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*Research Article*

# Shaping Central Banking for Sustainability: A Bibliometric Perspective on Green Monetary Policy

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**Abstract:** Shaping central banking for sustainability has become increasingly relevant as climate change and the pursuit of sustainable development challenge the conventional scope of monetary policy. Green monetary policy reflects efforts to align central banking with environmental and economic objectives, yet the scholarly literature on this issue remains fragmented. This study employs a bibliometric approach using R Studio (Bibliometrix) to analyze publications indexed in Scopus from 2015 to 2025. The dataset comprises more than 1,200 documents with an annual growth rate of nearly 12%, signaling the rapid expansion of research in this field. Bibliometric techniques, including citation mapping, co-authorship analysis, and keyword co-occurrence, are applied to identify influential authors, sources, and thematic clusters. The results indicate a steady increase in international collaboration and a consolidation of research themes, reflecting the growing importance of sustainability in central banking discourse. This study is expected to contribute by providing a structured overview of the intellectual landscape of green monetary policy, clarifying its links with sustainable development and climate change, and offering guidance for future research and policy innovation in sustainable central banking.

**Keywords:** Bibliometric Analysis; Climate Change; Green Monetary Policy; Sustainable Central Banking; Sustainable Development

## 1. Introduction

Climate change has emerged as a critical challenge to financial and economic stability, placing pressure on central banks to reconsider the scope of their mandates. Traditionally focused on price stability and economic growth, central banks are now increasingly expected to integrate sustainability concerns into their policy frameworks. Growing public concern over environmental issues underscores this shift, as climate-related shocks, both physical and transitional, pose significant risks to macro-financial stability. Although only a minority of central banks have explicit environmental mandates, these risks directly impinge on their core responsibilities, compelling monetary authorities to incorporate climate considerations into their frameworks to safeguard long-term stability (Dikau & Volz, 2021).

In this context, the concept of green monetary policy has emerged to capture central banks' efforts to align their instruments with environmental and sustainability objectives. Such measures may include adjusting collateral frameworks, integrating climate risks into asset purchase programs, and promoting green credit facilities (Campiglio, 2016). However, these initiatives remain contested. Critics argue that expanding central bank mandates into environmental domains may undermine independence or conflict with established objectives, while proponents warn that inaction could exacerbate systemic instability (Dafermos et al., 2018). Central banks are therefore navigating complex trade-offs between conventional policy goals and the urgent demands of climate resilience.

Against this background, the present study aims to map and analyze the current trends in green monetary policy adoption from 2019 to 2024. A bibliometric approach was employed using Scopus as the primary database, with additional studies included through hand searching and reference list checks. Bibliometric techniques such as citation analysis, co-

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authorship mapping, and keyword co-occurrence were applied to capture the intellectual landscape of research on central banking, sustainability, and climate-related risks. This study is significant because the literature on green monetary policy remains fragmented across economics, finance, and sustainability studies. By providing a structured bibliometric perspective, it clarifies the intellectual landscape, strengthens the link between central banking and climate resilience, and offers guidance for future research and policy development in sustainable finance.

## 2. Literature Review

The debate on the role of central banks in addressing climate change is grounded in their traditional mandates of price and financial stability. Conventional monetary theory emphasizes that central banks should operate independently and focus narrowly on inflation targeting and macroeconomic stability. However, the emergence of systemic risks associated with climate change has expanded the scope of discussion, suggesting that environmental shocks can significantly affect both price and financial stability (Dikau & Volz, 2021).

The concept of green monetary policy has been introduced to describe efforts by central banks to align their instruments with sustainability objectives. These measures include adjustments to collateral frameworks, integration of climate-related risks into asset purchase programs, and the promotion of green lending facilities. Such approaches illustrate how monetary policy tools can be adapted to mitigate climate risks and facilitate a transition toward a low-carbon economy (Campiglio, 2016). Nevertheless, these initiatives remain contested, with debates focusing on potential conflicts between environmental goals and the preservation of central bank independence (Dafermos et al., 2018).

Furthermore, climate change introduces both physical and transition risks that threaten financial stability. Physical risks arise from climate-related disasters, while transition risks stem from structural adjustments in the economy toward decarbonization. Both types of risks can impair asset values, disrupt financial markets, and destabilize macroeconomic conditions, thereby challenging the resilience of central banks. Recent empirical research shows that central bank resilience is vulnerable to climate shocks, particularly when exchange rate volatility and weak green policies are present (Yahya et al., 2025).

To address these challenges, the Network for Greening the Financial System (NGFS) has provided a framework for central banks and financial supervisors to integrate climate-related risks into their strategies. Its reports emphasize the use of climate scenarios, stress testing, and disclosure frameworks as tools to safeguard financial stability while supporting the green transition (NGFS, 2021). Complementing this institutional perspective, Zhang, Zhou, Naeem, and Rauf (2025), in a study published in the Journal of Environmental Management, show that central bank "green communication" can significantly reduce carbon emissions in energy-intensive firms. They identify three mechanisms through which such communication works: stimulating green innovation, strengthening external monitoring, and optimizing financing structures. These findings highlight that green monetary policy is not only symbolic but also capable of producing tangible effects in driving corporate transition toward low-carbon pathways (Zhang et al., 2025).

Despite a growing body of scholarship, the literature on green monetary policy remains fragmented across economics, finance, law, and sustainability studies. While some works emphasize theoretical foundations, others focus on empirical case studies or normative debates about the legitimacy of environmental mandates. This fragmentation underscores the need for a structured bibliometric perspective to map the intellectual landscape, identify influential contributions, and highlight emerging themes. By consolidating dispersed insights, a bibliometric approach can clarify the evolving role of central banks in shaping sustainable development and climate resilience

## 3. Research 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 Vos Viewer 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 green monetary policy in Indonesia.

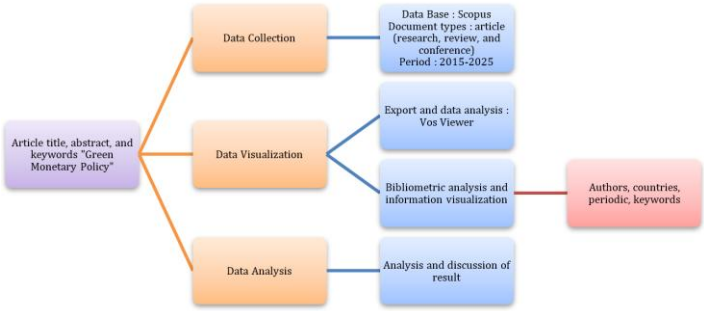


**Figure 1.** Methodology Phases Applied to the Present Work

This study used the bibliographic information from Scopus article database between 2015 to 2025 (Fig. 1). The sampling technique in this study was total sampling. The variables examined were title of publication, author, abstract, keywords, publication year, publisher journal, type of publication, affiliation. Data was extracted from the Scopus repository using Mendeley Desktop tools.

The search results were downloaded using the Scopus export tool as csv, then synchronized with Mendeley Desktop. The topic trend map was created using VosViewer version 1.6.19 in .csv format. The mapping we created used keyword co-occurrence analysis as the unit of analysis, including visualization of keyword mapping networks and keyword density (hotspots).

## 4. Results and Discussion

The image below provides an overview of research outputs spanning from 2015 to 2025. It includes data from 593 sources and a total of 1,209 documents, with an annual growth rate of 11.93% in publications. The analysis involves 6,167 authors, of which 1 are single-authored papers. A significant portion of the publications (27.71%) involve international co-authorship, and there is an average of 9.96 co-authors per document. The dataset also contains 7,961 author-provided keywords and 9,917 references. On average, the documents are 3.57 years old, and each document has received an average of 18.28 citations. These results provide insight into collaboration patterns, research impact, and the overall development of this academic field.


**Figure 2.** Main Information Overview (Using R Studio)

The dataset presented in Figure 2 offers a comprehensive overview of the bibliometric landscape of research on central banking, sustainability, and green monetary policy. Covering the period from 2015 to 2025, the corpus comprises 1,209 documents derived from 593 distinct publication sources. This reflects a robust and diversified scholarly interest, as the sources include academic journals, conference proceedings, and edited volumes that collectively represent multiple disciplinary perspectives, ranging from economics and finance to environmental studies and political science. The timespan of ten years is particularly valuable because it captures the momentum of green monetary policy research during a decade marked by intense global debates on climate change, the Sustainable Development Goals (SDGs), and the Paris Climate Agreement.

The annual growth rate of publications is recorded at 11.93 percent, which is considerably high compared to the average growth rate in many other fields of economics. Such a figure highlights that sustainability and central banking have transitioned from peripheral concerns to central themes in policy and academic circles. The growth is indicative of a rapidly expanding body of literature responding to the pressing need for monetary authorities to integrate climate-related risks into financial and macroeconomic frameworks. This aligns with the efforts of institutions such as the European Central Bank (ECB), the Bank of England, and the People's Bank of China, which have in recent years adopted explicit stances on climate change and green finance.

The involvement of 6,167 authors is another striking feature of the dataset. It demonstrates that the field attracts a wide and diverse academic community. Interestingly, only one document in the dataset is single-authored, underscoring the inherently collaborative nature of research on green monetary policy. Such collaboration is not only methodological—requiring expertise from economics, environmental science, and political economy—but also geographical, with 27.71 percent of publications involving international co-authorship. This high level of cross-border collaboration reflects the global character of climate change and sustainability challenges, which transcend national boundaries and require coordinated solutions. The average of nearly ten co-authors per document (9.96) further underlines the collective dimension of the field, suggesting that teams of scholars are increasingly pooling their knowledge, data, and methodological approaches to address complex questions.

Equally noteworthy is the richness of the thematic landscape, as evidenced by 7,961 author-provided keywords. This volume of keywords signifies the multiplicity of issues being addressed within the field, ranging from climate-related financial risks and green bonds to monetary transmission mechanisms and central bank mandates. The keyword diversity also reflects the evolving conceptual framework of green monetary policy, which draws from and contributes to discourses in sustainable development, macro-financial stability, and climate economics. The dataset also records 9,917 references, pointing to the extensive intertextuality of the field. Researchers are building on a broad base of prior knowledge, integrating insights from both older foundational works and contemporary debates, thereby ensuring continuity and intellectual depth.

The average age of the documents, 3.57 years, suggests a balance between historical and contemporary perspectives. It indicates that while the field continues to build on relatively recent scholarship, there is still engagement with slightly older research, ensuring that the knowledge base remains cumulative rather than fragmented. The average citation per document, at 18.28, further confirms the relevance and impact of this body of literature. Such a citation rate suggests that research in this area is not only being produced in large volumes but is also actively shaping discussions in academic, policy, and financial communities.

Taken together, these indicators point to a field that is both vibrant and rapidly evolving. The dynamics highlighted in Figure 2 mirror the growing recognition that central banking cannot remain detached from the sustainability agenda. As climate change increasingly shapes macroeconomic outcomes through risks to financial stability, inflationary pressures, and long-term growth trajectories monetary authorities are compelled to rethink their mandates. This bibliometric profile thus not only describes the scale and scope of academic activity but also reflects the shifting paradigms of central banking in the 21st century.

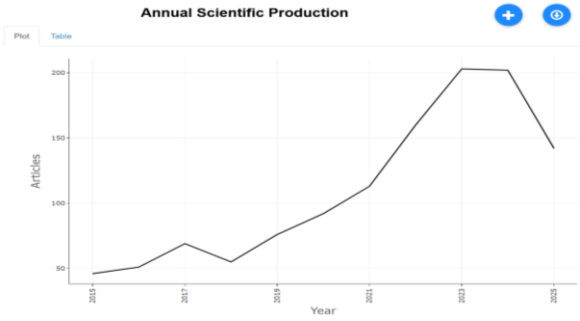


**Figure 3.** Annual Scientific Production (Using R Studio)

The annual scientific production illustrated in Figure 3 reflects the progressive evolution of research output within the field of central banking, sustainability, and green monetary policy over the timespan 2015–2025. At the beginning of the period, namely in 2015–2016, the number of publications remained relatively low and stable. This initial stagnation can be understood as a stage when the academic community had not yet fully embraced the integration of climate change and sustainability into monetary policy discourse. At that time, discussions on environmental economics and finance were still largely situated in the periphery of mainstream monetary research, and only a limited number of pioneering scholars began to highlight the relevance of central banks in addressing ecological challenges.

From 2017 onwards, a steady increase in publication output becomes visible. This gradual rise signifies the growing awareness among scholars that the traditional objectives of central banking price stability, inflation targeting, and financial stability could no longer be pursued in isolation from sustainability concerns. The period also coincided with a surge in global initiatives, such as the adoption of the Sustainable Development Goals (SDGs) in 2015 and the implementation of the Paris Agreement, both of which placed environmental sustainability at the forefront of policy agendas worldwide. These milestones likely provided

momentum for researchers to explore the intersection between monetary policy and environmental governance, leading to an acceleration of studies in subsequent years.

The sharp increase after 2018 marks a critical turning point. Publication output grew at a faster pace, reflecting a surge of interest driven by both academic and policy debates. Central banks and financial regulators across different regions, notably in Europe and Asia, began issuing reports and policy briefs on the risks of climate change to financial stability, thereby legitimizing the topic as a serious area of research. For instance, the European Central Bank (ECB) started publishing analyses on climate-related risks in its financial stability reviews, while the Bank of England expanded its climate stress-testing framework. Such developments provided empirical material and policy-driven motivation for scholars to publish more actively.

The period 2020–2022 represents the peak of scientific production, with publication numbers exceeding 200 articles annually. This coincided with the COVID-19 pandemic, during which research and writing activities intensified globally. Many scholars, facing disruptions to traditional fieldwork and professional routines, redirected their efforts toward analyzing existing datasets and producing academic outputs. The pandemic also sharpened discussions on resilience and sustainability, highlighting the vulnerabilities of global financial systems and reinforcing the need for green recovery strategies. Consequently, the discourse around central banking for sustainability expanded rapidly, producing a rich body of literature that peaked during these years.

After the peak, however, a decline in publication output becomes visible from 2023 onwards. While this downward trend may appear concerning at first glance, it can be interpreted through several perspectives. First, the exceptionally high output during the pandemic years might have been an anomaly, producing a temporary inflation in publication numbers. Second, the natural cycles of research productivity where a surge is followed by a stabilization phase are common in emerging fields. Third, and most importantly, the sharp drop projected for 2025 is likely attributable to incomplete data indexing, as bibliometric databases typically take time to capture the full volume of publications for the most recent year. Thus, the decline should not necessarily be seen as a reduction in scholarly interest, but rather as a transitional phase reflecting the maturation of the field.

Beyond the quantitative trajectory, the trends depicted in Figure 3 also capture broader intellectual and institutional shifts. The steady increase and eventual surge in publications align with the growing recognition of climate change as a systemic risk to global economies and financial systems. Scholars have progressively moved from conceptual discussions to more empirical, data-driven studies, exploring issues such as green quantitative easing, the role of central banks in climate stress testing, and the integration of environmental risks into monetary policy frameworks. The decline after the peak, meanwhile, suggests that the field is entering a phase of consolidation, where researchers are now more focused on refining theoretical frameworks and producing high-quality, policy-relevant studies rather than simply increasing publication volume.

The trajectory of annual scientific production also demonstrates the global nature of the research agenda. The increase in publications after 2018 coincides with the formation of the Network for Greening the Financial System (NGFS), a coalition of central banks and financial supervisors advocating climate-conscious monetary policies. The NGFS's reports and recommendations served as a catalyst for both policy and academic debates, inspiring new research questions and fostering international collaboration. Similarly, the visibility of climate change in major global events, such as the United Nations Climate Conferences (COP26 and COP27), likely reinforced the academic community's engagement with the subject.

In conclusion, Figure 3 illustrates more than just a numerical trend. It narrates the intellectual journey of how sustainability has moved from the margins to the center of central banking research. The trajectory reflects the interplay between global crises, institutional innovations, and scholarly initiatives that together shaped the rapid expansion of literature on green monetary policy. Although the decline in 2025 may appear as a downward trajectory, it is more accurately understood as an artifact of incomplete data and the natural progression of an academic field reaching maturity. The figure thus provides valuable insights into the dynamic and evolving nature of sustainability research within the context of monetary policy, confirming that the field has firmly established itself as a critical area of study for the future of central banking.

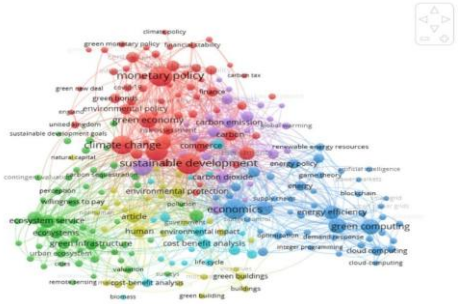


**Figure 4.** Network Visualization (Using Vos Viewer)

Figure 4 presents a network visualization of keyword co-occurrence within the analyzed literature, offering a clear picture of how different thematic areas are connected in research on green monetary policy. The visualization shows that this field is far from one-dimensional; instead, it draws on multiple disciplines and perspectives, ranging from economics and central banking to technology, ecology, and social development. By mapping how frequently certain terms appear together, the figure reveals the intellectual architecture of the field, represented by several clusters that form the backbone of current debates.

The first cluster, illustrated in red, revolves around concepts such as monetary policy, climate policy, and the green economy. This cluster reflects the core debates in the literature, namely how central banks can incorporate sustainability into their conventional objectives of price stability, financial stability, and economic growth. It signals that the issue is no longer peripheral but sits at the heart of monetary policy discussions, with scholars examining whether green monetary policy can serve as a legitimate instrument for climate mitigation and macroeconomic resilience. Closely linked to this is the blue cluster, which highlights technological innovation through terms such as green computing, energy efficiency, and renewable energy. This indicates a strand of research that sees technological advancement as a critical enabler of sustainable finance, pointing to the potential of digital banking, blockchain applications for green bonds, and the role of fintech in broadening access to environmentally aligned financial instruments.

The green cluster adds an ecological perspective, centered on ideas such as ecosystem services, environmental protection, and sustainable development. Here, the literature emphasizes that monetary and financial systems are embedded within natural systems, and that protecting ecological assets is fundamental to long-term stability. This body of work positions green monetary policy within a wider sustainability agenda, aligning it with global commitments such as the Paris Agreement and the Sustainable Development Goals. Complementing these strands is the yellow cluster, which brings in the socio-economic dimension by focusing on issues like economic growth, financial inclusion, and climate change adaptation. This reflects scholarly concern that a green transition must be inclusive and equitable, ensuring that vulnerable populations and developing economies are not left behind. It underscores that resilience to climate risks and access to sustainable finance are essential for a just and balanced transition.

What makes this visualization especially valuable is not only the presence of these clusters but also their interconnections. The overlap between the red and green clusters shows how macroeconomic and monetary debates are increasingly inseparable from ecological considerations, illustrating the convergence of financial stability and environmental sustainability. At the same time, the bridge between the blue and yellow clusters highlights the socio-technological link, suggesting that innovations in digital finance and green technologies must also be designed to promote inclusiveness and equitable adaptation strategies. These interconnections demonstrate that research in this field is not fragmented but part of a larger, integrated framework that demands collaboration across disciplines.

In sum, the network visualization provides a map of how green monetary policy is being conceptualized and operationalized within the academic community. The coexistence and overlap of economic, technological, ecological, and social dimensions reveal that sustainable central banking cannot be understood through a single lens but must instead be approached as a systemic, multidimensional challenge. This reinforces the notion that central banks, in shaping monetary policy for sustainability, must simultaneously address financial governance, technological innovation, environmental protection, and social equity.

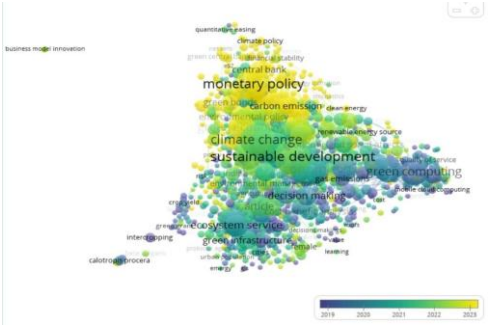


**Figure 5.** Overlay Visualization (Using Vos Viewer)

As a continuation of the network analysis in Figure 4, the overlay visualization provides temporal insights by mapping the evolution of research themes from 2019 to 2023. The color gradient, ranging from dark blue (earlier years) to bright yellow (recent years), highlights how scholarly attention has shifted over time. Early studies, represented in darker tones, concentrated heavily on foundational ecological and agricultural concepts such as intercropping, crop yield, and Calotropis procera. This indicates that initial discussions of sustainability in the broader literature were closely tied to environmental management and natural resource utilization rather than central banking or monetary frameworks. These earlier contributions laid the groundwork by situating climate change and ecosystem services as pressing challenges requiring systemic responses.

As the timeline moves toward 2020 and 2021, the visualization reveals a stronger emphasis on terms such as ecosystem service, green infrastructure, and environmental management, shown in shades of green. This phase reflects a transitional period when sustainability debates began to intersect more visibly with governance and decision-making, highlighting how environmental objectives were progressively framed as issues requiring institutional and policy-level solutions. This stage coincides with the growing global urgency of climate action following events such as the 2019 UN Climate Summit and increasing policy discussions on sustainable finance.

In the most recent years, indicated by the yellow nodes, the map shows the emergence of terms directly linked to the core of green monetary policy, including monetary policy, central bank, financial stability, carbon emission, and green bonds. The increasing prominence of these keywords illustrates the academic community's shift toward integrating sustainability directly into financial and monetary systems. At the same time, technological and innovation-driven terms such as green computing, mobile cloud computing, and renewable energy source remain highly visible, underscoring the recognition that digital transformation and technological advances play a critical role in enabling sustainable finance and climate-resilient economic models.

The overlay visualization therefore not only maps thematic clusters but also traces their chronological progression. It demonstrates that while the intellectual roots of this field stem from ecological and environmental sciences, research has rapidly evolved toward policy-oriented and financial dimensions in recent years. This transition aligns with the real-world trajectory of central banking, as institutions like the European Central Bank, the People's Bank of China, and Bank Indonesia have begun explicitly incorporating climate considerations into their policy frameworks. Overall, the figure captures the dynamic and evolving nature of the scholarly discourse, showing that green monetary policy is no longer a peripheral concern but a rapidly emerging frontier at the intersection of finance, sustainability, and innovation.

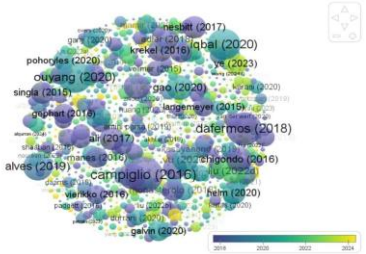


**Figure 6.** Overlay Visualization of Authors (Using Vos Viewer)

Figure 6 illustrates the overlay visualization of authors that have significantly contributed to the development of green monetary policy and its intersections with sustainability, finance, and climate-related research. The map highlights the temporal distribution of influential scholars, where earlier contributions (shown in darker colors, around 2015–2017) came from foundational works such as those of Langemeyer (2015), Campiglio (2016), and Dafermos

(2018). These studies were crucial in framing the initial nexus between climate change, macroeconomic stability, and financial policy. Moving into the transition period of 2018–2020, represented by shades of green, the field expanded with authors like Gao (2020), Iqbal (2020), Galvin (2020), and Alves (2019), who deepened the discussions by addressing the operationalization of green finance, risk assessment, and the role of central banks in promoting sustainability. In the more recent period, from 2021 onwards, highlighted in yellow, newer voices such as Ye (2023), Petraki (2023), and Alqurran (2024) emerge, signaling the incorporation of novel perspectives including digital finance, central bank digital currencies (CBDC), and global policy integration. The visualization thus not only maps the thematic progression of the field but also demonstrates the evolution of its intellectual structure, showing how earlier pioneers laid the groundwork for the subsequent expansion by newer authors. This layered development underlines the collaborative and dynamic nature of the scholarship surrounding green monetary policy and sustainable finance.

## 5. Conclusion

This study has provided a bibliometric analysis of research on green monetary policy and sustainable central banking from 2015 to 2025. As shown in Figure 2 and Figure 3, the field has grown rapidly, with over 1,200 documents, nearly 12 percent annual growth, and strong patterns of international collaboration. The trend in annual scientific production demonstrates how sustainability has moved from a marginal concern to the center of monetary policy research, with publication peaks in 2020–2022 influenced by the COVID-19 pandemic, the SDGs, the Paris Agreement, and the work of the NGFS. These findings confirm that green monetary policy has become an increasingly significant area of academic and policy attention.

The thematic and temporal results, reflected in Figure 4 and Figure 5, show that the field is highly interdisciplinary and dynamic. The four main clusters monetary and climate policy, technological innovation, ecological perspectives, and socio-economic inclusion are interconnected, underscoring the systemic nature of sustainability in central banking. The overlay visualization reveals how the research focus evolved chronologically, beginning with ecological management and resource use, transitioning toward governance and institutional design, and more recently emphasizing monetary instruments, financial stability, and digital finance. This progression highlights the shift from conceptual exploration to applied, policy-oriented research.

Finally, the author overlay in Figure 6 illustrates the intellectual trajectory that shaped this evolution. Foundational scholars such as Campiglio and Dafermos introduced early linkages between climate and finance, transitional contributors like Gao and Iqbal expanded the operational scope, and more recent authors including Ye and Alqurran brought forward themes of digital innovation and global coordination. Together, these findings consolidate fragmented scholarship and offer a structured overview of the intellectual landscape. They underline that the integration of environmental risks into central banking is not only an academic priority but also a pressing policy challenge, requiring innovative instruments, cross-disciplinary collaboration, and global cooperation to ensure long-term financial and environmental resilience.

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