highlights the significance of green financing in addressing environmental challenges, fostering innovation, and driving sustainable economic growth. The top journals, institutions, and authors contributing to the field are also identified, focusing on their affiliations and countries of origin. Through comprehensive analysis, the study aims to provide insights into the trajectory of green financing research, facilitate future research directions, and contribute to advancing sustainable finance practices.

## 1. INTRODUCTION

In recent years, the field of green financing has made significant strides in advancing our understanding of sustainable financial practices [1, 2]. The escalating research endeavors in this area parallel the global surge in adopting green financing mechanisms. Across the world, numerous nations are embracing green financing to address transformative shifts within various industries. This strategy effectively merges diverse environmental objectives, spanning from the mitigation of industrial pollution to the stewardship of water quality and biodiversity conservation [3].

The central tenet of “green financing” revolves around funding economic and business initiatives that yield ecological benefits, often under the umbrella of green economic development [4]. Underscore the alignment of green financing with the principles of environmental finance, explicitly targeting companies and enterprises dedicated to minimizing adverse impacts on both environmental sustainability and the looming specter of global warming. The unifying thread that ties together the concepts of the green economy, green financing, and environmental finance is their shared focus on allocating resources strategically to surmount financial hurdles through sustainable growth [5]. Notably, green financing assumes a pivotal role in propelling the clean and renewable energy sector, infusing considerations of long-term viability into the decision-making fabric of economic activities. The

cumulative effect of green financing manifests in enhancing ecological well-being and promoting sustainable development [6].

As Lin et al. [7] emphasized, the strategic deployment of green financing strategies plays a dual role: it contributes to reducing carbon emissions while simultaneously extending the lifespan of environmentally conscious economic recuperation. The study posits that the skillful execution of green financing policies could amplify the efficacy of carbon emission reduction efforts and even metamorphose climate change into a catalyst for favorable national outcomes, facilitating a gradual economic resurgence [7].

The past research indicates that green financing constitutes a subset of Sustainable Finance Innovation. Scholarly attention has progressively gravitated toward the innovation of sustainable financial instruments, including green bonds [8-10], sustainable loans [2, 11], and various financial mechanisms designed to bolster eco-friendly projects [12]. This research endeavor aims to foster the creation of novel financial frameworks that expedite investments in sustainable undertakings.

Furthermore, deeper exploration reveals the intricate nexus between green financing and its attendant Environmental and Social Impacts. Research within this domain is broadening to unearth more effective methodologies for assessing the environmental, social [11, 13, 14], and sustainable investment dimensions [15-17] stemming from green financing initiatives.

Lin et al. [7] meticulously scrutinize the regulatory and policy landscapes surrounding green financing [7]. This growing trend in research encompasses an in-depth investigation into governmental regulations and policies that wield influence over sustainable financing [7, 18, 19]. The present study focuses on the role of regulations in either fostering or hindering sustainable funding growth and the consequential policy ramifications for stakeholders in the market.

Multiple antecedent studies have probed the dimensions of public awareness, financial institutions, and market dynamics concerning green financing. Chen et al. [20] discern an ascending awareness about the role of green financing, paralleled by an augmented demand for green financing vehicles, as the public directs their attention toward financial entities. The escalating emphasis on education and awareness campaigns in sustainable finance is palpable, encompassing initiatives to enhance comprehension of the advantages and practices underpinning sustainable financing. This wide-ranging effort involves interventions that target the general public, market participants, and financial institutions alike [20-22].

The domain of green financing is inextricably intertwined with the tapestry of technological innovation. Sharif et al. [23] delve into the symbiotic relationship between technological advancement, green financing, and endeavors to curb carbon emissions. Emerging research trends also encompass the interplay between technological breakthroughs and sustainable finance. Studies conducted by Liu et al. [24] shed light on the transformative potential of technological innovation in augmenting efficiency and risk management within sustainable funding. Concurrently, other scholars have delved into the global and local concerns intersecting with green financing. The landscape of sustainable finance increasingly takes into account both global and localized issues, spanning from climate change [25-27] to renewable energy [3, 5, 28], and the broader global economic panorama [20, 29, 30]. These investigations aim to bridge the gap between sustainable finance and tangible solutions for the complex interplay of global economic and environmental challenges.

Green financing has witnessed substantial growth in recent years, with increasing research efforts reflecting a global surge in adopting sustainable financial practices. However, despite this momentum, a notable gap exists in the literature regarding a comprehensive analysis of the evolving trends in green financing through bibliometric methods. Previous studies have explored various dimensions, such as the role of green financing in carbon emission reduction, the symbiotic relationship with technological innovation, and the intricate nexus with environmental and social impacts. Yet, a holistic bibliometric analysis that dissects data based on geographical affiliations, authorship, and thematic keywords still needs to be explored.

Our study seeks to fill this research gap by employing VOS Viewer software and utilizing Scopus-indexed journals as the principal data source, systematically exploring green financing research. By doing so, we aim to contribute a unique perspective to the existing body of literature, unraveling trajectories and contours within the field. This approach addresses the need for a comprehensive bibliometric analysis and positions our study to make significant contributions to the understanding of green financing trends, ultimately serving as a practical touchstone for future research endeavors in sustainable finance.

Our study on the bibliometric analysis of green financing research aims to unravel the evolving trends within the field. It holds potential implications for informing and guiding policymakers in shaping effective regulations and policies. Examining regulatory and policy landscapes becomes pivotal as we delve into the intricate nexus between green financing and its environmental and social impacts. By thoroughly scrutinizing the existing governmental regulations and policies influencing sustainable financing, our findings may shed light on areas where policies can be refined, strengthened, or innovatively developed.

In light of our comprehensive analysis, we offer insights that can guide policymakers in fostering an environment conducive to sustainable funding growth. This could involve recommendations for aligning regulations with emerging trends, addressing potential barriers to green financing, and strategically incentivizing investments in eco-friendly projects. Furthermore, by identifying correlations among different themes and clusters within green financing research, our study may highlight areas where targeted policies could amplify positive outcomes or mitigate potential risks.

Ultimately, our research aspires to provide a nuanced understanding of green financing trends and practical recommendations that can inform the evolution of policies, ensuring they are adaptive and responsive to the dynamic landscape of sustainable finance. Through this dual lens of analysis and policy implications, our study seeks to contribute to the academic discourse and the real-world implementation of policies that foster environmentally conscious economic development.

The evolving trends in green financing research underscore the dynamic evolution within sustainable finance studies, demonstrating an escalated awareness and commitment to sustainable development and environmental preservation. In light of these trends, this research sets out to unravel the trajectories and contours of green financing by utilizing the VOS Viewer software, with Scopus-indexed journals as the principal data source. Employing “green financing” as the focal keyword, the authors conducted a comprehensive bibliometric analysis of the field.

Through this comprehensive analysis, the authors chart the various trajectories of research within green financing, meticulously dissecting data based on geographical affiliations, authorship, and thematic keywords while contextualizing these findings within the existing body of literature on green financing. This research endeavor aspires to furnish a practical touchstone for future studies and the unfolding evolution of theories related to green financing.

The specific objectives of this study encompass the following facets: (1) To analyze and understand the evolving trends in green financing through a comprehensive bibliometric analysis. (2) To investigate the distribution of publications related to green financing across different formats. (3) To categorize and analyze the distribution of green financing publications according to subject areas. (4) To identify, evaluate, and rank the top journals that are significant platforms for green financing publications. (5) To analyze and visualize the global geographical distribution of publications related to green financing. (6) To identify and showcase the leading institutions and authors in green financing research. (7) To analyze and explore clusters of themes within green financing research. (8) To analyze the correlations among different themes and clusters in green financing research and identify potential research gaps arising from these

correlations. (9) Uses density visualization techniques to assess the research concentration within specific themes and clusters related to green financing.

The research endeavors to contribute novel insights by utilizing bibliometric analysis through VOS Viewer software and Scopus-indexed journals to comprehensively unravel the evolving trends in green financing. By meticulously dissecting data on geographical affiliations, authorship, and thematic keywords, the research goes beyond conventional boundaries to comprehensively understand the evolving trends in green financing. This novel approach aims to provide a practical touchstone for future studies, contributing unique insights into the dynamics of sustainable finance.

## 2. METHODOLOGY

The bibliometric investigation highlights specific inquiries and proposed considerations for researchers at each process stage. The initial phase involves precisely defining the objectives and scope of the bibliometric research. Before proceeding to the second stage, scholars should carefully opt for appropriate bibliometric analysis techniques. In the third stage, meticulous data gathering for the bibliometric analysis holds considerable significance. Finally, in the fourth stage, researchers are tasked with conducting the bibliometric analysis, meticulously documenting, and presenting their findings [31].

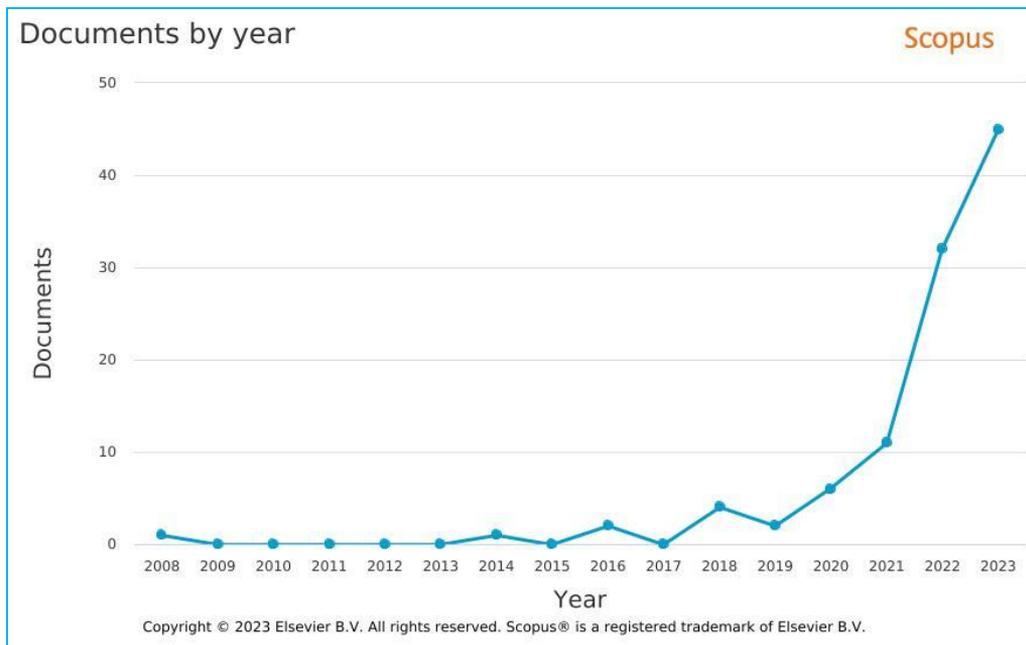
This scientific exploration employs bibliometric analysis as its chosen research methodology and draws upon data from Scopus and VOSviewer to illustrate the trends in green financing research. One trustworthy indexing database is Scopus. Academic publications, conference proceedings, and journals of superior quality are all included in Scopus. The database uses strict selection criteria in an effort to include credible, peer-reviewed sources, which raises the standard of the information as a whole. In this instance, data from the Scopus database may be deemed reliable for bibliometric analysis.

The study uses analytical and visualization tools (Scopus analysis and VOSviewer) to investigate patterns, connections, and progressions in the application of the topic under study [32]. While using Scopus ensures a comprehensive dataset, it is essential to note that the database may not encompass all potential sources related to green financing. The limitations inherent in database coverage and indexing criteria may result in the exclusion of some relevant publications. Additionally, the analysis is confined to documents mentioning green financing in their title, potentially overlooking pertinent studies that may employ different terminologies. Future research could address these limitations by exploring alternative databases and using broader search criteria to capture a more exhaustive range of relevant literature. Furthermore, the dynamic nature of the field may introduce a time lag in the availability of the latest publications, impacting the real-time representation of trends. Continuous updates and exploration of additional databases could enhance the accuracy and comprehensiveness of future bibliometric analyses in this domain.

## 3. RESULT OF BIBLIOMETRICS ANALYSIS

### 3.1 The research trend in green financing

To comprehend the evolving landscape of research in the realm of green financing, the researcher has conducted an exhaustive bibliometric analysis, encompassing an array of scholarly outputs, including journal publications, proceedings, book chapters, and other scientific contributions within the Scopus database. By employing the search term "green financing" in title searches, a corpus of 102 articles has been meticulously curated, spanning the temporal span from 2008 to 2023, as illustrated in Figure 1. The graphical representation of annual dissemination patterns is provided in Figure 1, effectively capturing the dynamic evolution of research attention.



**Figure 1.** The research trend in green financing  
Sources: Scopus.com (August 2023)

This growing phenomenon finds deep-seated connections with advancements transpiring within the realms of both financial and technological spheres. Both domains have emerged as vital arenas for catalyzing pioneering innovation, setting the stage for a strategic response to multifaceted challenges, particularly those posed by climate change. Consequently, the propulsion of green financial innovation and green technology innovation assumes the role of a paramount strategy, as they collectively contribute to tackling the complexities of environmental degradation.

It is worth acknowledging that the momentum propelling these innovations is fortified by environmental regulations, as highlighted by study [33]. These regulatory frameworks provide a compelling impetus, further accelerating the progress and uptake of innovations in sustainable finance and technology.

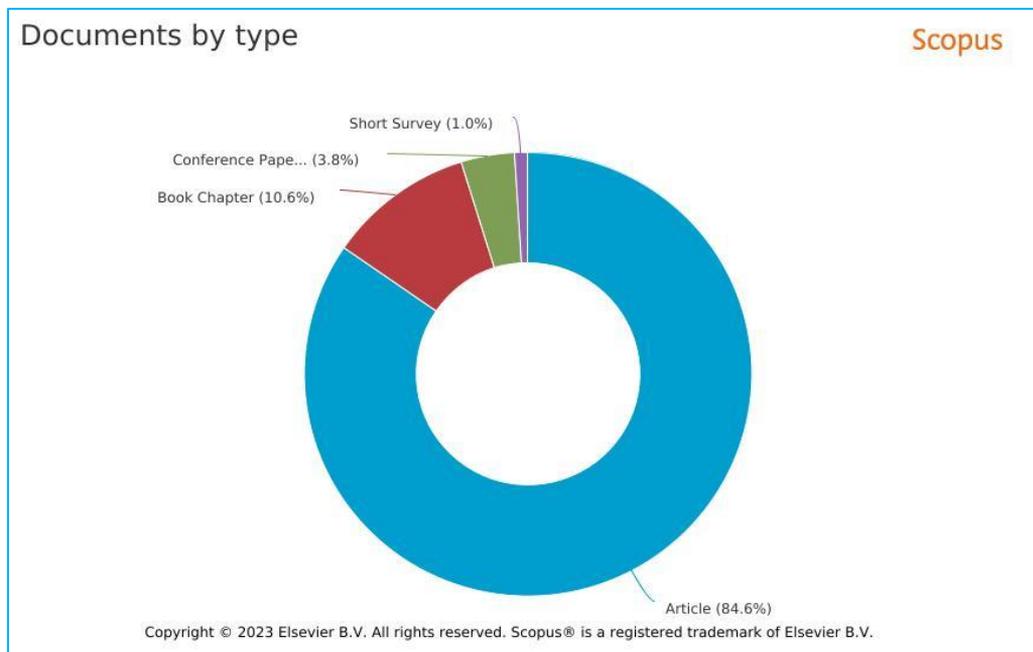
This comprehensive bibliometric analysis offers illuminating insights into the evolving research landscape centered on green financing. This surge in scholarly attention and production directly responds to the growing urgency for sustainable financial and technological solutions, which are necessary to address the intricate environmental challenges confronting our world today.

The bibliometric analysis of green financing reveals several key trends and insights, shedding light on the evolution, distribution, and concentration of research in this domain.

The dynamic research trend depicted in Figure 1 showcases a steady increase in scholarly outputs from 2008 to 2023. This surge indicates the growing global awareness and commitment to sustainable financial and technological solutions. The interconnectedness of financial and technological innovations catalyzed by environmental regulations underscores the pivotal role of these factors in addressing environmental challenges.

### 3.2 Distribution of green financing publications by type

Figure 2 offers a comprehensive panorama of the distribution of publications encompassing green financing across diverse formats. Notably, a significant majority, amounting to 83.8% of the entire corpus, finds its place within esteemed journal publications, contributing a substantial count of 86 documents. Approximately 11% is observed, contributing 11 papers in book chapters. The residual portion encompasses a heterogeneous amalgamation of conference papers, proceedings, and formats. This statistical portrayal robustly underscores the prevailing trend of empirical research that is diligently centered on green financing, where reputable journals function as the primary conduits for disseminating scholarly insights. This accentuates the instrumental role played by these journals in orchestrating the propagation of knowledge within this dynamic sphere.



**Figure 2.** Green financing publications by type  
Sources: Scopus.com (August 2023)

Figure 2 highlights that a significant majority of publications (83.8%) are found in esteemed journal publications, emphasizing the role of journals as primary conduits for disseminating insights. This indicates a strong focus on empirical research within the green financing discourse.

### 3.3 Distribution of green financing publications by subject area

When the distribution is scrutinized through the lens of subject areas, Figure 3 comes to the fore as an illustrative

exposition. The graphical representation in Figure 3 underscores five primary subject areas that have ascended as the central bastions of green financing studies that significantly contribute to the discourse of green financing: (1) Economic, Econometric, and Finance (23%): Within this domain, a tally of 46 documents stands tall, embodying the intricate convergence of economic principles, statistical methodologies, and financial strategies within the overarching canvas of green financing dialogue. (2) Environmental Science (23.5%): This expansive domain embraces a corpus of 47 documents, spotlighting the profound interlinkages between green financing and the broader ecological landscape.

(3) Energy (13.5%): Within this ambit, a collection of 27 documents holds sway, substantiating the pivotal role of the energy sector as an integral dimension within the tapestry of green financing, accentuating its paramount significance in steering the trajectory towards sustainable energy solutions. (4) Social Science (14%): This category commands 28 documents, underscoring the critical import of societal, behavioral, and human-centric dimensions in shaping the execution and repercussions of green financing endeavors. (5) Business, Management, and Accounting (8.5%): Within this purview, 17 documents coalesce, spotlighting the essential role of astute

business management and prudent financial accounting practices as catalysts in propelling successful green financing ventures.

The distribution across subject areas, as illustrated in Figure 3, underscores the multidisciplinary nature of green financing studies. Noteworthy concentrations are observed in Economic, Econometric, and Finance (23%) and Environmental Science (23.5%). This diversity reflects the intricate convergence of economic, environmental, and financial principles within the green financing dialogue.

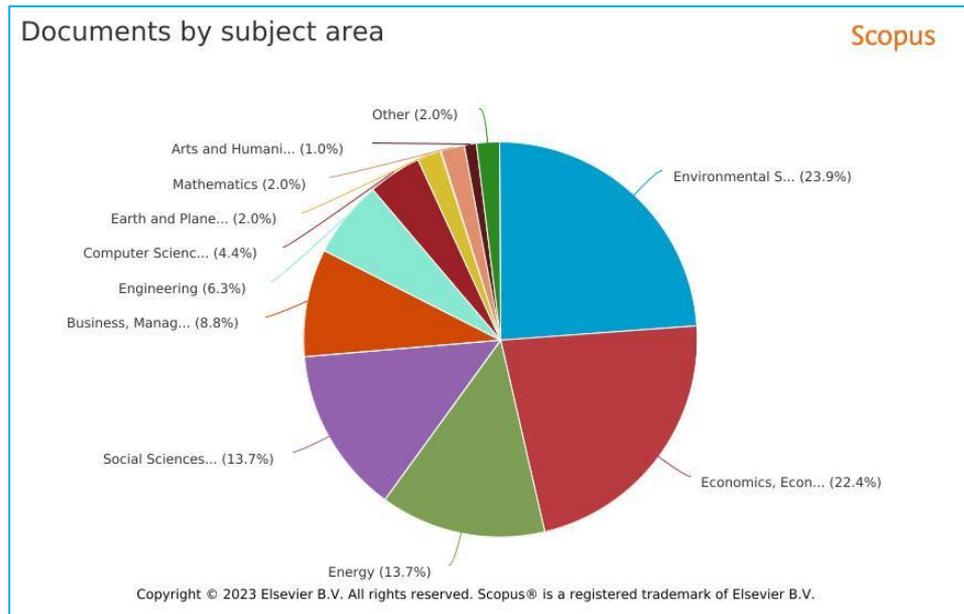


Figure 3. Publications by subject area  
Sources: Scopus.com (August 2023)

### 3.4 Top journals in green financing

Figure 4 unveils the hierarchy of the five prominent journals that serve as platforms for publications in green financing. Leading the pack is *Environmental Science and Pollution Research*, boasting a compilation of 13 documents spanning

the years 2021 to 2023. This journal caters to the global academic community across various domains of Environmental Science and its interconnected disciplines, explicitly emphasizing the study of chemical substances. Moreover, it extends its purview to encompass the intricate landscape of environmental economics.

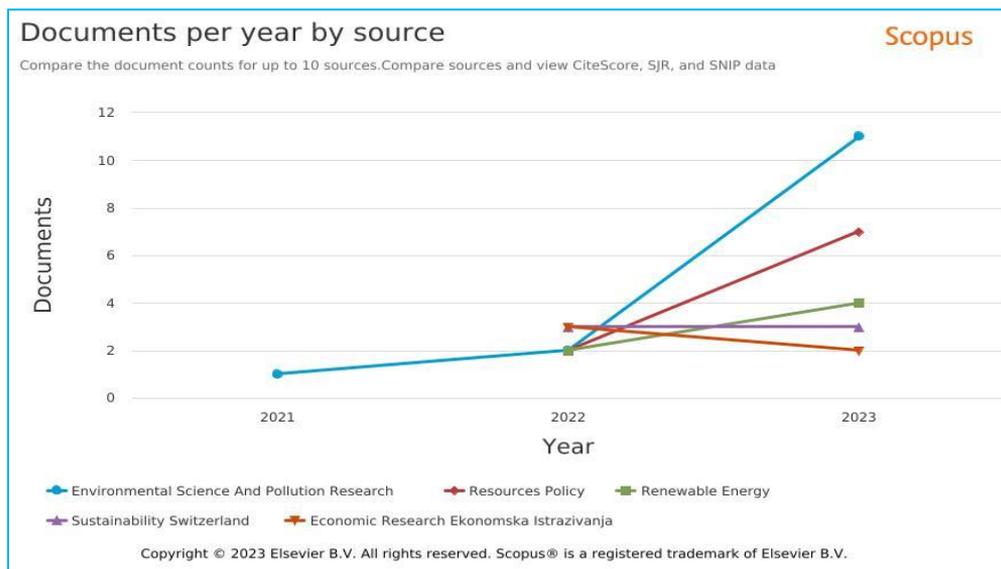


Figure 4. Top Journals in Green Financing  
Sources: Scopus.com (August 2023)

*Resources Policy* closely follows, featuring nine documents published between 2022 and 2023. This journal is meticulously dedicated to exploring economic and policy intricacies intertwined with the extraction, manufacturing, and utilization of minerals and fossil fuels. The scope of "Resources Policy" spans diverse domains, encompassing public policy, economics, social sciences, geography, and finance within the expansive realms of mining, non-fuel minerals, energy minerals, fossil fuels, and metals. The journal welcomes contributions encompassing associated natural resource subjects relevant to the minerals and fossil fuel sector. Themes like sustainability, environmental economics linked to mineral extraction and utilization, and the socio-economic implications of these activities find their place within its purview.

Claiming the third position is *Renewable Energy*, housing six documents published from 2022 to 2023. Serving as an international, multi-disciplinary journal, *Renewable Energy* is dedicated to renewable energy engineering and research domains. The journal's primary objective is to propel the dissemination and exchange of expertise spanning various subjects and technologies inherent to renewable energy systems and their integral components. It strives to promote the continuous integration of emerging advancements within these domains and encourages the harmonious assimilation of alternative energy approaches into existing practices.

The *Sustainability* journal is securing the fourth spot, boasting six documents. This open-access scholarly journal operates as a nexus of global and interdisciplinary perspectives encompassing technical, environmental, cultural, economic, and social sustainability for humanity. As a platform for advanced research, "Sustainability" endeavors to shed light on various facets of sustainability and sustainable development. It invites researchers to share their empirical, computational, and theoretical studies spanning multiple fields, including the natural and applied sciences, engineering, economics, social sciences, and humanities. By offering comprehensive insights, the journal seeks to catalyze an enriched understanding and facilitate the prediction and evaluation of worldwide transformations and advancements intrinsically linked to the principle of sustainability.

The fifth position is occupied by the *Economics Research Ekonomska Istraživanja* journal, featuring five documents published between the years 2022 to 2023. Functioning under a peer-review system and adhering to an open-access platform, this journal acts as a conduit for theoretical, applied, and empirical papers that span the gamut of economics. It traverses nano, micro, mezzo, and macro levels, aspiring to offer a rigorous scholarly discourse that holds significance across various economic spheres. The journal documents the transition from socialism to market-driven economies in Eastern Europe and beyond. Its overarching goal revolves around fostering diverse perspectives within economic research, ultimately contributing to global economic development.

The hierarchy of top journals (Figure 4) highlights prominent platforms for green financing publications. *Environmental Science and Pollution Research* strongly emphasize environmental economics. These journals are crucial in shaping the discourse and disseminating knowledge within the green financing landscape.

In the bibliometric analysis, Sang [34] found that *Environmental Science and Pollution Research* also occupies the first position. *Sustainability* takes the second position,

followed by *Renewable Energy* in the third position. *Resources Policy* secures the fourth position, while *Energy Economics* holds the fifth. The different positioning of *Sustainability* in this study compared to Sang's [34] research may be attributed to the fact that Sang [34] utilized scholarly literature on green finance from 1994 to early 2024. In contrast, this study focused on publications from 2008 to 2023 from the Scopus database.

### 3.5 Geographical distribution of green financing publications

The geographical dispersion of publications related to green financing is vividly depicted in Figure 5. This cartographic representation offers a comprehensive snapshot of research trends across various regions. The analysis unveils the following insights:

China emerged as a formidable leader in green financing, contributing an impressive tally of 58 documents. This extensive scholarly output can be attributed to China's substantial economic influence and unwavering dedication to sustainable development. Notably, the Chinese government has actively championed the proliferation of green bond markets and analogous sustainable financial mechanisms. Research conducted within China predominantly orbits around understanding how financial instruments can serve as catalysts for a transition toward a low-carbon economy.

The Asian region, as illustrated in Figure 5, has substantially embraced the exploration of green financing. Countries like Pakistan, Malaysia, India, and Indonesia share analogous concerns, often spotlighting the pivotal role of the financial sector in steering transitions toward renewable energy sources and endeavors to curtail carbon emissions. Notably, these nations are engrossed in nurturing the growth of green bond markets and kindred sustainable financial tools. In countries with abundant natural resources, the research thrust lies in harnessing green financing to propel technological innovation and advancement. This encompasses addressing challenges and leveraging opportunities related to the inception of sustainable financial instruments that buttress environmental conservation, resource management, and the propagation of renewable energy solutions.

Within the European region, characterized by robust financial institutions, expansive capital markets, and thriving high-tech enterprises, a distinct propensity for pioneering innovations within green financing comes to the fore. Research within this purview often delves into potential collaborations between the private sector and civil society, propelling sustainable investment. Noteworthy areas of exploration encompass establishing standards for sustainable financial reporting, discerning the intricate interplay between regulatory policies and the sustainable economic landscape, and meticulously analyzing the pathways through which regulations and public policies can cultivate an environment conducive to the proliferation of green financing mechanisms.

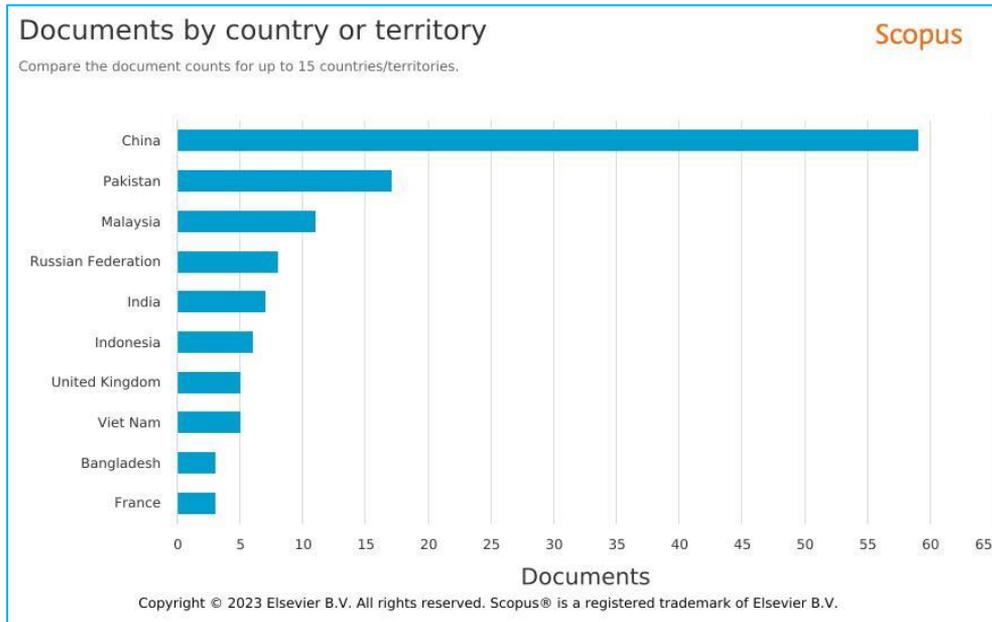
Figure 5 acts as a comprehensive global compass, illuminating the various trajectories of green financing research across different regions. It reflects the multifaceted nature of this field and the diverse approaches nations worldwide undertake as they endeavor to navigate the dynamic landscape of sustainable finance.

Figure 5 showcases the global landscape of green financing research, with China leading in scholarly output. The Asian region, characterized by shared concerns, and the European

region, focusing on collaborations and regulatory policies, contribute significantly. This global mapping reflects the diverse approaches nations undertake to navigate sustainable finance.

In the Bibliometric Analysis conducted by Muchiri et al. [35] from 2015 to 2022, examining the keywords “Green Finance,”

“Climate Finance,” “Carbon Finance,” “Environmental Finance,” and “Climate Change,” the study reveals a dominance of scientific research in green financing with primary contributors being China, the United Kingdom, the USA, Italy, Australia, France, Germany, Spain, Sweden, and the Netherlands.



**Figure 5. Mapping the Global Landscape**  
Sources: Scopus.com (August 2023)

Similarly, Bhatnagar and Sharma [36], utilizing Scopus database data spanning from 1997 to 2021 and exploring keywords like “green finance,” “climate finance,” “carbon finance,” “environment finance,” “green bond,” and “renewable energy finance,” find China leading. Following China, the subsequent contributors in descending order include the United States, the United Kingdom, Germany, Australia, France, Italy, the Netherlands, India, and Canada.

Furthermore, Sang [34], focusing on the keyword “green finance” in scholarly literature from 1994 to early 2024, identifies China as the foremost contributor. Sequentially after China, the leading contributors are found to be Pakistan, Japan, Malaysia, the United Kingdom, Vietnam, Australia, the United Arab Emirates, the United States, and India.

Despite China consistently securing the top position in these bibliometric analyses, a disparity emerges in the findings of Muchiri et al. [35], Bhatnagar and Sharma [36], and Sang [34]. In this analysis, the second position is occupied by Pakistan, using the keyword “green financing” and considering publications from 2008 to 2023 in the Scopus database. Subsequently, the order includes Malaysia, the Russian Federation, Indonesia, the United Kingdom, Vietnam, Bangladesh, and France.

The differences in the bibliometric analyses conducted by Muchiri et al. [35], Bhatnagar and Sharma [36], Sang [34], and this study can be attributed to several key factors, including the choice of keywords, the specified time frames, and the inclusion of distinct terms in the search queries. First, Variation in Keywords. Muchiri et al. [35] focused on a combination of keywords such as “Green Finance,” “Climate Finance,” “Carbon Finance,” “Environmental Finance,” and “Climate Change.” Bhatnagar and Sharma used a different set of keywords, including “green finance,” “climate finance,”

“carbon finance,” “environment finance,” “green bond,” and “renewable energy finance.” Nguyen Minh Sang concentrated solely on the keyword “green finance.” This study only uses the keyword “green finance” from the Scopus database. Second, Time Frame Differences. Muchiri et al. [35] analyzed publications from 2015 to 2022. Bhatnagar and Sharma [36] covered the period from 1997 to 2021. Sang [34] considered scholarly literature from 1994 to early 2024. This study considered scholarly literature from 2008 to 2023.

### 3.6 Leading institutions and authors in green financing research

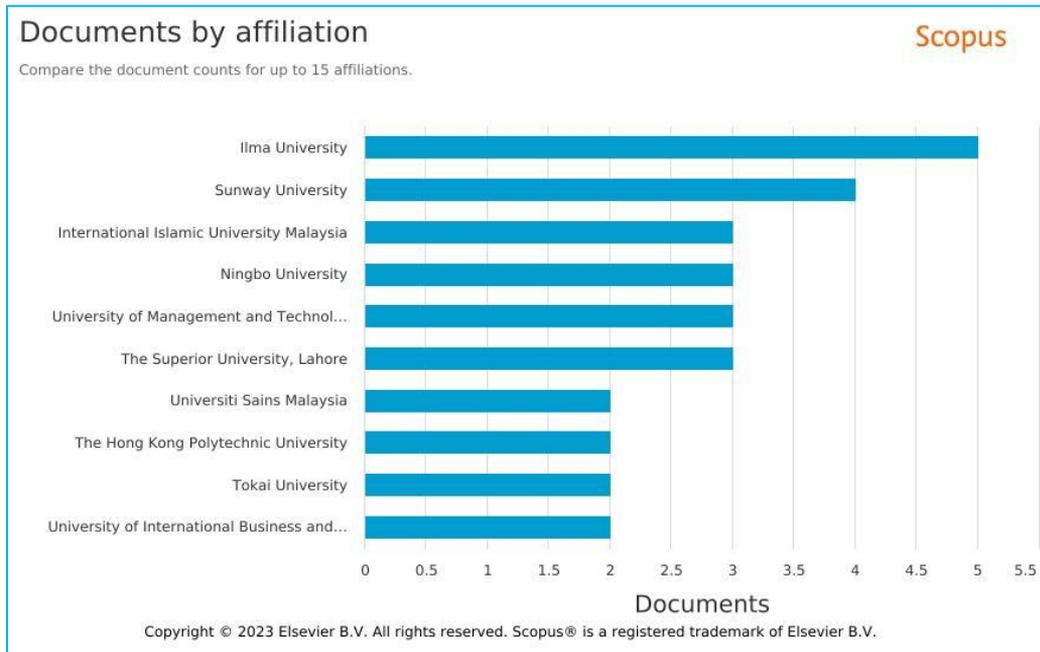
The data in Figure 6 symbolizes the distribution of the top 10 research publications based on their affiliations. This illuminating analysis uncovers the following insights: (1) Chinese universities: Leading the charge in green financing research, Chinese universities have emerged as potent contributors, collectively generating seven documents. Noteworthy institutions encompass Ningbo University [37-39], The Hong Kong Polytechnic University [29, 40], and the University of International Business and Economics, Beijing [23, 41]. (2) Pakistani universities: Universities in Pakistan assert their scholarly prowess by amassing 11 documents across three affiliations. Esteemed institutions include Ilma University [10, 23, 42-44], the University of Management and Technology [45-47], and The Superior University [23, 48, 49], Lahore. (3) Malaysian universities: Hailing from Malaysia, three affiliations account for nine documents, with Sunway University [12, 23, 50, 51], International Islamic University Malaysia [18, 21, 52], and Universiti Sains Malaysia [52, 53] at the forefront of this scholarly endeavor. (4) Japanese university: A solitary affiliation from Japan, Tokai University

[13, 15], is credited with contributing two documents to the corpus of green financing research.

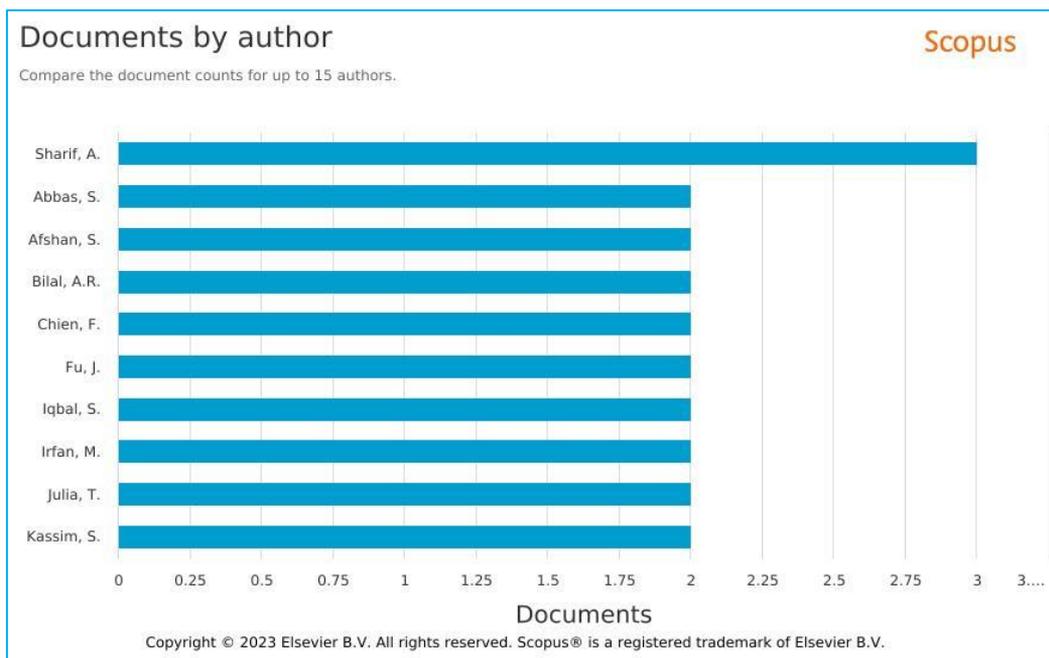
These affiliations are not merely academic entities but hubs of intellectual exploration intricately intertwined with the concerns of their respective countries of origin. The driving factors behind their leadership in green financing research are various elements, ranging from the size of their economies and governmental commitment to sustainable development to their innovative financial market landscapes and environmental imperatives. With the collective dedication and alignment with the global sustainability agenda position, these institutions are at the vanguard of formulating enduring economic policies,

practices, and innovations that harmonize with sustainability objectives.

The landscape of green financing research is personified by the insights emanating from Figure 7, which delineates the distribution of research publications by authors. Among the prolific authors, Sharif emerges as a luminary with three documents to their credit. Their affiliation with Sunway University Malaysia adds a significant dimension to their contributions. As a representative of their institution, Sharif's work exemplifies the intersection of rigorous research and practical application.



**Figure 6. Charting Prominent Affiliations**  
Sources: Scopus.com (August 2023)



**Figure 7. Top authors**  
Sources: Scopus.com (August 2023)

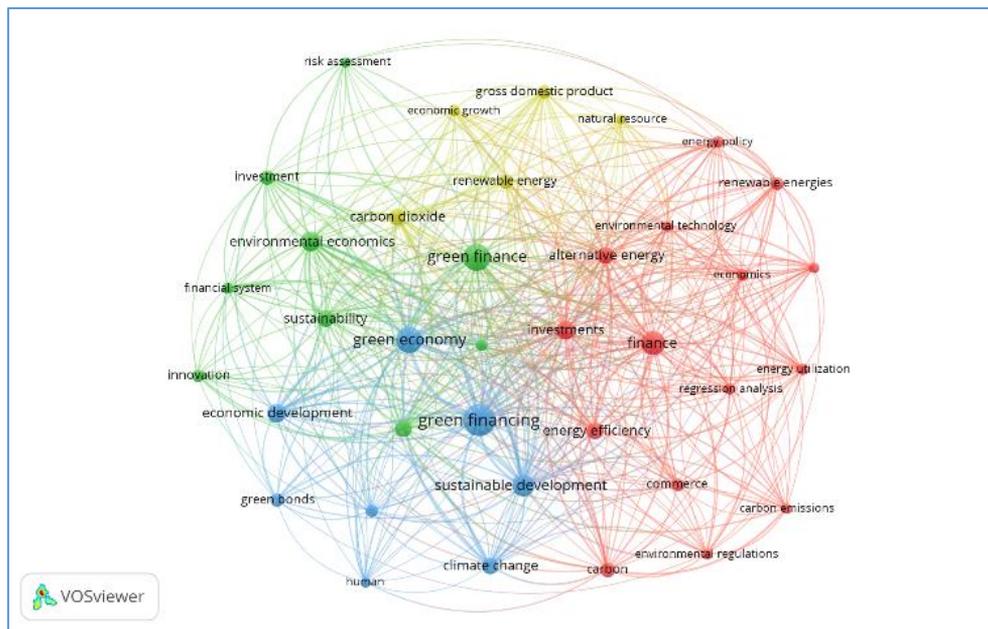
The origins of these authors, spanning China, Pakistan, Malaysia, and other Asian nations, are intricately intertwined with the focal concerns of their respective countries. This alignment is deeply rooted in addressing challenges related to building sustainable economies, championing environmental stewardship, and propelling technological innovation within the intricate fabric of financial mechanisms, all propelled by the principles of green financing.

The distribution of top research publications by affiliations (Figure 6) reveals the leadership of Chinese, Pakistani, and Malaysian universities. These institutions, deeply rooted in their countries' concerns, contribute significantly to the intellectual exploration of green financing. Prolific authors, such as Sharif, exemplify the intersection of rigorous research

and practical application.

### 3.7 Exploring clusters of themes in green financing: analysis and research gaps

The analysis of clusters of themes in green financing, as depicted in Figure 8, offers valuable insights into the interconnectedness and common threads within the research landscape in this domain. These clusters provide a framework for understanding the multidimensional nature of green financing and its various dimensions. Let's delve into the analysis and potential research gaps that emerge from these clusters:



**Figure 8.** Clusters of themes in green financing  
Sources: VOSviewer (August 2023)

#### 3.7.1 Cluster 1: Holistic approach to sustainable development

Cluster 1 encompasses diverse themes, including alternative energy, carbon emissions, economics, energy efficiency, environmental technology, and more. This cluster represents a holistic approach to sustainable development, integrating various economic, technological, and ecological aspects. The presence of terms like “investment” and “finance” underscores the pivotal role of financial mechanisms in driving sustainable endeavors.

#### 3.7.2 Cluster 2: Addressing climate change and economic growth

Cluster 2 focuses on climate change, economic development, and renewable energy. It underscores the interplay between addressing pressing global challenges like climate change while fostering economic growth. The inclusion of “green bonds,” “green economy,” and “sustainable development” suggests a strong alignment between environmentally conscious financial instruments and overarching sustainable goals.

#### 3.7.3 Cluster 3: Financial systems and environmental sustainability

Cluster 3 highlights themes like environmental protection, innovation, and risk assessment, all situated within the context

of financial systems. This cluster underscores the significance of ensuring the alignment of financial practices with environmental sustainability. “Green finance” and “investment” again emerge, emphasizing the role of financial mechanisms in promoting environmentally conscious practices.

### 3.8 Correlation and potential research gaps

The three clusters depict a rich web of interconnections, signifying the multidisciplinary nature of green financing research. These clusters reflect the integration of economic, environmental, and financial perspectives, underscoring the importance of a comprehensive approach to sustainable development.

#### 3.8.1 Research Gap 1: Comprehensive framework for green financing

Despite the interconnectedness of these themes, a comprehensive framework that intricately weaves together the economic, environmental, and financial dimensions of green financing might be a research gap. Developing such a framework could provide practical guidelines for governments, businesses, and financial institutions to navigate the complexities of sustainable development.

### 3.8.2 Research Gap 2: Impact assessment of green financial instruments

While terms like “green bonds” and “investment” appear across clusters, a more detailed analysis of the actual impact of these financial instruments on environmental sustainability could be a promising avenue for research. This could involve evaluating the effectiveness of green bonds in promoting renewable energy projects or assessing the long-term impact of sustainable investments on carbon emissions reduction.

### 3.8.3 Research Gap 3: Role of financial regulation in green financing

The clusters touch upon financial systems and regulations, suggesting a possible research gap in understanding how regulatory policies can encourage or impede the growth of green financing initiatives. Exploring the potential synergies between regulatory frameworks and sustainable financial practices could offer insights into creating an enabling environment for green financing.

The clusters in green financing research reflect a multidimensional landscape that integrates economic, environmental, and financial considerations. The correlations among the themes and potential research gaps highlight the need for comprehensive frameworks, impact assessment of financial instruments, and a deeper exploration of the regulatory landscape to foster sustainable development through green financing.

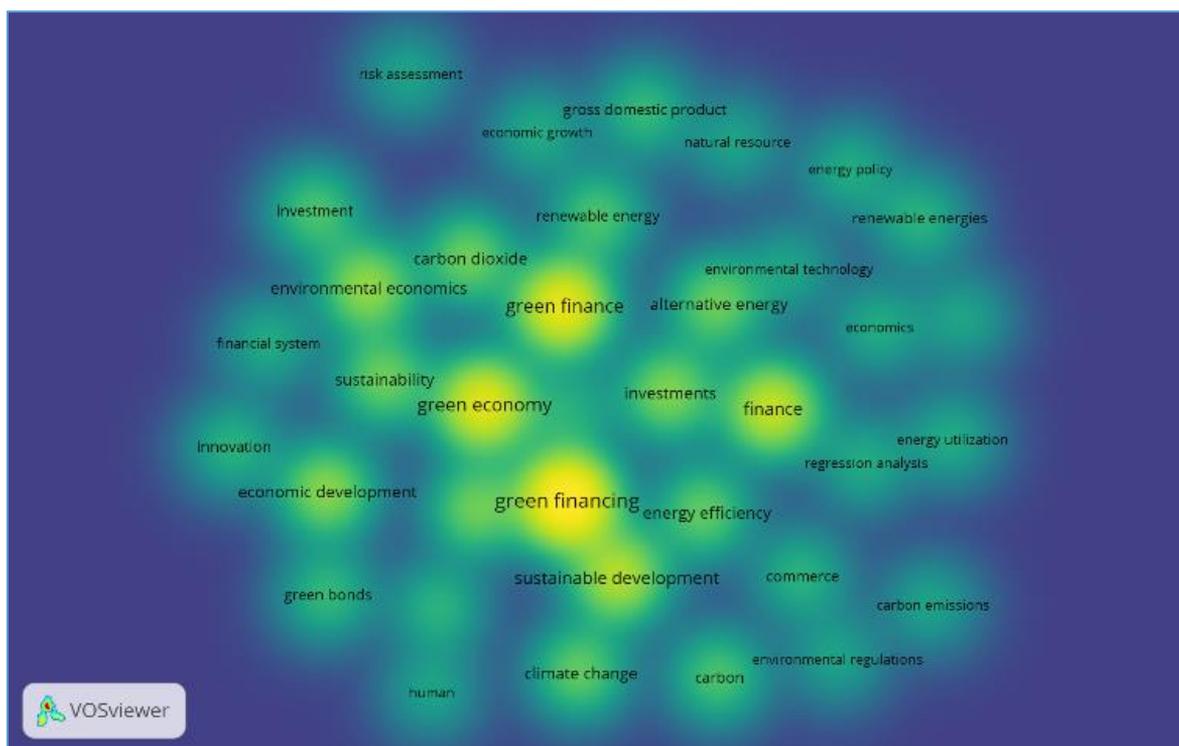
Clusters of themes (Figure 8) offer a multidimensional framework, emphasizing the interconnectedness of economic, environmental, and financial perspectives. Research gaps identified in holistic frameworks, impact assessments of financial instruments, and the role of financial regulation provide directions for future research (3.8).

### 3.9 Assessing research concentration: Insights from density visualization

VOSviewer's density visualization technique offers an insightful approach to assessing research concentration within a specific field. This method facilitates the identification of the depth and extent of scholarly exploration on a particular topic. The construction of the density map is grounded in both the quantity and the depth of research endeavors, where a more vibrant and intense coloration denotes a higher degree of research activity and emphasis [54].

In the context of the provided information, Figure 9 serves as an illustrative example, showcasing the application of density visualization in the context of research related to green financing. The depicted visualization indicates the density distribution of various research themes associated with green financing. Notably, themes such as alternative energy, carbon emissions, economics, energy efficiency, environmental technology, climate change, economic development, renewable energy, environmental protection, innovation, and risk assessment are represented by a diminishing shade of green.

This fading green hue suggests that these specific research themes have garnered relatively limited attention within the scope of green financing studies. This observation highlights an existing gap in the research landscape. Despite the growing importance of green financing and its integral role in addressing environmental concerns and sustainable development, the identified themes still need to be explored. This phenomenon underscores an opportunity for researchers to delve into these underrepresented areas and contribute to a more comprehensive understanding of how green financing can effectively address a broader range of interconnected challenges.



**Figure 9.** Density of themes in green financing  
Sources: VOSviewer (August 2023)

Employing VOSviewer's density visualization technique provides a methodological advancement in assessing research concentration. The density map constructed through this technique aids in discerning the extent and intensity of research activity. The application of this technique to green financing, as evidenced by Figure 9, reveals that specific vital research themes still need to be explored within this context. This observation emphasizes the need for further research to bridge these identified gaps, fostering a more holistic understanding of green financing's potential impacts and implications.

Density visualization (Figure 9) identifies underrepresented themes, signaling potential research gaps. Specific areas, such as alternative energy, carbon emissions, and environmental technology, warrant further exploration. This observation highlights opportunities for researchers to contribute to a more comprehensive understanding of green financing's potential impacts and implications.

So, the preliminary findings underscore the vibrant and evolving nature of green financing research. The identified trends, distributions, and concentrations provide a foundation for future studies to delve into the identified research gaps, ultimately contributing to the advancement of sustainable financial practices and environmental stewardship.

#### 4. CONCLUSION

The bibliometric analysis conducted in this study unveils the dynamic landscape of green financing research, offering profound insights into trends, contributors, affiliations, and thematic clusters. Aligned with global environmental concerns and sustainability goals, green financing has gained momentum as a catalyst for funding economic endeavors with ecological benefits. Our analysis has provided:

- Critical perspectives on the trajectory of green financing research.
- Emphasizing its significance in addressing environmental challenges.
- Driving innovation.
- Fostering sustainable economic growth.

A notable shift in research attention is evident, particularly with a substantial surge in green financing publications since 2020. This surge reflects an increasing awareness of the urgent need to address environmental challenges and develop sustainable financial mechanisms. As a strategic response, green financing integrates economic and technological innovations to combat complex ecological problems.

The multidisciplinary nature of green financing is vividly portrayed through its diverse subject areas, spanning economics, environmental science, energy, social sciences, and business management. Leading journals, including *Environmental Science and Pollution Research*, *Resources Policy*, *Renewable Energy*, *Sustainability*, and *Economics Research Ekonomika Istraživanja*, serve as essential platforms for disseminating insights and shaping the discourse in this field.

From a geographical standpoint, China emerges as a standout leader in green financing research, with active contributions from Pakistan, Malaysia, and Japan. These nations align their research with their unique concerns, economies, and environmental imperatives.

Prominent institutions, including Chinese universities, Pakistani universities, Malaysian universities, and Tokai

University from Japan, are pivotal in advancing green financing research. These institutions embody their countries' commitments to sustainable development, innovation, and environmental stewardship.

Authorship analysis spotlights critical contributors, with Sharif from Sunway University Malaysia leading the way. These authors mirror their countries' concerns, focusing on sustainable economies, environmental stewardship, and technological innovation through green financing.

Clusters of green financing themes illustrate the multidimensional nature of the research landscape. These clusters correlate and intertwine, emphasizing the need for comprehensive frameworks, impact assessments of financial instruments, and a deeper understanding of regulatory landscapes to foster sustainable development through green financing.

In synthesizing key findings, our analysis highlights the growing prominence of green financing as a solution to pressing environmental challenges. Moving forward, we recommend future research to delve into specific areas identified as gaps, addressing the nuanced challenges and opportunities in sustainable finance. Practical applications of our findings extend to researchers, policymakers, and practitioners, offering valuable insights for navigating this dynamic field and contributing to the advancement of sustainable finance practices. Professionals in the field can utilize this research to inform strategic decision-making, design innovative financial mechanisms, and guide sustainable economic initiatives, ultimately benefiting the environment and society.

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