SUSTAINABILITY AND GREEN ECONOMY IN DEVELOPMENTAL PARADIGMS: A BIBLIOMETRIC ANALYSIS OF SCHOLARLY TRENDS AND TRANSFORMATIONS

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Abstract

This study aims to ascertain the trajectory and scope of green economy research inside Scopus-indexed papers. This research uses bibliometric analytic methodologies to investigate all publications cataloged in the Scopus database about the green economy within a sustainable development framework spanning 1990 to 2023. The data collected was analyzed using both Excel and r/r studio software. Vosviewer is a software tool that enables the simultaneous visual study of keyword occurrence and document extracts. The researcher identified 859 publications that align with the designated role, subject matter, and specified criteria. The findings of this study reveal a yearly growth rate of 17.98%, with the highest number of publications observed in the field of environmental science in the year 2022. China is the nation that exhibits the highest level of scholarly output in terms of publications associated with the Chinese Academy of Sciences. Lyulyof, o. He is widely recognized as a highly prolific author within the field of the green economy. The bibliometric analysis conducted was restricted to the utilization of Scopus data. This study did not consider other national and international datasets. This study offers a concise survey of the literature available to scholars engaged in academic research and presents suggestions for future research endeavors.

Keywords*:* Green Economy, Sustainable Development, Research Trajectory, Ecological Economics, Circular Economy

INTRODUCTION

Problems between economic development, resources, and the environment There is growing pressure on economies and communities worldwide to develop sustainably. Because of the irresponsible resource use that degrades the environment (Erdogan et al., 2022). The 2030 agenda for sustainable development and the 17 sustainable development goals (SDGs) that address this issue do not align with this—several establishments design strategies utilizing the green economy idea to facilitate sustainable resource management5. (Merino-Saum et al., 2018). Planning for sustainable development starts with reducing reliance on fossil fuels (Baz et al., 2022) to eco-friendly and sustainable methods (Sun & Zhang, 2022).

A few nations, like green finance, are beginning to transition from economic expansion to green productivity strategies (Apriantoro et al., 2022). Moreover, green innovation to achieve sustainable green development goals (Jiakui et al., 2023). For many nations, green development is the only path forward for sustainable growth. Global transfers based on market mechanisms and the legal framework, technological and industrial advancements, and stricter environmental protection laws are the usual ways capitalist nations accomplish their aspirations for green growth. The global division of labor and the key technological leadership positions held by Western nations are critical to the success of this green development approach (Xu et al., 2023). Some Western countries, especially in Europe, are starting to implement green agreements by running a zero-waste economy and recycling construction waste and building materials (Dubale et al., 2023).

Due to the great opportunities with abundant untapped natural resources, Asian countries are also implementing many reforms through the green economy, giving them excellent prospects for "green" economic development (Goldstein et al., 2017). China is one nation that has transitioned into a new phase of normalized development. As China's economy shifts from rapid expansion to high-quality development, the government's primary objective is sustainable green development (Ye et al., 2022). One of China's strategic goals in its transition is to run a green economy in sustainable economic development so that it becomes a trend from the core of economic development (Subhi et al., 2023). Industrial products that are run focus on the green economy (C. Wu, 2022) and humanization (Zuo et al., 2023).

To enhance progress toward sustainable development, the transition phase towards sustainable development has received impetus (Gissin et al., 2018), primarily driven by the recent economic crisis (Dobre & Boboc, 2013). Towards achieving the green economy sustainability transition goal, of course, it is necessary to use renewable energy sources in its implementation; not a few countries in the world state that they have implemented a transition towards a bright, green, and sustainable economy, and are accompanied by evidence of a climate change to achieve sustainable development goals within the scope of social, and other related environment (Bilas et al., 2022).

A green economy is based on the need to accelerate the transition to sustainable development, which has been primarily fueled by the recent economic crisis as a means of closing the gap between environmental and moral ideals and as circumstances change. (Dobre & Boboc, 2013). A green economy can significantly and profoundly alter the direction of sustainable development goals (Borel-Saladin & Turok, 2013). Reducing reliance on fossil fuels is one of the main objectives of a "green economy," which will enable a resource-efficient and ecologically conscious society to grow sustainably (Chen et al., 2023). Conducting a thorough evaluation of green economy efficiency and comparing it with emission reductions is essential to achieving the objective of sustainable green economy development (Yumei et al., 2022).

Bibliometric indicators are a valuable tool for assessing the outcomes of scientific research, analyzing the relationship between science and technology, mapping out different fields of knowledge, tracking the advancement of new knowledge in particular fields, and serving as an indicator for future strategic planning.

The goal of this study is to trace how the green economy has evolved in the context of sustainable development using papers from 1990 to 2023 that the Scopus database has indexed. Based on discoveries made in the Scopus database, the first two publications on the green economy were discovered in 1990, which was chosen as the launch year.

REVIEW OF LITERATURE

According to (Karuppiah et al., 2022), sustainable development practice was initially presented to the British government in 1989 for environmentally friendly industrial

practices, it garnered a great deal of attention internationally during the 2008 global financial crisis. Because green economic practices provide measurable financial and economic benefits from national and international policy, their interest has steadily increased in recent years. Nonetheless, many nations struggle to implement sustainable green development (Y. et al., 2021). The drop in the growth rate of economic development was the reason behind the decline in the growth rate of the inclusive green growth index from 2007 to 2018, with a recovery only beginning after 2016. The advent of new revolutionary technologies, sometimes called the "fourth industrial revolution," heralded this recovery and crucially created a new avenue for long-term, environmentally friendly economic growth (Tamasiga et al., 2022).

According to Ahmed et al (2022), environmental factors have grown to be one of the challenges facing the green economy in many nations, particularly in those with substantial and stable economies but limited room for sustainable green development. Despite having notable rates of economic growth, Nigeria, Mexico, Indonesia, and Turkey have yet to be able to sustain environmental quality at the same time. Consequently, the environmental indices of these nations constitute an obstacle to their pursuit of green development that is sustainable. In a long-term development strategy that significantly affects energy savings and emission reduction, cutting energy consumption intensity by 3.33% and carbon emission intensity by four is required to maintain environmental quality (Zhang et al., 2023). In the economic field, according to Sharma et al. (2023), the COVID-19 pandemic and subsequent global economic downturn have resulted in a reduction in global energy consumption, the collapse of stock markets, and a decrease in energy costs. Pursuing green economy initiatives has led to a decline in competitiveness, posing a threat to the attainment of neutrality and sustainable development objectives. According to empirical findings, the green economy is very vulnerable to economic shocks, as seen by fluctuations in oil prices and sustainability as a whole (Khoirunisa et al., 2023).

According to Yin et al., (2022), efforts to realize green economic development are one of which is by optimizing industrial production, one of which is by using the Industrial Internet of Things (IIOT). Where this industrial production has appeal because it was born from digitalization, which has a significant influence on sustainable development (Beier et al., 2018); achieving sustainable development goals (SDGs) requires unprecedented

investment (Apriantoro et al., 2022), one of which is the participation of the private sector to bridge the financing gap to achieve this goal. Engaging the private sector can contribute significantly to achieving the 2030 agenda for sustainable development (Prakash & Sethi, 2022). In addition, to be able to achieve this goal, several factors supporting energy policy are needed to determine green economic growth through the government, which has a vital role in implementing production based on low carbon emissions that is more efficient and environmentally friendly (Khan et al., 2023).

RESEARCH METHOD

Method bibliometric analysis was used in this study (Apriantoro et al., 2023). Data was extracted from the Scopus database between 1990 and 2023 utilizing a Boolean search engine. The search was conducted at 11:00 WIB on July 22, 2022. Researchers analyzed citations, document content, and networks using R and Rstudio tools, Vosviewer, and Microsoft Excel. The researchers processed the dataset in three steps (Apriantoro & Diniyah, 2024).

In the first stage, to ensure pertinent research is done on bibliometric subjects, researchers will first study the literature on connected themes. Furthermore, a literature review is considered to represent the research's breadth accurately and can help select relevant keywords.

In the second stage, using the boolean operators title-abs-key (green and economy) and title-abs-key (sustainable and development and goals), the researcher searches Scopus in the second step, yielding 1,501 (non-filter) documents. Then, to limit only articles as document types, document sources are limited to journals, and only articles are in English, filtering is done using the and operator (limit-to (srctype, "j")) and (limit-to (language, "English")) to provide a final document count of 859.

In the third stage, the final search documents were analyzed using R, Rstudio, Scopus analyzer, and other tools to determine the number of documents per year and the number of documents per journal, author, affiliation, country, and subject/field. A network-level document analysis was also performed, utilizing Vosviewer for visualization and Microsoft Excel for data processing. The procedure for this research can be seen in Figure 1 below:

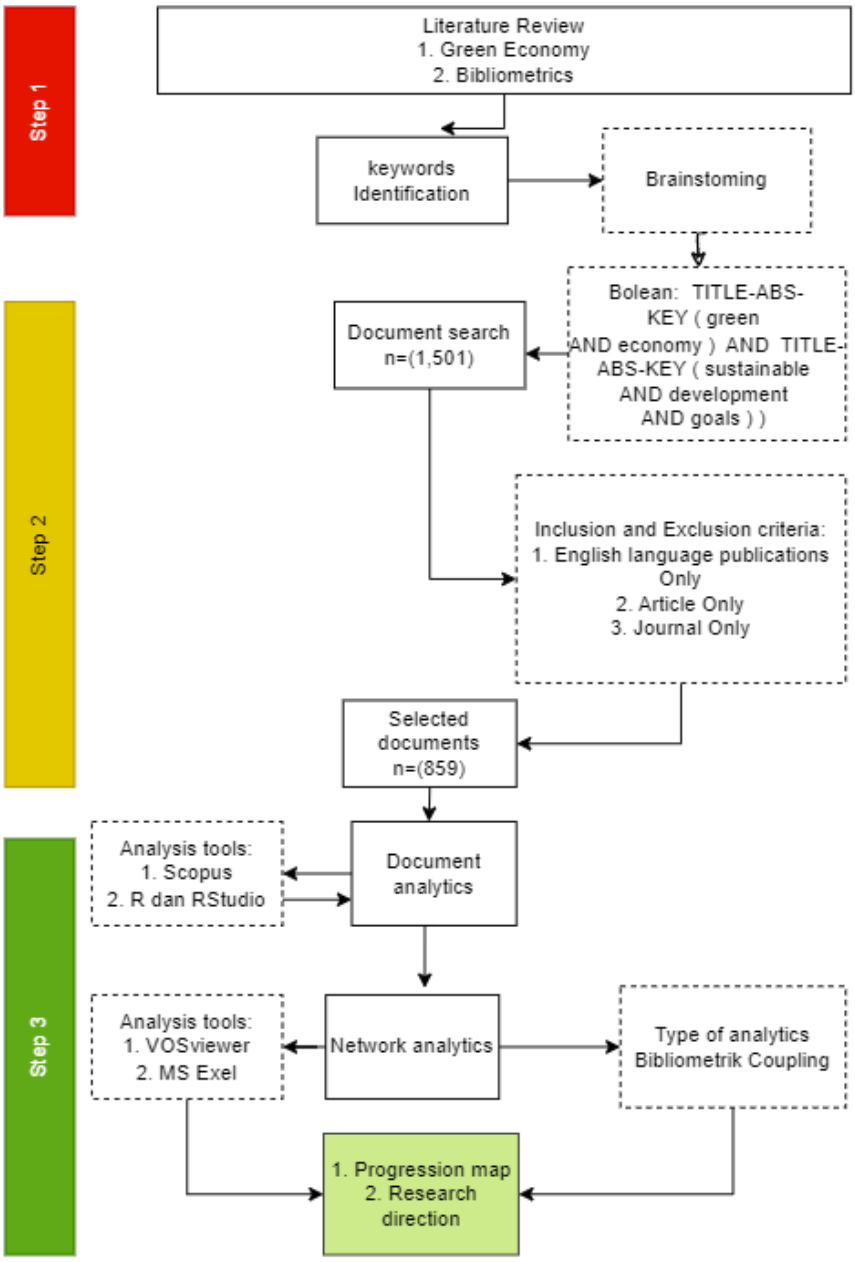

Figure 1
Research Procedure

RESULTS AND DISCUSSION

Document Analysis

Table 1 provides an overview of the 859 documents collected over 33 years. This includes 2833 authors, 102 single authors, 34.92% international authorship collaboration, and 52435 references, with an average citation per document of 17.04.

Table 1

Main Information About the Data

Description	Results
Timespan	1990:2023
Sources (Journals, Books, Etc)	365
Documents	859
Annual Growth Rate %	17.98
Document Average Age	2.44
Average Citations Per Doc	17.04
References	52435
Keywords Plus (Id)	3958
Author's Keywords (De)	2823
Authors	
Authors	2833
Authors Of Single-Authored Docs	102
Authors Collaboration	
Single-Authored Docs	105
Co-Authors Per Doc	3.94
International Co-Authorships %	34.92
Article	859

The data provided reflects an exciting picture of scientific publications from 1990 to 2023. With an average annual growth rate of 17.98%, there has been a significant increase in the number of documents published. Collaboration between researchers also appears to be quite common, with an average of almost four authors per document, while international collaboration reaches 34.92%. The average age of relatively new documents of 2.44 years indicates the relevance and current research topics discussed. The high number of references (52,435) and the average citation per document of 17.04 indicates that the publication significantly impacted the scientific community. The diversity of research topics covered is reflected in the number of widely used keywords, both in Keywords Plus and Author's Keywords. Analysis of these data provides a deep understanding of the dynamics and characteristics of the scientific literature during a given period.

Figure 2 shows the development of publications on the green economy theme from 1990 to 2023; this data is obtained based on the Scopus database. The first publications appeared in 1990 with a total of 1 publication and stagnated until 2009. In 2010, publications began to experience significant growth. Publications reached their highest peak in 2022, with 246 publications.

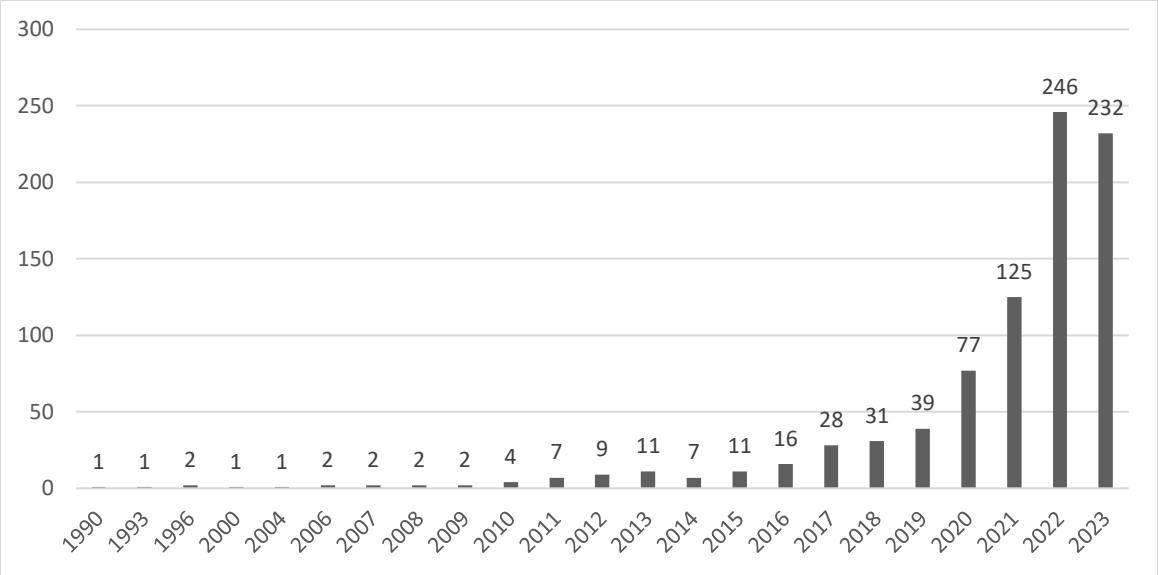

Figure 2
Development of Green Economy Publications by Year

Figure 3 shows the ten most influential authors in publications about the green economy. Lyulyove. o and Pimonenko t lead with the number of publications of 7 documents each, followed by Kwilinski, a taghizadeh-hesary, f, and Zopras, aa with six documents each and then followed by Udeagha, mc, Umar, m, and Zaman, k with five documents each, and Ahmad, m with a total of 4 publications.

In the context of the distribution of green economy-related publications, data analysis shows that two authors, Y. Luvol and P. Rimonenko T., stand out with seven publications each. Both authors are pioneers in this field, demonstrating their significant contributions to the corpus of green economy literature. Behind them, there are four authors—K. Wilinsky A. and T. TahirashvilI A., and Z. Orpas and Udegah A.A.—who each contributed with six publications, cementing their position as thought leaders in the subjects discussed.

Meanwhile, B. Amar C., U. Mari M., and V. Ovseikali L. have each authored five Publications, placing them as active contributors who are also crucial in the academic dialogue of the green economy, albeit with a slightly lower volume than the top group. On the other side of the spectrum, Z. Aman K. and A. Ahmad M. have four publications, which indicate their participation in this topic, albeit with a smaller number.

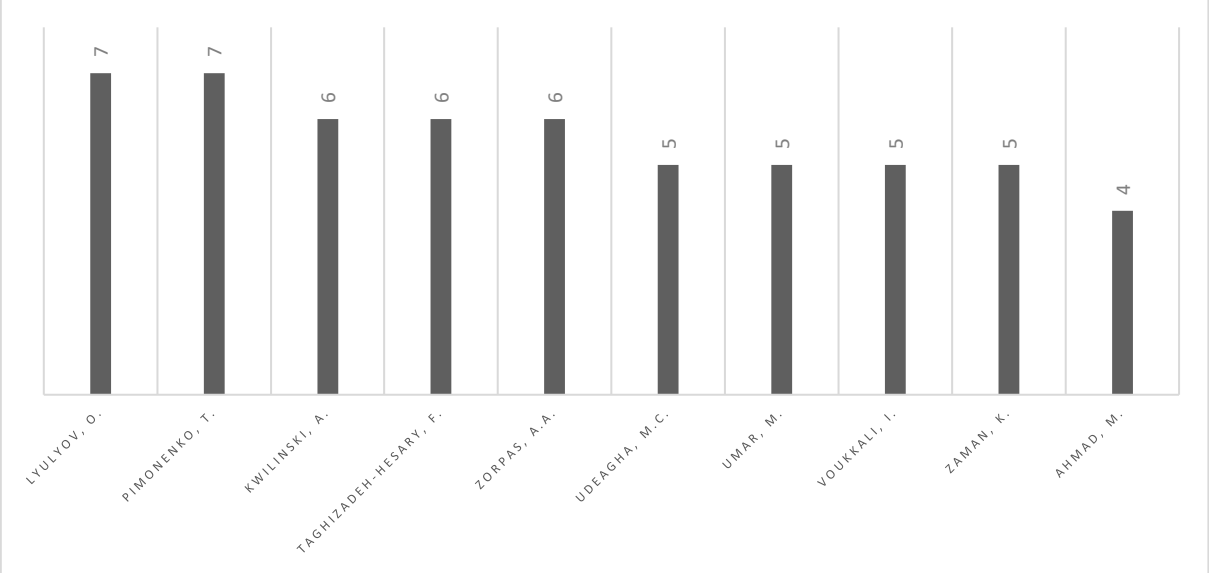

Figure 3
Most Relevant Author

Figure 4 shows the ten most influential affiliations in publications about the green economy; this data is obtained based on the Scopus database. The population with the most affiliation data is the China Academy of Science, with a total of 21 documents. The second largest affiliated population is Ilma University, with 12 documents. Furthermore, the most affiliated populations are Sumy State University and Tsinghua University, with 10 documents each.

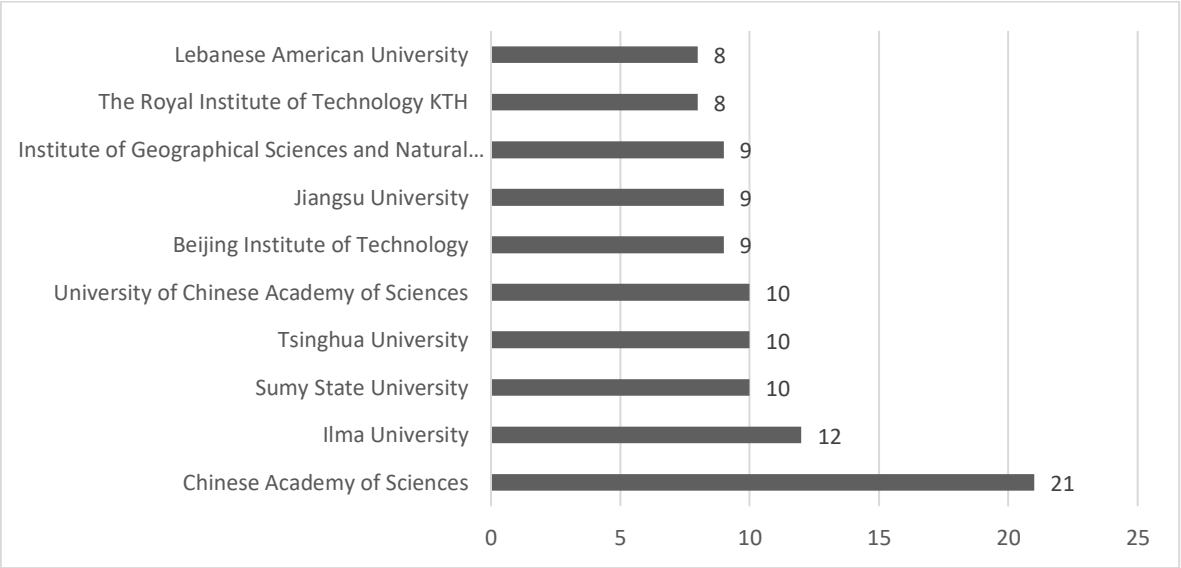

Figure 4
Most Relevant Affiliation

Figure 5 shows publications by country with a green economy theme; this data is obtained based on the Scopus database. China leads publication with a total of 297 documents. They were followed by the United Kingdom with a total of 73 documents. Then there are India and Pakistan, with 63 documents each. Next is the United States with 57 documents, followed by Italy with 55 documents. Next, Poland has 47 documents, Germany and Malaysia have 44 documents each, followed by Spain with 39.

European countries dominate with five countries, while Asian continent countries occupy the second dominance with 4 countries; this shows that research with the theme of the green economy is rife with European countries.

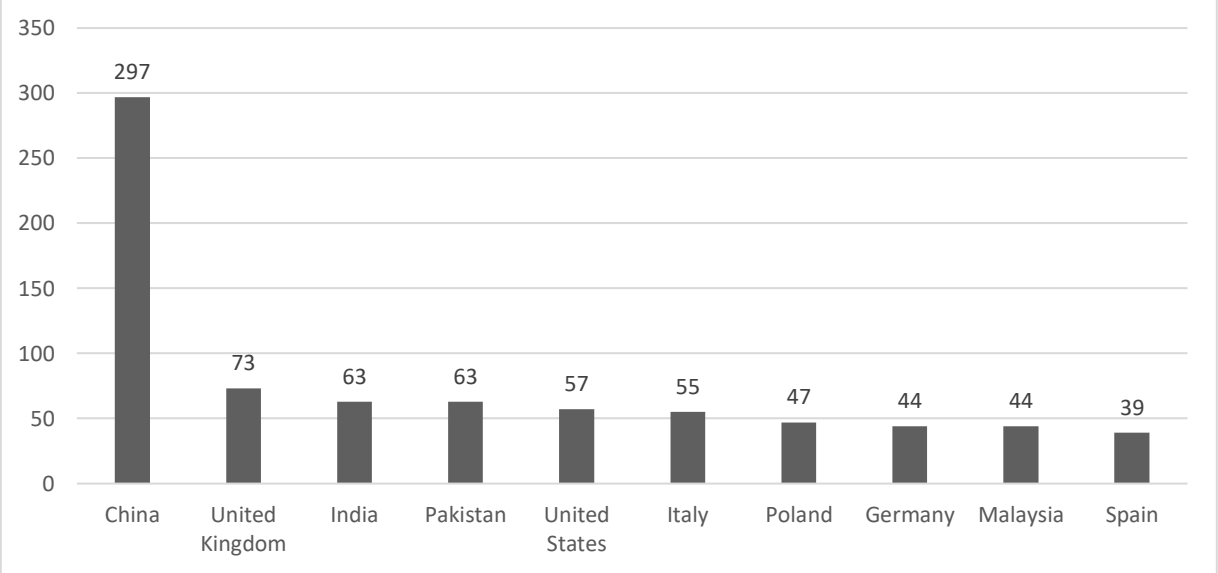

Figure 5
Most Relevant Country

From the publication productivity data provided by the country, we can perform an analysis to understand the distribution of publications at the continental level. In Asia, publication productivity was heavily influenced by significant contributions from China, which recorded 297 publications. Other Asian contributors include India and Pakistan, each with 63 publications, and Malaysia with 44 publications. In total, Asia reached an impressive number of 467 publications.

Meanwhile, Europe also showed substantial numbers, although Asia was lower. With the United Kingdom ahead with 73 publications, followed by Italy with 55, Poland with 47, Germany and Malaysia each with 44, and Spain with 39, Europe garnered 258 publications.

North America, represented only by the United States in this dataset, has 57 publications, a lower number than Asia and Europe.

By looking at these figures, Asia is the most dominant continent in terms of publication productivity, thanks to the enormous contribution of China. Europe, with several contributing countries, came in second, while North America, with one representative country, was far behind in this calculation. This shows an overview of how intellectual and academic distribution may differ worldwide, with Asia, particularly China, leading in the number of publications.

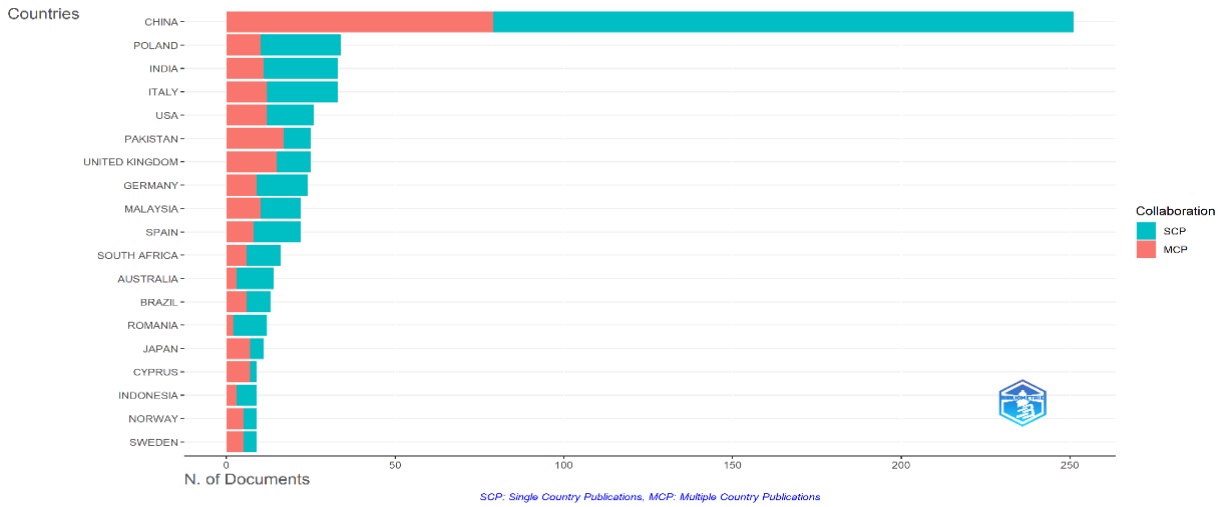

Figure 6
Corresponding Author's Countries

Figure 7 shows the author's correspondence data; the results show that, in general, it appears that the author collaborates with other authors in the same country or is known as single country publication (SCP) compared to multiple country publication (MCP). China has the highest MCP of 79 and SCP of 172. Then, it was followed by Poland, which had 10 MCP and 24 SCP. Third place is India, with 11 MCP and 22 SCP. Then Italy with 12 MCP and 21 SCP. Then there is the USA, with 12 MCP and 14 SCP. Pakistan has 17 MCP and 8 SCP.

The presented graphs provide an in-depth view of the global scientific publication landscape by differentiating between Single Country Publications (SCP) and Multiple Country Publications (MCP). China stands out with a significant number of documents, which shows a solid internal research capacity and may be a reflection of significant investments in R&D. On the other hand, a strong pattern of international collaboration is

evident from the high number of collaborative publications from Poland and India, indicating the adoption of policies that encourage cross-border research synergies. Interestingly, countries such as the United States display a balance that leans more towards independent publications, which could reflect an established research infrastructure and a tendency to pursue national research initiatives.

Furthermore, collaborative publications from European countries indicate the possibility of the success of regional cooperation programs such as those offered by the European Union. Factors such as education and research policies, national economies, and language and culture play an essential role in shaping the dynamics of this publication. Countries with larger economies and policies that support international cooperation tend to have higher MCP profiles, while language factors provide an advantage for English-speaking countries in global scientific discourse. In addition, political dynamics and international social relations may also influence the tendency towards SCP or MCP.

This analysis highlights the importance of understanding the various factors influencing international scientific collaboration. In an increasingly interconnected global context, strategies that strengthen research networks and facilitate cooperation between countries can contribute to more excellent scientific progress. This approach will enable policymakers and funding agencies to design policies that support and promote international collaboration, enrich the quality of research, and maximize its impact globally.

Figure 7 shows publications by source with a green economy theme; this data is obtained based on the Scopus database. The publication with the highest source was Family Planning Perspectives, with a total of 65 publications, followed by Religion, with 53 publication documents. Furthermore, there are the Journal of Adolescent Health and PLOS One, each with 49 publication documents. Next is the International Journal of Environmental Research, with a total of 44 publications.

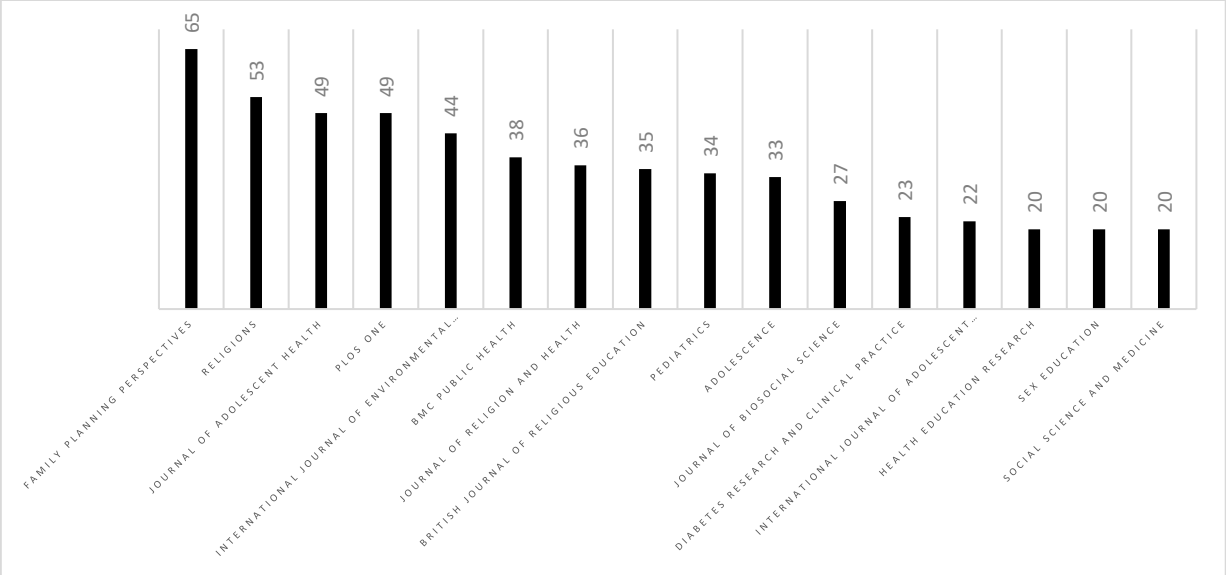

Figure 7
Documents by Source

This bar graph reveals exciting insights into the research focus reflected in the number of publications per journal. The dominance of specific topics is evident, with "Family Planning Perspectives" leading the way with 65 publications, underscoring the relevance and urgency of the topic of family planning in today's global academic and policy discourse. The presence of "Religious Education" and "Journal of Adolescent Health" comes next, with 53 and 49 publications, respectively, highlighting the increased interest in education in the context of religion and adolescent well-being. This reflects a broader trend in which adolescent health and religious education are taking center stage as important as physical health.

Journals focusing on environmental and social issues, such as "Ecology and Society" and "Public Health Reports" also feature many publications, demonstrating the trend of research toward integration between environmental, community, and urban health. However, journals with a more specific focus, such as "Diabetes Care" and "International Journal of Adolescent Medicine and Health," despite having fewer publications, mark the importance of research focusing on specific health conditions and adolescent health. Meanwhile, the equitable number of publications in "Health Education Research," "Sex Education," and "Social Science and Medicine" signifies a consistent recognition of the importance of research in health education, sexual education, and the intersection of social sciences and medicine.

In conclusion, this graph provides a perspective on the current distribution of research that may reflect policy trends, funding needs, and research interests. Nonetheless, it is essential to remember that the number of publications is not the only indicator of quality or influence within the discipline. It should be considered in conjunction with other qualitative indicators for a more thorough understanding.

Table 2 is the most globally cited document. Analysis of the presented scientific publication data reveals several important aspects of citation dynamics and research impact. An article by Kalmykova Y. from 2018, published in "Resources, Conservation, and Recycling," stands out as the most influential, with a total of 684 citations, signifying the importance and recognition of the scientific community to her contribution. This was followed by D'amato D.'s work from 2017, which showed a remarkable impact when normalized for the same field and period citation practice, with a score of 14.42. Also impressive is the performance of articles by Shen Y. from 2021, which, although recently published, have attracted rapid and significant attention, as reflected in the average citation value per year of 92.33.

When evaluating citations per year, more recent articles tend to have higher numbers, which reflects the urgency and relevance of topics such as those addressed by Chen Tl. in 2020 in "Science of the Total Environment. On the other hand, the work of Pearce D. from 1996 still collects citations, albeit with a more moderate number, suggesting that some studies have retained their relevance for decades.

Table 2
Most Global Site Document

Paper	Total Citations	Tc Per Year	Normalized Tc
Kalmykova Y, 2018, Resour Conserv Recycl	684	114.00	13.23
D'amato D, 2017, J Clean Prod	521	74.43	14.42
Shen Y, (2021). Sci Total Environs	277	92.33	13.77
Wu W, (2014). Acc Chem Res	229	22.90	3.87
Tukker A, 2008, J Clean Prod	223	13.94	1.98
Karlsson R, 2006, J Clean Prod	222	12.33	1.46
Gianfrate G, 2019, J Clean Prod	178	35.60	5.45
Chen Tl, (2020). Sci Total Environs	174	43.50	5.85

Landrigan Pj, (2020). Ann of Global Health	166	41.50	5.58
Pearce D, (1996). Environ Dev Econ	158	5.64	1.85

Taken together, the distribution of these citations suggests that while some studies quickly gained widespread recognition for the relevance or urgency of the topic, other studies enjoyed sustained influence over time. These findings suggest that journals such as the "Journal of Cleaner Production" serve as vital platforms for research addressing clean production and sustainability and that the field remains dynamic and sustainable in accumulating insights critical to the scientific community and policymakers.

Network Analysis

Figure 8 analyzes events from green economy research, with a minimum number of clusters of 12. There are 3 clusters formed consisting of 46 cluster 1, 46 cluster 2, and 43 cluster 3. The dominant keyword, "sustainable development," is the most dominant in total link strength 3128.

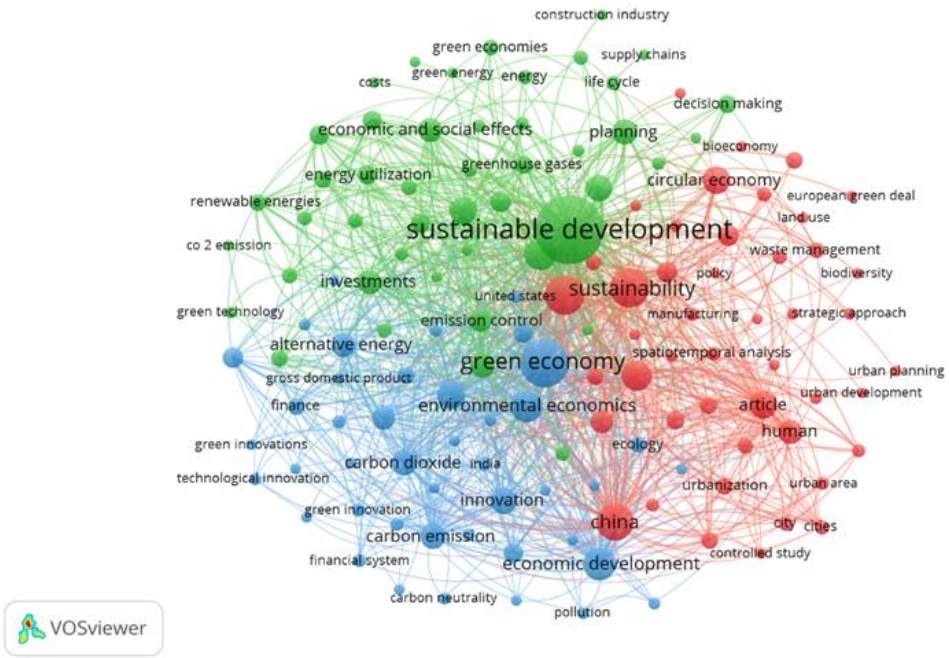

Figure 8
Co-Occurrence Visualization

The network visualization offers a compelling snapshot of the prevailing themes within the green economy and sustainable development literature. The dominant color clusters delineate distinct thematic categories, with terms such as "sustainable development," "green economy," and "sustainability" prominently situated at the academic discourse's core, affirming their status as central concepts driving research in this arena. The mapping signifies the importance of technological innovation, renewable energy utilization, and carbon emission reduction, all intimately connected with efforts to mitigate environmental impacts and climate change.

Geographic references to countries like the United States, India, and China highlight the international context of this research, indicating that green economic development is being studied and implemented globally, focusing on national policies and innovative efforts. Discussions around "circular economy" and "economy" reflect a trend towards more sustainable economic approaches and waste reduction. At the same time, using analytical methodologies such as "spatiotemporal analysis" indicates the rigorous application of quantitative and empirical research techniques.

Moreover, the visualization reflects the interdisciplinary nature of research in this field, suggesting that solutions to sustainable development challenges necessitate integrating knowledge from economics, ecology, technology, and societal studies. The policy implications are significant, with keywords like "policy," "economic development," and "land use," signaling that the research outcomes have practical consequences for policymakers and the implementation of sustainable development strategies. Overall, the visualization provides a rich summary of the topics defining current scientific dialogue in the green economy and sustainable development.

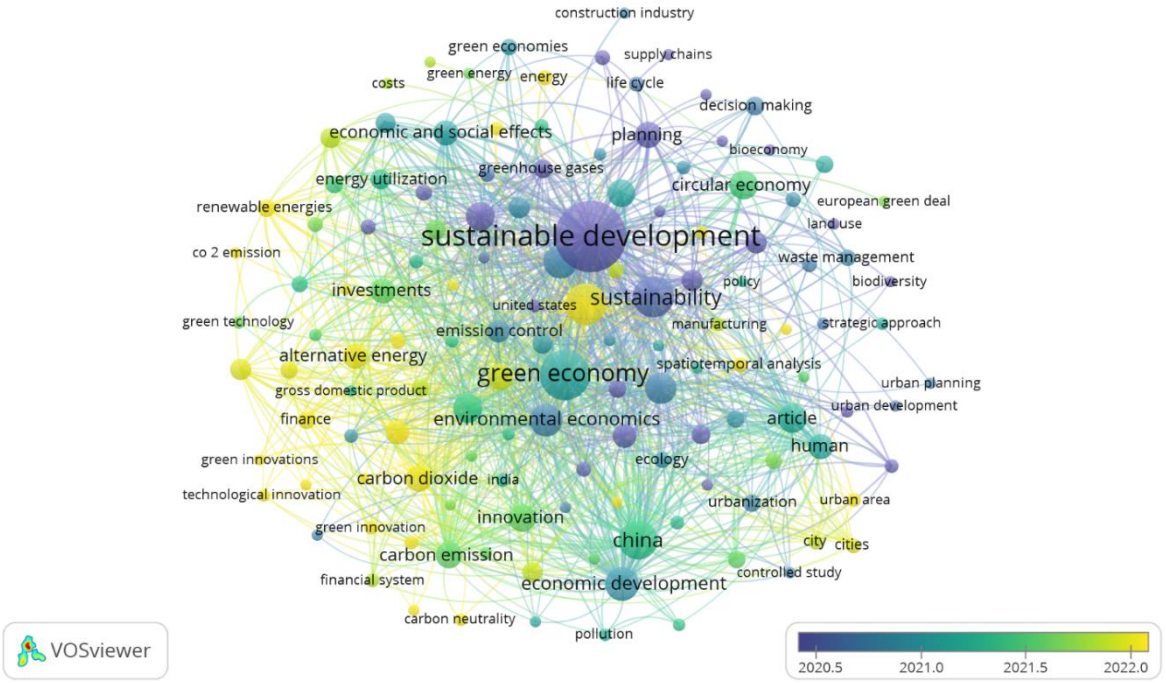

Figure 9
Overlay Visualization

Figure 9 shows the keyword network analysis based on overlay. The visualization map provided, constructed using VOSviewer, offers a bibliometric analysis of the literature about sustainable development, with a particular focus on the temporal distribution of research topics from mid-2020 to the end of 2022. This temporal scope suggests a dynamic landscape of academic discourse, where the recency of research about specific keywords can indicate the emerging areas of focus within sustainability studies.

The prominence of keywords such as "circular economy," "green economies," and "carbon neutrality" towards the latter end of the timescale-nearing 2022-hints at a shift in scholarly attention, potentially correlating with recent global events or policy shifts that necessitate a more concentrated analysis in these areas. Such a chronological clustering of keywords might reflect the academic community's response to the evolving priorities in environmental policy, technological advancements, or socio-economic transformations mandated by the exigencies of climate change.

Furthermore, the temporal analysis of this dataset reveals a narrative of intellectual evolution, where the most current research topics often represent a reaction to or development of previous findings. The proximity of specific keywords to the end of the timescale under

scrutiny underscores their topical relevance and the novelty of the research. For instance, a surge in discussions on "carbon emission" control and "renewable energies" in recent times could be interpreted as an academic alignment with global sustainability goals and the international push towards achieving carbon neutrality.

In summary, the visual map serves as a chronometric barometer for the freshness of research within sustainable development, denoting not only the frequency of publication but also potentially signifying the shifts in academic and practical emphasis that mirror the global sustainability agenda. As such, the analysis provides insight into the intellectual currents and their trajectories, highlighting the most contemporaneous strands of thought shaping the discourse on sustainable development.

Table 3
The Occurrence of Each Cluster

Keywords	Occurrences	Clusters
1. Circular Economy	85	1
2. United Nations	37	
3. Urbanization	30	
4. Environmental Impact	45	
5. Sustainability	166	
6. Sustainable Development Goals	162 45	
7. Environmental Management	93	
8. Environmental Protection	45	
9. Environmental Impact	56	
10. Environmental Policy		
1. Sustainable Development	494	2
2. Planning	71	
3. Economics	83	
4. Climate Change	112	
5. Investments	63	
6. Energy Utilization	42	
7. Emissions Control	51	
8. Economic And Social Effects	64 47	
9. Energy Efficiency	77	
10. Sustainable Development Goals		

1.	Green economy	239	3
2.	Economic Growth	82	
3.	Environmental Economics	105	
4.	Alternative Energy	60	
5.	Green Finance	46	
6.	Renewable Energy	55	
7.	Economic Development	114	
8.	Carbon Dioxide	70	
9.	Carbon Emissions	68	
10.	Environmental Sustainability	38	

Table 3 lists keywords related to sustainable development along with their occurrences and cluster assignments. Analyzing the occurrences (or frequency) of these keywords within their respective clusters can offer insights into the focal areas of recent academic research and discourse within sustainability.

Cluster 1: Policy and Governance

The keyword "Circular Economy" has the highest occurrences in Cluster 1, signaling a strong academic focus on transitioning to sustainable, closed-loop systems that minimize waste and resource consumption. The prominence of "The United Nations" underscores the pivotal role of international governance in driving research and policy formulation for sustainable development.

"Urbanization" and "Environmental Impact," with 30 and 45 occurrences, respectively, reflect the scholarly attention to the challenges and impacts of urban growth on the environment. This suggests an integrated perspective on urban development and environmental considerations.

"Sustainability" and "Sustainable Development Goals" (SDGs) dominate this cluster with 166 and 162 occurrences, respectively. This indicates a significant emphasis on the broader concepts of sustainability and the specific targets set by the United Nations, showing that these are central to current academic discussions and research within sustainability.

Cluster 2: Practical Implementation and Effects

"Sustainable Development" is a standout keyword in Cluster 2, with a remarkable 494 occurrences, reinforcing its status as a core topic within sustainability studies. The high frequency of this term suggests that sustainable development is not only a conceptual framework but also a practical goal for various disciplines and sectors.

"Planning" and "Economics," with 71 and 83 occurrences, highlight the importance of strategic planning and economic considerations in implementing sustainability. These figures suggest a focus on integrating sustainability into economic models and urban and regional planning.

Keywords like "Climate Change," "Investments," and "Emissions Control," with occurrences ranging from 42 to 112, reflect the critical areas of investment, policy, and practice aimed at mitigating climate change and controlling emissions, indicating these are active areas of research and application.

Cluster 3: Economic and Energy Transition

"Green Economy" has a notable 239 occurrences, indicating that the concept is a significant research area within the economic transition towards sustainability.

"Economic Growth" and "Environmental Economics," with 82 and 105 occurrences, respectively, emphasize the reconciliation of economic expansion with environmental stewardship.

"Alternative Energy," "Green Finance," and "Renewable Energy," with occurrences between 46 and 60, indicate a focused research interest in sustainable economic instruments and energy solutions, aligning economic activity with environmental imperatives.

"Economic Development," "Carbon Dioxide," and "Carbon Emissions," with high occurrences, reflect the concentration on the economic aspects of sustainability and the crucial issue of greenhouse gas emissions.

CONCLUSION

The bibliometric analysis of sustainable development literature, particularly within the context of the green economy, reveals an increasing scholarly engagement with themes central to integrating environmental stewardship within economic frameworks. The frequency of occurrences for terms such as "Circular Economy," "Sustainable Development Goals," and "Green Economy" across various clusters highlights a significant academic focus on transformative approaches to economic development that prioritize sustainability. The data indicates a growing emphasis on policy and governance (Cluster 1), the pragmatic application of sustainable principles (Cluster 2), and a transition towards renewable energies and economic models that support ecological balance (Cluster 3). This trend suggests a

scholarly consensus on the urgency of addressing environmental challenges through sustainable development, as evidenced by the heightened attention to these areas in publications, particularly in the face of recent global economic shifts and environmental crises. The alignment of academic research with international sustainability targets underscores the role of scientific inquiry in informing and supporting policy and industrial practices aimed at achieving a sustainable future.

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