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Research Article

Green Bonds and Monetary Policy: What Recent Bibliometric Evidence Reveals

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Abstract: Global concern on climate change has encouraged policymakers and central banks to adopt green financial instruments such as green bonds within sustainable monetary frameworks. Research on the integration of green bonds and monetary policy has grown rapidly in recent years, reflecting wider trends in sustainable finance, climate risk management, and central bank policy innovation. Green bonds play an important role in supporting low-carbon transitions and can influence monetary operations through asset purchases and collateral policies. This study applies a bibliometric analysis of publications on green bonds and monetary policy indexed in Scopus from 2021 to 2025. Using bibliometric methods with VOSviewer and R Studio, the analysis maps dominant themes, co-authorship networks, and the evolution of green monetary studies. The results show strong growth in research output, high levels of international collaboration, and a concentration on sustainable development and green finance. However, fewer studies address climate policy uncertainty and geopolitical risk, even though these factors are highly relevant to financial stability and the effectiveness of monetary policy. Future research in these underexplored areas could provide stronger scientific foundations for building more adaptive and resilient monetary systems in both developed and emerging economies.

Keywords: Central Bank Policy; Climate Risk; Green Bonds; Monetary Policy; Sustainable Finance

1. Introduction

Climate change has evolved into a systemic threat that generates profound climate risks for the global economy and financial systems. Extreme weather events and transition risks associated with decarbonization have been shown to weaken banking resilience by increasing non-performing loans and destabilizing the credit system (Damette et al., 2025). At the same time, climate policy uncertainty generates spillovers into stock, bond, and currency markets, creating volatility that disrupts monetary transmission mechanisms and investor confidence (Liu et al., 2025). These developments demonstrate that climate risks are no longer limited to environmental concerns but directly undermine financial stability, making them a central issue in economic policymaking.

In response, sustainable financial instruments have gained momentum, with green bonds emerging as a strategic tool to mobilize investment in renewable energy, sustainable infrastructure, and low-carbon projects. Beyond financing environmental objectives, green bonds are increasingly viewed as mechanisms to reduce systemic exposure to climate-related shocks and strengthen the foundations of financial stability (Hermala et al., 2025). Their adoption in both developed and emerging economies highlights their dual function: advancing climate goals while reinforcing financial resilience. This dual role situates green bonds at the nexus of finance and policy, making them highly relevant for the design of long-term economic strategies.

The growing intersection between green finance and monetary policy further underscores this importance. Climate shocks such as El Niño and policy uncertainty have already revealed their potential to undermine banking stability and complicate central banks' efforts to safeguard financial systems (Liu et al., 2025). In addition, recent evidence indicates that crises ranging from global financial turbulence and geopolitical shocks to the COVID-

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19 pandemic exacerbate contagion across markets, heighteninsg systemic risks and threatening financial stability (Huai et al., 2025). These dynamics highlight the urgency for central banks to adapt their policy frameworks by embedding sustainability considerations, positioning green bonds as a strategic instrument for stabilizing economies and enhancing resilience against climate risks.

2. Literature Review

The relationship between green bonds and monetary policy has become one of the most dynamic topics in the intersection of finance, sustainability, and economic governance. Over the past decade, green bonds have evolved from niche instruments into central tools of sustainable finance, reflecting a broader global commitment to mitigating climate change and building resilient financial systems. Bibliometric evidence covering the period 2021–2025 shows a marked increase in the number of scholarly publications addressing these instruments, with particular attention given to their role in linking environmental objectives to monetary and fiscal frameworks. The clustering of keywords such as green bonds, sustainable finance, monetary policy, and climate risk underscores the consolidation of this field as a core area of research, no longer confined to specialized environmental finance journals but increasingly present in mainstream economics and policy debates.

One of the most important insights emerging from the literature is the recognition that climate risks are systemic financial risks, directly affecting monetary stability. Green finance addresses these risks by channeling capital into renewable energy and sustainable infrastructure. (Shaheen, 2024)demonstrate through a cost–benefit analysis that renewable energy projects funded through green financial instruments, including bonds, yield significant net benefits for society. While initial investment costs are high, the long-term returns in terms of reduced greenhouse gas emissions, improved public health, and energy security outweigh the expenditures. Their findings highlight that green finance does not merely address environmental concerns but contributes directly to macroeconomic resilience by lowering exposure to fossil fuel volatility and climate-related shocks.

Europe stands at the forefront of institutionalizing green bonds, with the European Central Bank (ECB) playing a pioneering role in embedding sustainability into its collateral frameworks and asset purchase programs. (Smoleńska, 2025) argues that European capitalisms are undergoing a profound transition in which green bonds are not only financial innovations but also political–economic tools central to the sustainability agenda. The inclusion of green criteria in ECB operations represents a historic departure from the traditional principle of market neutrality in central banking, thereby acknowledging climate change as a systemic risk requiring monetary intervention. Bibliometric mapping corroborates this development by showing Europe as the most productive region in terms of publications on green bonds and monetary policy, with academic outputs closely aligned to real-world institutional reforms. However, heterogeneity persists across member states, where varying levels of institutional capacity shape the pace and effectiveness of green finance integration.

In developing economies, green bonds present a very different picture. (Smoleńska, 2025)examine the issuance of green sovereign bonds and find that while they provide valuable opportunities to attract global capital and signal alignment with sustainability commitments, they simultaneously expose countries to vulnerabilities. These include debt sustainability challenges, exchange rate risks, and volatility in investor confidence. For states with limited fiscal capacity and weak institutional frameworks, the risks can outweigh the benefits, potentially exacerbating financial fragility. Bibliometric evidence confirms that research on green bonds in developing countries remains underrepresented, highlighting an important gap in the literature. Without stronger governance mechanisms, international support, and credible monitoring frameworks, the promise of green sovereign bonds may remain unfulfilled in these contexts.

The United States has contributed significantly to the literature, albeit with a distinctive emphasis on financial innovation. (Damoah & Yeboah, 2025)show how innovative instruments such as blended finance, sustainability-linked loans, and securitization of green assets can mobilize private and institutional capital for climate change mitigation. Their study illustrates how these mechanisms can de-risk investments, expand investor participation, and accelerate renewable energy financing. This perspective aligns with bibliometric findings that position the United States as one of the leading contributors to research on innovative financial mechanisms. However, unlike Europe, the U.S. model often relies more heavily on market-driven solutions than on central bank interventions, raising questions about the relative effectiveness of voluntary financial innovation compared to institutionally embedded frameworks.

In OECD countries more broadly, the effectiveness of green finance appears to be contingent on structural and institutional factors. (Ostadzad & Ghafoorian Yavarpanah,

2025)use non-linear panel data analysis to show that the benefits of green finance for renewable energy transitions are maximized only in contexts with mature financial institutions, strong research and development capacity, and high economic complexity. Their findings highlight that financial instruments alone are insufficient; instead, green bonds must operate within an ecosystem that includes innovation, governance, and institutional readiness. This perspective helps explain why some economies derive substantial benefits from green finance while others struggle to replicate these outcomes. It also connects with bibliometric evidence indicating that clusters of research increasingly link green finance not only to monetary policy but also to technological innovation and economic complexity.

Despite these advances, the literature also identifies several critical challenges. Climate policy uncertainty emerges as one of the most significant barriers to the long-term credibility of green bond markets. (Liu et al., 2025)find that uncertainty in climate regulation creates asymmetric spillover effects in financial markets, discouraging investors from committing to long-term green instruments. This uncertainty undermines the ability of green bonds to function as stable anchors of sustainable finance. Bibliometric mapping suggests that while the topic of policy uncertainty is beginning to appear more frequently, it remains underexplored compared to other areas such as renewable energy financing. Addressing this gap is essential for strengthening investor confidence and ensuring the durability of green bond markets.

Geopolitical risks further complicate the landscape. (Huai et al., 2025)note that geopolitical shocks, such as the Russia–Ukraine war, have disrupted energy markets and reshaped investment flows into renewables. Such conflicts not only affect commodity prices but also alter the strategic calculations of investors and policymakers, underscoring the vulnerability of green finance to external shocks. Bibliometric trends confirm that while research on geopolitics remains a relatively small cluster, its prominence has been growing in recent years, suggesting an emerging recognition of the intersection between finance, security, and sustainability.

Synthesizing across bibliometric evidence and empirical findings, it becomes clear that green bonds are transitioning from peripheral innovations to central instruments in global financial governance. In advanced economies, they are increasingly embedded into central bank operations, fiscal frameworks, and financial innovation systems. In developing economies, they remain tools of opportunity and risk, requiring strong governance to prevent adverse outcomes. The literature highlights that while progress has been made, the role of central banks outside of Europe remains underexplored, the risks of climate policy uncertainty and geopolitical instability are insufficiently studied, and the distributional challenges between developed and developing economies require more systematic analysis.

Taken together, these findings underscore the dual nature of green bonds: they are both financial instruments for mobilizing capital and political–economic tools that reshape how monetary and fiscal policy align with sustainability. Their effectiveness is contingent not only on the design of financial instruments but also on institutional readiness, policy stability, and global cooperation. The literature thus situates green bonds at the heart of the evolving relationship between climate governance and monetary policy, while also identifying significant gaps that must be addressed to ensure their role as stable and equitable instruments of sustainable finance.

3. Research Method

The initial search was conducted using the Scopus database, and the retrieved documents were analyzed in three stages (Figure 1): (1) defining search criteria to identify relevant records and filtering the data (collection stage); (2) exporting documents to VOSviewer software for bibliometric analysis of publications, authors, countries, institutions, journals, and research domains (visualization stage); and (3) interpreting the data to identify key themes in studies related to green bonds and monetary policy.

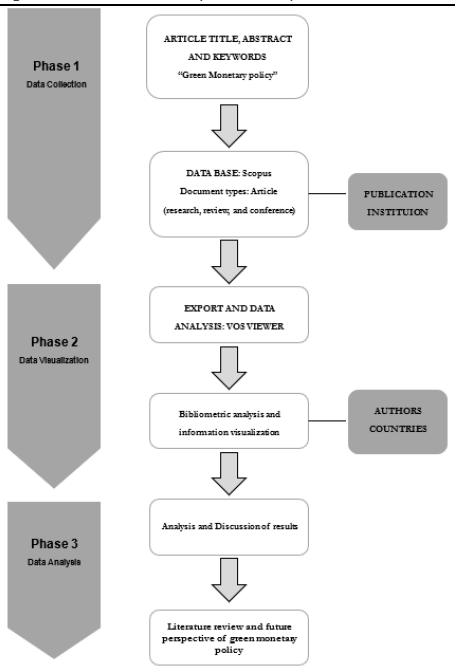

Figure 1. Research Methodology Steps

This study utilized bibliographic data from Scopus articles published between 2020–2025 with a total sampling technique. The variables examined included titles, abstracts, authors, keywords, publication years, journals, document types (research articles, reviews, and conference papers), and institutional affiliations. Data were retrieved from Scopus using the English query "green monetary policy" and exported in .csv format via the Scopus export tool, then synchronized with Mendeley Desktop.

In the visualization stage, bibliometric analysis was performed using VOSviewer version 1.6.19. Network visualization and density mapping were employed to identify co-authorship patterns, institutional and country collaborations, keyword co-occurrence, and influential research clusters. Descriptive statistics, such as annual publication trends, most productive journals, and most cited authors, were analyzed using Microsoft Excel.

Finally, the data were interpreted through bibliometric mapping and qualitative review. The analysis focused on highlighting research hotspots, collaboration networks, influential authors, and thematic developments in green monetary policy. This phase also included the identification of research gaps and provided insights into the future trajectory of sustainable monetary policy.

4. Results and Discussion

The bibliometric dataset covering the years 2021–2025 demonstrates that research on green monetary policy is undergoing rapid expansion. A total of 3,198 documents were identified across 631 distinct publications, with an impressive annual growth rate of 38.65%. This acceleration indicates that sustainability concerns within monetary policy are becoming increasingly central in scholarly debates and policy-oriented research. The growing number of outlets also reflects the multidisciplinary nature of the field, spanning economics, finance, environmental studies, and governance.

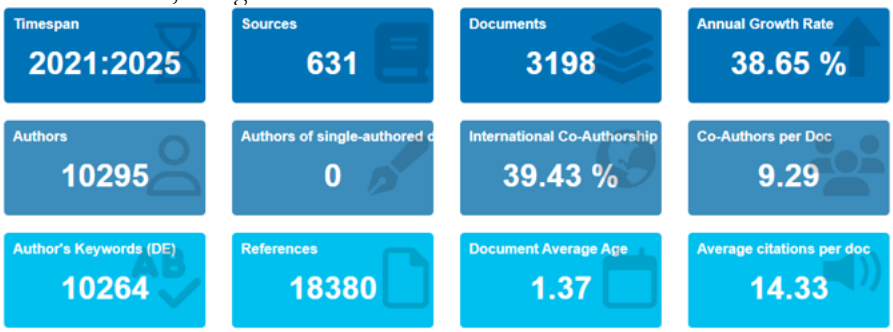

Figure 2. Main information on overview (R Studio)

Collaboration emerges as a defining feature of this research area. Contributions from 10,295 authors reveal the absence of single-authored works, underscoring the complex and interdisciplinary character of the topic. Each paper involves on average 9.29 co-authors, and

nearly 39.43% of publications demonstrate international collaboration. Such patterns highlight the global relevance of green monetary policy and the recognition that addressing climate-related financial risks requires joint efforts across countries and institutions.

In terms of thematic development, authors provided 10,264 unique keywords, which signal the diversity of issues explored, including green finance, sustainable development, climate risk, and central banking practices. The inclusion of 18,380 references indicates intensive engagement with existing literature and shows that the field is both building upon established knowledge and expanding into new conceptual territory. The relatively young average document age of 1.37 years confirms that the field is still emerging, dominated by recent contributions, yet it already demonstrates strong scholarly momentum.

Despite its novelty, the field has already gained significant academic traction, with each document receiving an average of 14.33 citations. This citation rate points to the growing influence of the research and its ability to shape discourse at the intersection of monetary policy and environmental sustainability. Taken together, the findings emphasize that green monetary policy is not only a fast-growing academic domain but also a collaborative and impactful area of inquiry that is likely to expand further in both scope and significance in the coming years.

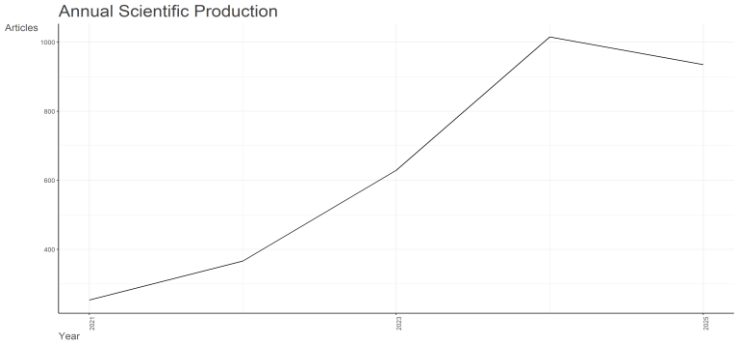

Figure 3. Annual Scientific Production (using R Studio)

Annual scientific production shows a clear upward trend from 2021 to 2024, with research output growing at an accelerated pace. In 2021, publications were relatively modest, with only around 250 articles, reflecting the early stages of academic attention to green monetary policy. By 2022, this number had grown to more than 350 publications, marking the beginning of a steady expansion as the subject gained recognition within academic and policy circles.

A significant surge occurred in 2023, when the number of publications exceeded 600, nearly doubling the output of the previous year. This sharp increase suggests that the field was rapidly maturing, driven by global discussions on climate change, sustainable finance, and the role of central banks in addressing environmental challenges. The trend reached its peak in 2024, with more than 1,000 articles, demonstrating that research in this area had become a mainstream scholarly pursuit, attracting contributions from multiple disciplines and international collaborations.

In 2025, a slight decline is observed, with the number of publications dropping to around 950. However, this decrease should be interpreted with caution, as the data for the year is still incomplete. It is highly probable that the final count will rise by the end of the year, which would sustain the upward trajectory seen in prior years. Overall, the trend illustrates a dynamic and expanding research domain that continues to attract strong scholarly interest, with momentum likely to persist in the years ahead.

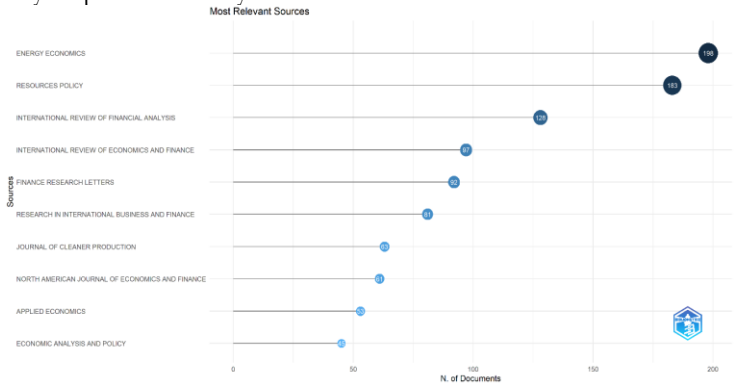

Figure 4. Most Relevant Sources (using R Studio)

The most influential source in the dataset is Energy Economics, which accounts for 198 articles, making it the leading journal in advancing research on green monetary policy. Its

dominance reflects the growing importance of integrating energy and environmental concerns into monetary and financial policy frameworks. Closely following is Resources Policy with 183 publications, a journal that underscores the connection between resource management, sustainability, and macroeconomic strategies. These two sources alone contribute a substantial portion of the literature, indicating that the energy–economy nexus is central to current research.

Other highly relevant sources include the International Review of Financial Analysis (128 articles), the International Review of Economics and Finance (97 articles), and Finance Research Letters (92 articles). These journals focus heavily on financial market dynamics, investment strategies, and monetary frameworks, suggesting that research on green monetary policy is not only concentrated on environmental issues but also embedded within broader financial and economic discourses. Their contribution demonstrates how sustainability has become a critical theme in mainstream finance and economics scholarship.

In addition, specialized and interdisciplinary journals further enrich the knowledge base. The Research in International Business and Finance (81 articles) and the Journal of Cleaner Production (53 articles) highlight how green monetary policy intersects with international trade, business strategy, and environmental production practices. Similarly, the North American Journal of Economics and Finance (51 articles), Applied Economics (50 articles), and Economic Analysis and Policy (45 articles) expand the field by incorporating regional perspectives, applied methodologies, and policy-oriented insights.

Overall, the distribution of publications across these journals confirms that green monetary policy is a multidisciplinary research frontier. The prominence of energy, finance, and policy-focused journals illustrates that the field is positioned at the intersection of economics, environmental science, and governance. This breadth of publication sources also indicates a strong and growing academic interest, with different disciplines contributing unique perspectives to the evolving debate on how monetary frameworks can support sustainability transitions.

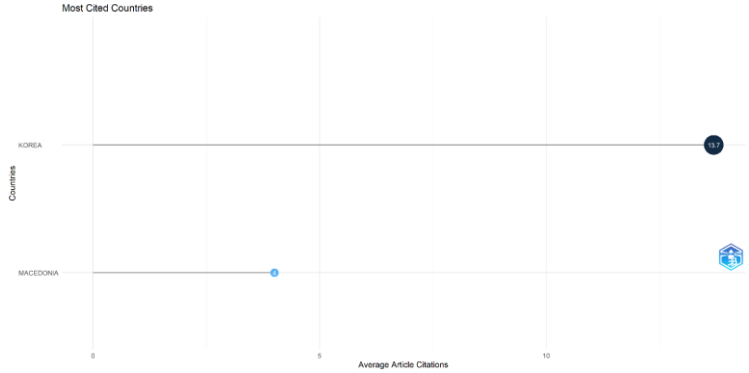

Figure 5. Most Cited Countries (using R Studio)

The citation analysis shows that Korea is the most influential country in the field of green monetary policy, with an average of 13.7 citations per article. This indicates that Korean research outputs are widely recognized and integrated into subsequent studies, reflecting both the quality and international relevance of the work. The strong citation performance also suggests that Korea's academic community plays a leading role in shaping debates around sustainable finance and climate-related monetary frameworks, likely supported by national policies that emphasize green growth and innovation.

Meanwhile, Macedonia appears on the chart with a lower average of around 3 citations per article, showing active but less influential engagement in the field. The disparity between Korea and Macedonia highlights the uneven distribution of scholarly impact across countries, which may be driven by differences in research funding, institutional capacity, and global collaboration networks. Overall, this pattern underscores the importance of fostering stronger international partnerships to enhance the visibility and influence of contributions from emerging research communities.

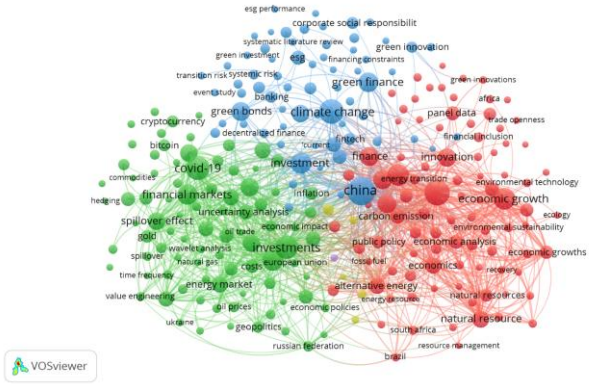

Figure 6. Network Visualization (using Vos Viewer)

The co-occurrence network map reveals that the field is structured around several major clusters of research, represented by distinct colors. The red cluster emphasizes macroeconomic and policy-related themes such as economic growth, innovation, carbon emission, natural resources, public policy, and alternative energy. This indicates that a significant strand of the literature links green monetary policy with broader discussions of economic development, resource management, and sustainability transitions. The frequent co-occurrence of terms like China, Brazil, and South Africa also highlights the role of emerging economies in advancing research on the intersection between sustainability and growth.

The blue cluster centers on finance and climate-related issues, with key nodes such as green finance, green bonds, climate change, ESG, and corporate social responsibility. This cluster reflects the growing importance of sustainable investment practices, the integration of environmental, social, and governance (ESG) principles, and the role of financial markets in supporting climate mitigation strategies. The presence of banking, systemic risk, and financing constraints further suggests that scholars are examining how financial stability and regulatory frameworks adapt to climate-related risks.

Meanwhile, the green cluster focuses on market dynamics and uncertainty, with keywords such as financial markets, spillover effect, uncertainty analysis, energy market, oil prices, and geopolitics. The inclusion of COVID-19, cryptocurrency, and bitcoin illustrates how researchers have expanded the discussion to consider external shocks and technological disruptions in relation to monetary and financial systems. This cluster demonstrates the multidimensional nature of green monetary policy research, which is not only tied to climate issues but also to global crises and market volatility.

Taken together, the network highlights the interconnectedness between sustainable finance, climate change, and macroeconomic policy. Central keywords such as green bonds, green finance, climate change, and economic growth appear as the largest nodes, confirming their pivotal role in shaping the discourse. The presence of supporting terms such as panel data, economic analysis, and energy transition suggests a strong methodological and policy-oriented focus. At the same time, less prominent nodes, such as policy uncertainty and geopolitical risks, point to emerging research gaps that could be further explored. Overall, the map demonstrates that the literature on green monetary policy is broad, interdisciplinary, and rapidly evolving, connecting debates on sustainability, finance, innovation, and global economic governance.

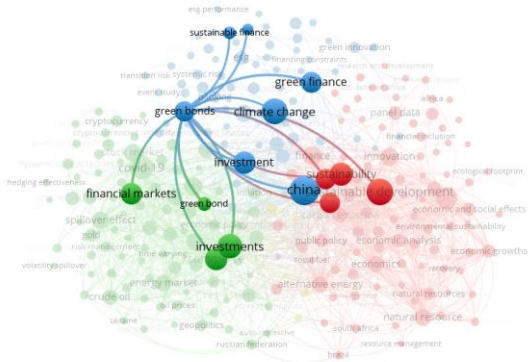

Figure 7. Network Visualization of Term Telemedicine (using Vos Viewer)

The focused network map reveals that green bonds and sustainable development emerge as the two most influential nodes, both highly connected and frequently co-occurring with other terms. Their size and centrality confirm that they serve as the main pillars of scholarly work on the intersection of finance, climate change, and development policy. The blue cluster, centered around green bonds, green finance, climate change, and investment, underscores the role of sustainable finance mechanisms in addressing environmental challenges. It reflects how academic research emphasizes financial innovation and investment strategies as crucial instruments to mitigate climate risks.

The red cluster, dominated by sustainability and sustainable development, extends the discussion toward economic and policy-oriented frameworks. Terms such as economic analysis, carbon emission, and public policy appear in close proximity, highlighting the governance and developmental aspects of sustainability transitions. This suggests that research does not only focus on financial tools but also critically engages with policy implications and global development agendas.

Meanwhile, the green cluster links financial markets with global uncertainties. Keywords such as financial markets, COVID-19, spillover effect, and geopolitics illustrate that research also considers systemic risks and external shocks when analyzing the role of green finance. This dimension indicates that the sustainability-finance nexus is influenced by macroeconomic volatility, crises, and global interconnectedness.

Taken together, the visualization demonstrates that green bonds act as a bridging concept between finance, climate policy, and sustainable development. By connecting clusters that deal with environmental issues, market risks, and development strategies, green bonds provide a conceptual and practical framework through which researchers explore how financial instruments can advance sustainability goals. This mapping underscores the interdisciplinary character of the field and points to future directions, particularly in integrating financial innovation with policy frameworks to address both climate change and global economic stability.

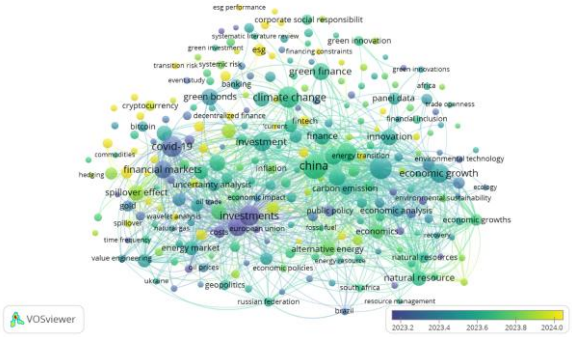

Figure 8. Overlay Visualization of Term Telemedicine (using Vos Viewer)

Overlay visualization in bibliometric analysis, generated using VOSviewer, maps out a network of frequently used keywords in academic research related to green finance, climate change, and monetary policy. Each node (circle) represents a keyword or concept, with the larger nodes reflecting terms that occur more frequently within the dataset. The edges (lines) between nodes indicate co-occurrence relationships, where thicker and denser lines represent stronger or more frequent connections. The colors of the nodes correspond to the average publication year in which the keywords appear, with the color bar at the bottom right providing a timeline from early 2023 (blue) to mid-2024 (yellow-green). Darker shades represent earlier topics, while lighter shades indicate more recent developments.

Keywords such as "investments," "climate change," "green finance," and "economic growth" appear as central and larger nodes, highlighting their dominance in the field. In contrast, terms like "ESG," "energy transition," and "green innovation" are represented in yellow-green shades, suggesting their prominence in more recent research. Similarly, global issues such as "COVID-19," "cryptocurrency," and "geopolitics" remain visible but appear in darker hues, indicating their earlier focus in the timeline.

The clustering patterns reveal distinct thematic areas. A central cluster links green finance, climate change, investments, and economic growth, reflecting the interdisciplinary nature of sustainable finance research. Another cluster emerges around uncertainty analysis, spillover effects, and financial markets, pointing to studies on risks and volatility. Additional groups highlight themes of carbon emissions, energy markets, and public policy, emphasizing the integration of environmental sustainability with economic and financial systems.

Connections between the clusters show how topics are interrelated. For instance, green finance and climate change are strongly linked to investment, innovation, and energy transition, reflecting how financial mechanisms support decarbonization strategies. Similarly,

geopolitics and uncertainty analysis connect with financial markets and spillover effects, illustrating the influence of external shocks on monetary and sustainable finance studies. Overall, the overlay visualization provides a comprehensive picture of how research on green bonds and monetary policy has evolved, with an increasing shift toward climate-related instruments, ESG, and adaptive monetary strategies in the most recent years.

5. Conclusion

This bibliometric study demonstrates that research on green bonds and monetary policy has expanded rapidly between 2021 and 2025. The growth in scientific output, high international collaboration, and the dominance of interdisciplinary keywords reflect the increasing relevance of sustainable finance in global academic and policy debates. Green bonds have emerged as the central theme, strongly connected with issues such as climate change, green finance, investment, and economic growth, underscoring their dual role in supporting low-carbon transitions while reinforcing financial stability.

The analysis further shows that earlier studies were shaped by global crises, with terms like COVID-19, spillover effects, and cryptocurrency highlighting the disruptive role of pandemics and market shocks in monetary and financial research. Over time, however, the thematic focus has shifted toward emerging sustainability agendas, particularly ESG, green innovation, and energy transition, which now dominate the most recent clusters. This transition illustrates a move from short-term crisis response toward long-term resilience and climate adaptation.

Methodologically, the field relies heavily on quantitative, evidence-based approaches, as reflected in recurring terms such as panel data, economic analysis, and policy frameworks. This shows a consistent effort to ground discussions of green monetary policy in robust empirical foundations. At the same time, the co-occurrence networks reveal significant gaps, especially concerning climate policy uncertainty and geopolitical risks, which remain underexplored despite their strong implications for monetary stability and central bank strategies.

In summary, the findings highlight that the integration of green bonds into monetary frameworks is no longer a peripheral issue but a growing pillar of sustainable economic governance. To advance the field, future research should deepen its exploration of underrepresented themes particularly uncertainty and geopolitical dimensions while continuing to refine the role of green financial instruments in stabilizing economies. Addressing these gaps can strengthen the scientific and policy foundations for building adaptive, resilient, and climate-aligned monetary systems in both developed and emerging economies.

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