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Green Economics in Global Perspective based on Bibliometric Review

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ABSTRACT

This study presents a comprehensive bibliometric analysis of green economics literature from 1967 to 2024, highlighting thematic clusters, research trends, potential research topics, and author collaborations. The analysis identifies key themes such as green innovation, energy, economic activities, green investment, and policy frameworks, emphasizing the multifaceted nature of the field. Temporal trends reveal a progression from foundational economic activities to a focus on green innovation and integrated policy initiatives. Potential research areas include financial instruments like green bonds, regulatory frameworks, and the economic benefits of sustainable practices. The author collaboration network shows significant cooperative efforts, with tightly-knit clusters of researchers driving advancements in green economics. This interdisciplinary and collaborative nature suggests that future research will benefit from continued partnerships and integrated approaches to sustainability.

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1. INTRODUCTION

The concept of green economics has increasingly taken center stage in global economic discourse, reflecting a growing consensus on the need for sustainable development [1]. Green economics integrates environmental health, sustainable development, and social equity into economic planning and policy-making [2], [3]. This approach diverges significantly from traditional economic theories that primarily focus on economic growth and productivity, often at the expense of the environment [4]. In recent decades, the adverse impacts of industrialization—such as climate change, biodiversity loss, and widespread pollution—have underscored the urgent need to adopt more sustainable economic practices [5].

Green economics challenges the conventional metrics of economic success by proposing that true progress cannot be measured by GDP alone, but should also consider the ecological and social footprints of economic activities [6]. This paradigm shift advocates for policies that ensure economic activities contribute positively to environmental sustainability [7]. It encourages innovations such as renewable energy, efficient waste management, and sustainable agriculture, which are essential in mitigating environmental degradation [8]v. The international community, including governments, corporations, and civil society,

has shown varying levels of engagement with green economic principles, illustrating a complex landscape of implementation [9], [10].

The relevance of green economics has been magnified by global commitments such as the Paris Agreement and the Sustainable Development Goals (SDGs), which aim to reduce carbon emissions and promote sustainability [11]. These international agreements have prompted countries to reassess their economic models and integrate green principles to align with global standards [12], [13]. However, the transition towards a green economy is fraught with challenges including economic restructuring, policy reformulation, and the need for substantial investment in green technologies [14], [15].

The academic interest in green economics is evidenced by a surge in scholarly articles, research funding, and educational programs focusing on this area. A bibliometric analysis of existing research can reveal the evolution of the field, key themes, and research gaps [16], [17]. Such a review is crucial as it provides a comprehensive overview of the intellectual landscape, showing how theories and practices in green economics have developed and spread across different regions and disciplines [18]. Understanding these dynamics is essential for identifying effective strategies that can be implemented globally to achieve sustainable economic growth.

Despite the growing body of research on green economics, there remains a critical gap in synthesizing this extensive literature to understand the global trends and regional differences in the adoption of green economic principles. Many studies focus on specific aspects of green economics or on particular regions, leading to a fragmented understanding of the field. There is a need for a systematic review that compiles and analyzes global research trends, thematic concentrations, and scholarly networks to provide a holistic view of how green economics is conceptualized and applied worldwide. This bibliometric review aims to fill this gap by mapping the global research landscape, thus providing insights into the prevailing economic, social, and environmental discourses influencing sustainable development.

The primary objective of this research is to conduct a comprehensive bibliometric analysis of the literature on green economics to understand the global perspectives and methodological approaches that have shaped the field. This study will identify the most influential works, authors, and regions contributing to the discourse, evaluate the thematic evolution of the literature, and detect the emerging trends and potential future directions. By doing so, it aims to offer a detailed narrative on the global adoption of green economics, facilitating a better understanding of the effective strategies and policies that have been implemented, and highlighting the challenges and opportunities that lie ahead.

2. LITERATURE REVIEW

2.1 Evolution and Theoretical Foundations of Green Economics

Green economics has its roots in the environmental movement of the 1970s, which highlighted the limits of traditional economic models in addressing environmental issues. Pioneers like Herman Daly and Robert Costanza contributed foundational ideas, advocating for an economy that prioritizes ecological sustainability over mere economic expansion [19], [20]. These early theories have evolved into what is now recognized as green economics, which argues for the intrinsic value of nature, not merely as a resource to be exploited but as a vital component of economic activity that must be preserved for future generations [19]. This theoretical shift has been supported by extensive research demonstrating the negative impacts of unsustainable economic practices on global ecosystems, thereby reinforcing the call for a paradigm shift towards sustainability [21].

2.2 Key Concepts and Frameworks in Green Economics

The literature on green economics encompasses several key concepts, including the circular economy, ecological economics,

and the green growth model. The circular economy emphasizes minimizing waste and maximizing the continual use of resources, creating a closed-loop system that enhances resource efficiency [22]. Ecological economics, a closely related concept, focuses on the sustainability of economic systems within ecological constraints, integrating ecological and economic understanding [23]. Meanwhile, green growth strategies advocate for fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which the well-being of humanity depends [24]. These frameworks collectively form the cornerstone of modern green economic thought and have been widely discussed and debated in scholarly articles.

2.3 Empirical Studies and Regional Applications

Empirical research on green economics has been diverse, with studies examining the effectiveness of specific green policies and practices across various regions. For instance, studies in Europe have focused on the implementation of the EU's Green Deal, which aims to make Europe the first climate-neutral continent by 2050 through a comprehensive suite of policy initiatives [25]. In contrast, research in Asia often centers on the challenges and opportunities in transitioning to green economies in emerging markets, with particular emphasis on China's and India's renewable energy policies [26], [27]. These empirical studies provide valuable insights into the practical challenges and successes of implementing green economic principles and help to identify factors that influence the effectiveness of these initiatives.

2.4 Bibliometric Analyses in Green Economics

Bibliometric reviews in green economics provide a meta-analysis of the field's scholarly landscape. Such studies employ quantitative methods to analyze the volume, growth, and distribution of literature on green economics, often identifying key themes, authors, and influential publications. For instance, a bibliometric analysis by [28] traced the evolution of research in ecological economics, revealing a growing focus on sustainable development and resilience thinking. Another study by [29] examined global research trends in the circular economy, identifying major contributors and thematic shifts towards technology and innovation in waste management. These bibliometric studies are instrumental in mapping the intellectual territory of green economics and in illustrating the depth and breadth of the research conducted in this field.

2.5 Critical Debates and Emerging Trends

The literature also reveals critical debates and emerging trends within green economics. One ongoing debate concerns the balance between economic growth and environmental sustainability, with some scholars advocating for degrowth as a necessary step to achieve true sustainability [30]. Another contentious issue is the role of technology in green economics; while technological innovations are often seen as solutions to environmental problems, there is an argument that they can also contribute to increased consumption and thus further environmental degradation [31]. Additionally, emerging research is increasingly focusing on the social dimensions of green economics, examining how policies can be designed to be not only environmentally sustainable but also socially equitable [32].

3. METHODS

This study employs a bibliometric analysis methodology to examine the extensive body of literature on green economics, providing a systematic and quantitative overview of the field's development, key themes, and global impact. The data for this bibliometric review is extracted from Google Scholar, to ensure comprehensive coverage of published articles, conference proceedings, and books from the inception of green economics in the early 1970s up to the present day. The search strategy involves using specific keywords such as "green economics," "sustainable development," "ecological economics," "green

growth," and "circular economy," alongside Boolean operators to refine and expand the search results.

Once the initial data set is compiled, the study employs VOSviewer software tool for data visualization and network analysis, allowing for the identification of key research clusters, influential authors, and fundamental publications within the field. These tools also facilitate the examination of the relationships between various sub-themes and the evolution of research trends over time. The bibliometric analysis includes several metrics such as citation analysis to determine the most impactful works, co-citation analysis to explore the relationships between different works, and co-authorship analysis to identify collaborative networks and influential researchers in the field.

Additionally, this study incorporates a content analysis of the titles, abstracts, and keywords of the retrieved documents to categorize the literature into thematic areas. This allows for a more nuanced understanding of the predominant themes and methodological approaches in green economics research. The content analysis also helps in detecting emerging trends and shifts in focus, which might indicate new directions for future research or changes in policy emphasis. To ensure the reliability and validity of the findings, this study adopts rigorous inclusion and exclusion criteria. Only peer-reviewed articles and scholarly books published in English are considered. Grey literature, such as unpublished theses and non-peer-reviewed reports, is excluded to maintain the academic rigor of the analysis. Moreover, the study includes a sensitivity analysis to test the stability of the results against changes in the dataset, such as the addition or removal of specific journals or articles.

The final component of the methodology involves a critical synthesis of the bibliometric and content analysis results, integrating quantitative data with qualitative insights to provide a comprehensive narrative on the state of green economics research globally. This synthesis not only highlights the most influential contributions and authors but also discusses the practical implications of the findings for policymakers, researchers, and practitioners in the field of green economics.

4. RESULTS AND DISCUSSION

Table 1. Citation Metrics

Publication years:	1967-2024
Citation years:	57 (1967-2024)
Papers:	980
Citations:	162202
Cites/year:	2845.65
Cites/paper:	165.51
Cites/author:	79977.94
Papers/author:	461.63
Author/paper:	2.89
h-index:	198
g-index:	346
hI,norm:	129
hI,annual	2.26
hA-index	89
Papers with ACC >= 1,2,5,10,20:	
976,964,884,728,515	

Source: Publish or Perish Output, 2024

The bibliometric analysis presented in Table 1 provides a detailed overview of the scholarly landscape of green economics from 1967 to 2024. Over these 57 years, the field has seen the publication of 980 papers, which have collectively garnered 162,202 citations.

This significant volume of research and citation underscores the growing importance and influence of green economics within the academic community. The steady increase in citations, averaging 2,845.65 per year, indicates a consistent and expanding interest in sustainable economic practices, reflecting the field's relevance in addressing global environmental and economic challenges.

The average number of citations per paper, 165.51, is remarkably high, suggesting that the research outputs in green economics are not only numerous but also of high quality and significant impact. This average implies that the findings and discussions presented in these papers are widely utilized and referenced, contributing substantially to the body of knowledge and influencing subsequent research, policy, and practice. The high citation rate per paper points to the value and applicability of the research within broader environmental and economic contexts, highlighting its critical role in shaping sustainable development strategies.

Examining the metrics related to authorship reveals further insights into the collaborative nature of research in green economics. The average citations per author, 79,977.94, alongside the average papers per author, 461.63, reflect a high degree of scholarly productivity and collaboration. With an average of 2.89 authors per paper, it is evident that research in this field typically involves multi-author collaborations, which can enhance the robustness and interdisciplinary nature of the studies. Collaborative efforts are essential in tackling the complex, multifaceted issues inherent in green economics, as they bring together diverse perspectives and expertise.

The various indices used to measure the impact and productivity of the research, such as the h-index, g-index, hI,norm, hI,annual, and hA-index, all indicate a substantial and sustained impact. An h-index of 198 means that at least 198 papers have each received at least 198 citations, highlighting the depth of highly influential work in the field. The g-index of 346, which emphasizes the top-cited papers, further underscores the quality and impact of the research contributions. The normalized h-index (hI,norm) of 129 and the annual h-index (hI,annual) of 2.26 provide additional layers of insight, indicating that the influence of the research is both broad and enduring, relative to the number of contributing authors. The hA-index of 89 also reflects high author productivity and influence, showing that many researchers consistently produce work that is widely cited and impactful.

The distribution of highly cited papers offers another perspective on the field’s impact. Nearly all the papers (976 out of 980) have been cited at least once, demonstrating a high level of recognition across the board. Furthermore, a significant number of papers have garnered multiple citations: 964 papers have been cited at least twice, 884 papers at least five times, 728 papers at least ten times, and 515 papers at least twenty times. This distribution highlights not only the widespread relevance of green economics research but also the existence of a substantial body of work that has profoundly influenced the field.

Table 2. Most Cited Literature

Citation	Author and Year	Title
6088	[6]	Blueprint 1: for a green economy
3352	[33]	Do green supply chains lead to competitiveness and economic performance?
2705	[34]	Green revolution: impacts, limits, and the path ahead
2411	[35]	Economic reasons for conserving wild nature
2354	[36]	Does it pay to be green? A systematic overview
1890	[37]	Is green growth possible?
1847	[38]	Harnessing green IT: Principles and practices

1603	[39]	Public opinion toward immigration reform: The role of economic motivations
1557	[40]	Doing well by doing good? Green office buildings
1291	[41]	Economic news and bond prices: Evidence from the US Treasury market

Source: Publish or Perish Output, 2024

Table 2 presents a compilation of the most cited literature within the field of green economics, highlighting seminal works that have profoundly influenced the academic and practical discourse on sustainable economic practices. Each of these papers has garnered substantial citations, reflecting their significant impact and enduring relevance. Here, we delve into the contributions and importance of each of these works to understand their roles in shaping the field of green economics.

The most cited work, "Blueprint 1: for a Green Economy" by Pearce, Markandya, and Barbier, with 6088 citations, is a foundational text in the field. This landmark publication introduced the concept of integrating environmental considerations into economic decision-making. The authors argue for a redefinition of economic progress, emphasizing sustainability and the need to account for environmental costs. This work laid the groundwork for subsequent research and policy development, advocating for economic systems that support long-term ecological balance. Its high citation count reflects its pivotal role in shaping both theoretical frameworks and practical policies in green economics.

Rao and Holt's paper, cited 3352 times, explores the relationship between green supply chains and economic performance. Their research demonstrates that incorporating environmental practices into supply chain management can enhance competitiveness and economic outcomes. This study is significant because it bridges the gap between sustainability and business performance, providing empirical evidence that environmental responsibility can lead to financial benefits. The widespread citations indicate its importance in guiding businesses toward sustainable practices that do not compromise, but rather enhance, their economic viability.

Pingali's work on the Green Revolution, with 2705 citations, critically examines the successes and limitations of this agricultural transformation. The Green Revolution, which significantly increased food production through advanced agricultural techniques, also brought about environmental and social challenges. Pingali's analysis is crucial for understanding the complexities of large-scale agricultural interventions and their long-term sustainability. His insights into the environmental impacts and the need for sustainable agricultural practices resonate widely, as reflected in the substantial number of citations.

The collaborative paper by Bruner, Cooper, Costanza, Farber, Green, and others, cited 2411 times, presents compelling economic arguments for biodiversity conservation. The authors quantify the economic benefits of conserving wild nature, such as ecosystem services that support human well-being. This research provides a robust economic justification for conservation efforts, influencing policy and conservation strategies worldwide. The high citation count underscores the paper's impact on both academic research and practical conservation initiatives, highlighting the economic value of preserving natural ecosystems.

Ambec and Lanoie's paper, with 2354 citations, systematically reviews the financial implications of adopting green practices. Their analysis shows that environmental sustainability can be economically advantageous, challenging the notion that green initiatives are a financial burden. This work is instrumental in shifting corporate and investor attitudes towards sustainability, providing evidence that green practices can enhance profitability and competitiveness. The extensive citations reflect its influence on promoting sustainable business strategies and informing policy debates.

Hickel and Kallis, in their highly cited paper (1890 citations), critically evaluate the feasibility of green growth, questioning whether economic growth can be decoupled from environmental degradation. Their work challenges optimistic views of green growth, arguing for more radical changes to achieve true sustainability. This paper is significant for its provocative stance, stimulating debate and further research on the limits of growth-oriented sustainability strategies. The high citation count indicates its importance in shaping critical discussions on sustainable development.

Murugesan's work on green IT, with 1847 citations, outlines principles and practices for reducing the environmental impact of information technology. His research emphasizes the role of IT in promoting sustainability, both through its applications and by reducing its own ecological footprint. This paper is pivotal in guiding the IT industry towards greener practices and is widely cited in research on sustainable technology. Its significant citation count underscores the relevance of IT in broader sustainability efforts.

Citrin, Green, Muste, and colleagues, with 1603 citations, explore the economic motivations behind public opinions on immigration reform. Although not directly related to environmental sustainability, this work's inclusion reflects the interconnectedness of economic, social, and environmental issues. The findings highlight how economic perceptions influence public attitudes, providing insights relevant to policies that integrate economic and social dimensions of sustainability. The substantial citations indicate its broader impact on understanding economic motivations in public policy.

Eichholtz, Kok, and Quigley's paper, cited 1557 times, investigates the financial performance of green office buildings. Their research demonstrates that green buildings can yield higher returns and occupancy rates, supporting the case for sustainable real estate investments. This work is crucial for promoting sustainable architecture and urban planning, showing that environmental responsibility can align with economic benefits. The high citation count reflects its influence on the real estate industry and sustainable building practices.

Finally, Balduzzi, Elton, and Green's paper, with 1291 citations, examines the impact of economic news on bond prices. While not directly focused on green economics, this research contributes to the broader understanding of economic dynamics, which is essential for developing comprehensive sustainability strategies. The insights gained from this study are relevant for policymakers and investors in shaping economic policies that consider both financial and environmental stability. The significant citation count indicates its relevance in economic and financial research.

4.1 Keywords Co-Occurrence Analysis

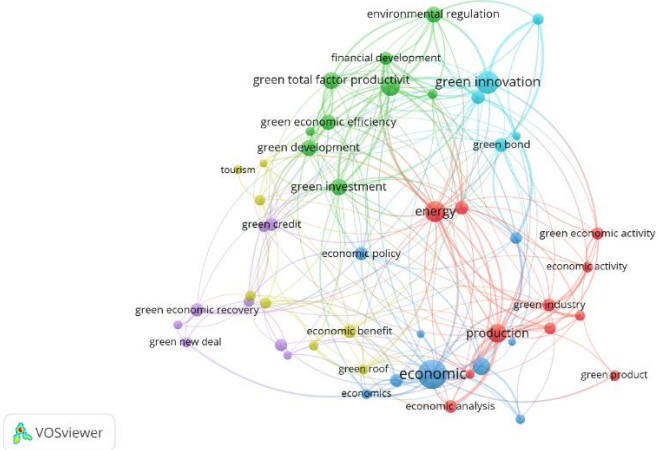

Figure 1. Network Visualization
Source: Data Analysis, 2024

The first network visualization from VOSviewer offers a detailed depiction of the interconnected themes and research trends in the field of green economics. Each node represents a keyword or topic, with the size of the node indicating the frequency of the keyword's occurrence in the literature. The lines connecting the nodes represent the co-occurrence of these keywords in the same publications, with the thickness of the lines reflecting the strength of the connections. The different colors signify distinct clusters or thematic areas within the broader field of green economics. This visualization provides valuable insights into the major research foci and their interrelations.

The network is divided into several prominent clusters, each representing a different thematic area within green economics. The primary clusters include themes related to green innovation, energy, economic activities, green investment, and green economic policies. Each cluster is analyzed below to understand the specific focus and interconnections within the literature.

The light blue cluster, centered around "green innovation," is one of the largest and most interconnected themes in the network. This cluster includes related keywords such as "environmental regulation," "financial development," "green bond," and "green total factor productivity." The prominence of green innovation reflects the significant interest in developing new technologies and practices that enhance environmental sustainability while promoting economic growth. The strong connections with environmental regulation and financial development indicate that policy frameworks and financial mechanisms are critical enablers of green innovation. The inclusion of green bonds highlights the role of innovative financial instruments in funding sustainable projects.

The red cluster focuses on "energy," encompassing related terms like "production," "green industry," "green economic activity," and "economic activity." The centrality of energy in the network underscores its pivotal role in green economics. Sustainable energy production and consumption are fundamental to reducing environmental impacts and achieving economic sustainability. The connections to green industry and economic activities suggest a broad interest in how energy transitions can support industrial sustainability and overall economic performance. This cluster reflects ongoing research into renewable energy sources, energy efficiency, and the economic implications of transitioning to a green energy system.

The blue cluster is centered on "economic" and includes keywords such as "production," "economic analysis," "economic benefit," and "green product." This cluster highlights the integration of economic analysis with green practices, emphasizing the importance of understanding the economic implications of sustainable production and consumption. The presence of terms like economic benefit and green product suggests that researchers are exploring how green products and practices can provide economic advantages, supporting the argument that sustainability can be economically beneficial.

The green cluster revolves around "green investment," with related terms like "green development," "green economic efficiency," and "green total factor productivity." This cluster indicates a strong interest in the financial aspects of green economics, particularly how investments in sustainable practices and technologies can drive economic development. The connections to green economic efficiency and productivity highlight the focus on maximizing the economic returns of green investments, suggesting that efficiency and productivity are key considerations in sustainable economic planning.

The yellow cluster, which includes keywords like "green economic recovery," "green new deal," "green credit," and "tourism," points to the policy dimensions of green economics. This cluster reflects the increasing emphasis on policy frameworks that support sustainable economic recovery and growth. The mention of the green new

deal signifies interest in comprehensive policy initiatives aimed at addressing climate change and economic inequality. The inclusion of green credit and tourism suggests that financial incentives and sustainable tourism are also important areas of research within this policy-focused cluster.

The network visualization reveals significant interconnections and overlaps between these thematic clusters, indicating the interdisciplinary nature of green economics research. For instance, the linkages between green innovation and financial development suggest that economic and financial factors are crucial for driving innovation in sustainability. Similarly, the connections between energy and economic activity highlight the intertwined relationship between sustainable energy practices and overall economic performance. The overlapping themes also suggest that green economics is not studied in isolation but rather as a complex system where various factors interact. The strong ties between green investment and green economic efficiency, for instance, indicate a focus on how financial investments can enhance economic efficiency while promoting sustainability. This interconnectedness underscores the need for integrated approaches that consider multiple dimensions of sustainability, including technological, economic, financial, and policy aspects.

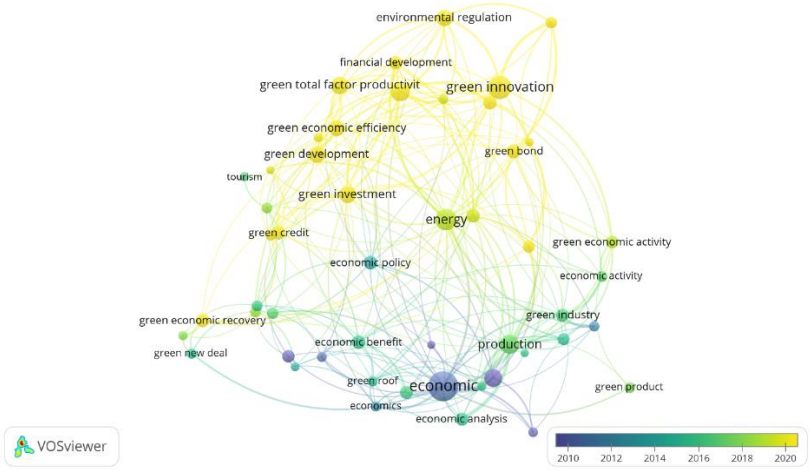

Figure 2. Overlay Visualization
Source: Data Analysis, 2024

The second VOSviewer network visualization map includes a temporal dimension, indicated by a color gradient from blue to yellow, representing the progression of research topics in green economics over the years. This visualization not only maps the key themes and their interconnections but also highlights how the focus of research has shifted over time, from 2010 to 2020.

The yellow cluster, which includes keywords such as "green innovation," "environmental regulation," "financial development," and "green total factor productivity," represents a relatively recent focus in green economics research. The prominence and interconnections of this cluster indicate that innovation in green technologies and practices has become a central theme, especially in recent years. The focus on environmental regulation and financial development within this cluster underscores the importance of policy frameworks and financial mechanisms in driving green innovation. The shift towards green innovation reflects a growing recognition of the need for new technologies and approaches to address environmental challenges and achieve sustainable economic growth.

The green cluster, centered around "energy," includes related terms such as "green bond," "green economic efficiency," "green development," and "green investment." This cluster illustrates the

significant attention given to sustainable energy practices and their economic implications. The evolution of this cluster over time shows a growing interest in how energy transitions can support economic sustainability. The connections between green bonds and green investment indicate that innovative financial instruments are increasingly being used to fund energy projects, reflecting a trend towards integrating financial solutions with sustainable energy initiatives. This shift highlights the critical role of energy in achieving broader sustainability goals.

The blue cluster is centered on "economic," encompassing keywords such as "production," "economic analysis," "economic benefit," and "green product." This cluster reflects the foundational aspect of economic activities within green economics research. Over the years, there has been a consistent focus on understanding the economic implications of sustainable practices. The presence of terms like economic benefit and green product suggests that researchers have been exploring how green products and practices can provide economic advantages, supporting the argument that sustainability can be economically beneficial. The temporal progression within this cluster indicates a sustained interest in quantifying and demonstrating the economic benefits of green initiatives.

The yellow-green cluster revolves around "green investment," with related terms such as "green development," "green credit," and "economic policy." This cluster represents the financial aspects of green economics, highlighting how investments in sustainable practices and technologies can drive economic development. The connections to green economic efficiency and productivity suggest a focus on maximizing the economic returns of green investments. The temporal evolution of this cluster shows an increasing emphasis on financial mechanisms and policies that support green investments, reflecting a trend towards leveraging financial tools to promote sustainability.

The green-blue cluster, which includes keywords like "green economic recovery," "green new deal," "tourism," and "economic activity," points to the policy dimensions of green economics. This cluster reflects the increasing emphasis on policy frameworks that support sustainable economic recovery and growth. The inclusion of the green new deal signifies interest in comprehensive policy initiatives aimed at addressing climate change and economic inequality. The connections to green economic recovery and tourism suggest that sustainable tourism and economic recovery are important areas of research within this policy-focused cluster. The temporal progression within this cluster indicates a growing recognition of the role of policy in driving sustainable economic practices.

The temporal dimension of the visualization, indicated by the color gradient, provides insights into how the focus of green economics research has evolved over the years. Early research, represented by blue nodes, primarily focused on fundamental economic activities and their implications for sustainability. This includes topics like production, economic analysis, and green products. As the field has progressed, indicated by the transition from green to yellow nodes, there has been a noticeable shift towards more specific themes such as green innovation, energy, and investment.

From 2010 to 2014, research in green economics primarily focused on establishing the foundational concepts and exploring the economic implications of sustainable practices. During this period, there was a significant emphasis on understanding how traditional economic activities could be made more sustainable and the economic benefits of doing so. From 2014 to 2018, the focus shifted towards integrating financial mechanisms and policy frameworks with sustainable practices. This period saw a growing interest in green bonds, green investment, and economic policies that support sustainability. The research during this time aimed to demonstrate the feasibility and benefits of integrating sustainability into financial and policy frameworks. From 2018 onwards, there

has been a marked emphasis on green innovation and the role of technology in driving sustainable economic growth. The prominence of terms like green innovation, environmental regulation, and financial development in recent years indicates a growing recognition of the need for new technologies and innovative approaches to address environmental challenges. This shift reflects the evolving understanding that achieving sustainability requires not only policy and financial support but also technological advancements and innovative solutions.

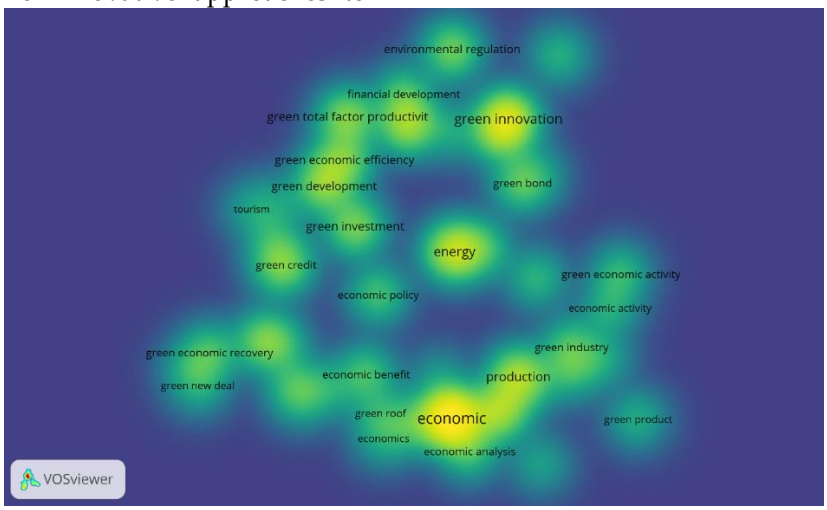

Figure 3. Density Visualization
Source: Data Analysis, 2024

The figure of VOSviewer density visualization map offers a detailed look into the concentration and prominence of various research topics within the field of green economics. In this visualization, the density of color indicates the frequency and intensity of research activity associated with specific keywords. Brighter and more concentrated areas (yellow) represent topics with a higher density of related publications and research activity, while darker areas (blue) indicate lower activity. This density map provides valuable insights into the core areas of focus within green economics and helps to identify key trends and themes in the literature.

One of the most prominent areas in the density map is "green innovation," which appears as a bright yellow node indicating significant research activity. The high density around green innovation suggests that this is a central theme within green economics, reflecting the importance placed on developing new technologies and practices that enhance environmental sustainability. Green innovation encompasses a range of topics, including technological advancements, innovative business practices, and policy frameworks that support sustainable development. The strong emphasis on green innovation indicates that researchers are actively exploring ways to address environmental challenges through innovative solutions.

The term "energy" is another highly concentrated area in the density map, indicating substantial research focus. Energy is a critical component of green economics, as sustainable energy production and consumption are essential for reducing environmental impacts and achieving economic sustainability. The bright yellow color around energy suggests that this topic is a key area of interest, with researchers examining various aspects of energy transitions, renewable energy sources, energy efficiency, and the economic implications of sustainable energy practices. The prominence of energy in the map underscores its importance in the broader context of green economics.

Keywords such as "environmental regulation," "economic policy," and "green economic recovery" appear in areas of moderate to high density, indicating a strong

focus on policy and regulatory frameworks within green economics research. Environmental regulation is critical for ensuring that economic activities are conducted in a manner that protects the environment and promotes sustainability. The density around these terms suggests that researchers are examining the effectiveness of various policy instruments and regulatory measures in driving sustainable economic practices. The inclusion of terms like "green economic recovery" and "green new deal" indicates an interest in comprehensive policy initiatives aimed at addressing climate change and economic inequality.

The insights gained from the density visualization map have several implications for future research in green economics. First, the centrality of green innovation and energy suggests that these areas will continue to be critical focal points for research. Innovations in technology and energy systems are essential for achieving sustainable economic growth, and ongoing research will likely explore new ways to enhance these areas. Second, the strong connections between economic analysis and green practices indicate a need for further studies that quantify the economic benefits of sustainability. Researchers should continue to develop models and methodologies that demonstrate the economic advantages of green products and practices, providing robust evidence to support policy and business decisions. Finally, the interdisciplinary nature of the research highlighted by the density map underscores the importance of collaborative research that integrates insights from multiple fields. By combining expertise in economics, environmental science, technology, and policy, researchers can develop comprehensive solutions to the complex challenges of green economics.

4.2 Co-Authorship Network Analysis

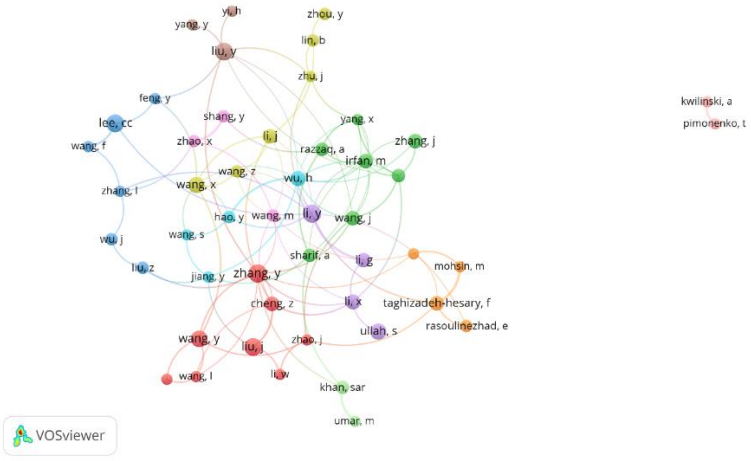

Figure 4. Network Visualization
Source: Data Analysis, 2024

The VOSviewer network visualization map illustrates the collaborative relationships among authors in the field of green economics. Each node represents an author, with the size of the node reflecting the number of publications or the significance of their contributions. The lines connecting the nodes indicate co-authorships, with thicker lines representing stronger collaborative relationships. Different colors signify distinct clusters of collaboration, indicating groups of authors who frequently work together.

The visualization reveals several prominent clusters, each indicating a tightly-knit group of researchers with frequent collaborations. One of the most notable clusters is the red cluster, which includes authors like Zhang Y, Wang L, Liu J, and Cheng Z. This cluster is highly interconnected, suggesting a strong collaborative network among these

researchers. The dense connections within this cluster indicate that these authors frequently co-author papers, contributing significantly to the field of green economics. Their collaborative efforts likely focus on specific sub-themes or projects within the broader domain, leveraging their collective expertise to advance research in this area.

Another significant cluster is the blue cluster, which includes authors such as Wu J, Lee CC, Wang F, and Zhang L. Similar to the red cluster, this group of authors demonstrates strong interconnections, indicating a well-established collaborative network. The presence of multiple clusters with different colors, such as the green, yellow, and purple clusters, suggests that the field of green economics is characterized by several distinct research groups, each contributing to different aspects of the field. For example, the green cluster with authors like Zhang J, Yang X, and Razaq A, indicates a separate collaborative effort, possibly focusing on different research questions or methodologies within green economics.

The map also highlights some authors who appear to be more isolated or have fewer connections compared to the main clusters. Authors like Kwilinski A and Pimonenko T are situated on the periphery of the network, indicating that they may collaborate less frequently with the main groups or focus on more niche areas of research. These peripheral positions can also suggest emerging researchers or those exploring novel, less mainstream topics within green economics. Overall, the VOSviewer visualization provides a comprehensive overview of the collaborative landscape in green economics, highlighting the key contributors, their collaborative networks, and the potential areas for further interdisciplinary and cross-institutional collaborations.

5. CONCLUSION

The analysis of thematic clusters, research trends, potential research topics, and author collaborations in green economics reveals a dynamic and interdisciplinary field marked by significant innovation and collaboration. Thematic clusters such as green innovation, energy, economic activities, green investment, and policy frameworks highlight the multifaceted nature of green economics, emphasizing the importance of technological advancements, sustainable energy practices, financial mechanisms, and comprehensive policies. Research trends over the years show a clear evolution from foundational economic activities towards more recent emphases on green innovation and integrated policy initiatives, reflecting an increasing recognition of the need for new technologies and holistic approaches to sustainability. Potential research topics identified include the continued exploration of financial instruments like green bonds, the effectiveness of various regulatory frameworks, and the economic benefits of sustainable practices. The author collaboration network underscores the importance of cooperative research efforts, with several tightly-knit clusters of researchers contributing significantly to the field. These collaborations enhance the depth and breadth of green economics research, suggesting that future advancements will likely result from continued interdisciplinary and cross-institutional partnerships.

REFERENCES

[1] A. Khandelwal, Y. Chawla, and H. Saxena, "Achieving a Picturesque Global Green Economy by Sustainable Consumption and Production (SCP): Green Economy and Sustainable Development," in *Handbook of Research on Sustainable Consumption and Production for Greener Economies*, IGI Global, 2023, pp. 213–229.

[2] A. Mishra and S. Alavi, "Green energy, carbon emission and economic prosperity; an evidence of global perspective," *Int. J. Energy Sect. Manag.*, vol. 17, no. 4, pp. 661–676, 2023.

[3] S. Tagliapietra, L. Klaas, and W. Guntram, "The global quest for green growth: an economic policy perspective," *SUSTAINABILITY*, vol. 2022, no. 14, pp. 555–570, 2022.

[4] M. Rustamova and D. Khairova, "Green Economy-a Perspective Direction of Development of the Oil and Gas Sector of Uzbekistan," *Bull. Sci. Pract.*, vol. 8, no. 11, 2022.

[5] I. Tomashuk, "Green economy as a guarantee of sustainable development," *Three Seas Econ. J.*, vol. 3, no. 2, pp. 105–119,

2022.
[6] D. Pearce, A. Markandya, and E. Barbier, *Blueprint 1: for a green economy*. Routledge, 2013.
[7] S. Verma and D. Kandpal, "Green economy and sustainable development: a macroeconomic perspective," in *Environmental sustainability and economy*, Elsevier, 2021, pp. 325–343.
[8] H. Henderson, "Growing the green economy globally," *Int. J. Green Econ.*, vol. 1, no. 3–4, pp. 276–298, 2007.
[9] M. L. A. Kurniawan, "The Application of Green Economy in the Framework of the 2025 Garbage Clean Bantul Movement (Bantul Bersama)," *Asian J. Healthc. Anal.*, vol. 1, no. 2, pp. 65–70, 2022.
[10] I. Ngare *et al.*, "Defining green economy aspects for eco-friendly industrial approaches; their linkages across the sustainable innovation paradigm," *Sci. Res. Essays*, vol. 17, no. 2, pp. 17–23, 2022.
[11] E. Pourkarimi and Y. Hojjat, "A review of international green economy and green tax policies," *CIFILE J. Int. Law*, vol. 1, no. 1, pp. 29–36, 2019.
[12] M. Anwar, "Green economy sebagai strategi dalam menangani masalah ekonomi dan multilateral," *J. Pajak Dan Keuang. Negara*, vol. 4, no. 1S, pp. 343–356, 2022.
[13] G. Megwai, N. Njie, and T. Richards, "Exploring green economy strategies and policies in developing countries," *Int. J. Green Econ.*, vol. 10, p. 338, Jan. 2017, doi: 10.1504/IJGE.2016.081905.
[14] M. Sverdan, "Green economy: Development in the light of new policy," *Green, Blue Digit. Econ. J.*, vol. 2, no. 1, pp. 45–52, 2021.
[15] C. Zhao, "Research on the Green Economic Development on the Basis of Cultural and Creative Industry," in *E3S Web of Conferences*, EDP Sciences, 2021, p. 2038.
[16] J. J. Zhu, R. Zhang, K. Kanhalikham, Z. Liu, and X. Shen, "Green economy studies amongst the global climate change challenge between 2016 and 2022: a bibliometric review," *Front. Ecol. Evol.*, vol. 11, p. 1168437, 2023.
[17] L. Terzić, "Why is the transition to a green economy important for achieving sustainability? A review of some theoretical approaches and empirical research presented in the literature," *Икономическа мисъл*, no. 3, pp. 307–332, 2023.
[18] K. Wahida and H. Uyun, "Tatanan Indonesia Dalam Mewujudkan Pertumbuhan Ekonomi Berkelanjutan Melalui Green Economy," *Harmon. J. Ilmu Komun. dan Sos.*, vol. 1, no. 2, pp. 14–26, 2023.
[19] H. E. Daly, *Ecological economics and sustainable development*. Edward Elgar Publishing, 2007.
[20] R. Costanza, "Ecological economics: a research agenda," *Struct. Chang. Econ. Dyn.*, vol. 2, no. 2, pp. 335–357, 1991.
[21] R. Costanza *et al.*, "The value of the world's ecosystem services and natural capital," *Nature*, vol. 387, no. 6630, pp. 253–260, 1997.
[22] M. Geissdoerfer, P. Savaget, N. M. P. Bocken, and E. J. Hultink, "The Circular Economy–A new sustainability paradigm?," *J. Clean. Prod.*, vol. 143, pp. 757–768, 2017.
[23] M. Common and S. Stagl, *Ecological economics: an introduction*. Cambridge University Press, 2005.
[24] C. H. L. OECD, *OECD Science, Technology and Innovation Outlook 2016 Country Profile*. OECD Paris, France, 2016.
[25] D. Silander, "The European Commission and Europe 2020: Smart, sustainable and inclusive growth," in *Smart, sustainable and inclusive growth*, Edward Elgar Publishing, 2019, pp. 2–35.
[26] D. Zhang and Q. Kong, "Green energy transition and sustainable development of energy firms: An assessment of renewable energy policy," *Energy Econ.*, vol. 111, p. 106060, 2022.
[27] B. Sharma, P. Mittal, and M. S. Obaidat, "Power-saving policies for annual energy cost savings in green computing," *Int. J. Commun. Syst.*, vol. 33, no. 4, p. e4225, 2020.
[28] C. Amenta and C. Stagnaro, "The failures of the entrepreneurial state: Subsidies to renewable energies in Europe," *Quest. Entrep. State*, p. 233, 2022.
[29] H. Zhao, H. Zhao, and S. Guo, "Evaluating the comprehensive benefit of eco-industrial parks by employing multi-criteria decision making approach for circular economy," *J. Clean. Prod.*, vol. 142, pp. 2262–2276, 2017.
[30] G. Kallis, "In defence of degrowth," *Ecol. Econ.*, vol. 70, no. 5, pp. 873–880, 2011.
[31] M. Huesemann and J. Huesemann, *Techno-fix: why technology won't save us or the environment*. New Society Publishers, 2011.
[32] D. Schlosberg and L. B. Collins, "From environmental to climate justice: climate change and the discourse of environmental justice," *Wiley Interdiscip. Rev. Clim. Chang.*, vol. 5, no. 3, pp. 359–374, 2014.
[33] P. Rao and D. Holt, "Do green supply chains lead to competitiveness and economic performance?," *Int. J. Oper. Prod. Manag.*, vol. 25, no. 9, pp. 898–916, 2005.
[34] P. L. Pingali, "Green revolution: impacts, limits, and the path ahead," *Proc. Natl. Acad. Sci.*, vol. 109, no. 31, pp. 12302–12308, 2012.
[35] A. Balmford *et al.*, "Economic reasons for conserving wild nature," *Science (80-.).*, vol. 297, no. 5583, pp. 950–953, 2002.
[36] S. Ambec and P. Lanoie, "Does it pay to be green? A systematic overview," *Acad. Manag. Perspect.*, pp. 45–62, 2008.
[37] J. Hickel and G. Kallis, "Is green growth possible?," *New Polit. Econ.*, vol. 25, no. 4, pp. 469–486, 2020.
[38] S. Murugesan, "Harnessing green IT: Principles and practices," *IT Prof.*, vol. 10, no. 1, pp. 24–33, 2008.
[39] J. Citrin, D. P. Green, C. Muste, and C. Wong, "Public opinion toward immigration reform: The role of economic motivations," *J. Polit.*, vol. 59, no. 3, pp. 858–881, 1997.
[40] P. Eichholtz, N. Kok, and J. M. Quigley, "Doing well by doing good? Green office buildings," *Am. Econ. Rev.*, vol. 100, no. 5, pp. 2492–2509, 2010.
[41] P. Balduzzi, E. J. Elton, and T. C. Green, "Economic news and bond prices: Evidence from the US Treasury market," *J. Financ. Quant. Anal.*, vol. 36, no. 4, pp. 523–543, 2001.