

CIRCULAR ECONOMY SUSTAINABILITY IN DEVELOPING COUNTRIES: A BIBLIOMETRIC ANALYSIS OF GLOBAL TRENDS, KEY THEMES, AND RESEARCH GAPS (2017-2025)

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ABSTRACT

Purpose: The main focus of this study is to understand research trends, identify key academic actors, and explore the impact of the circular economy in various dimensions of development. In this way, it is hoped that this study will not only contribute to the development of knowledge but also serve as a reference for policymakers, practitioners, and researchers in developing strategies for the transition to a circular economy in developing countries.

Design/methodology/approach: This study uses a bibliometric approach to identify and map publication trends in circular economy research in developing countries. With this approach, researchers can identify the extent to which the circular economy has become a focus of research, as well as the topics that dominate scientific debate. The bibliographic data collection process involved several stages. The first stage involved entering the terms “circular AND economic AND in AND developing AND country” in the article title field of the Scopus database for the period 2017-2025 with the document type “Article,” which yielded 364 documents. Then, the language was limited to English, resulting in a dataset of 358 articles. To ensure the relevance and accuracy of these articles, a recheck was performed using Microsoft Excel to review the titles, followed by a review of the abstracts for content suitability, with a final result of 168 articles that met all the specified criteria.

Findings: The review indicates that growing global attention to the topic. The dominant themes focus on waste management, recycling, and sustainable development, while research trends are gradually shifting toward more empirical, policy-oriented, and interdisciplinary studies. However, gaps remain in integrating renewable energy, social aspects, and circular business models, and scholarly contributions are still concentrated in a limited number of countries, highlighting the need for broader participation and more collaborative, policy-driven research in developing economies

Research limitations/implications: This study is limited to the selected database and publication period, which may limit the generalization of the findings. Future research should expand the data sources, apply empirical approaches, and integrate less explored aspects such as renewable energy, social dimensions, and circular business models to strengthen circular economy studies in developing countries.

Practical implications: These findings provide insights for policymakers, researchers, and practitioners in identifying key trends and research gaps in circular economy studies. These results can support the development of more effective policies, encourage interdisciplinary collaboration, and guide the implementation of circular economy practices to promote sustainable development in developing countries.

Originality/value: This study contributes to the literature by presenting a structured thematic mapping of circular economy research and by identifying emerging themes and potential gaps for future research.

Paper type: Literature review

Keyword: Circular Economy, Sustainability, Developing Countries, Bibliometric, Recycling

A. INTRODUCTION

The current global economic landscape faces major challenges related to limited natural resources, environmental degradation, and increased demand due to rapid population growth (Maja & Ayano, 2021). These problems are deeply felt by developing countries that are still in a stage of economic and social transition (Ramos-Mejía et al., 2018). The problems experienced by developing countries as mentioned earlier include dependence on commodity exports, economic instability, limited infrastructure, and vulnerability to climate change (Ko et al., 2024). This is due to demographic pressures, which are caused by excess domestic demand. Examples include rice imports as a means of meeting domestic rice demand, or mining aimed at meeting domestic demand for both oil and gas and non-oil and gas minerals. Then, economic instability is caused by domestic demands, for example, the poor quality of life of the people, so they want more stable socio-economic conditions (Derkenbaeva et al., 2025). Economic resource management tends to be short-term oriented, so that sustainable management as practiced by developed countries has not yet been achieved (Wang & Xu, 2024). For example, the management of waste as fuel for electricity has not yet been achieved by developing countries, compared to developed countries that have already achieved this. The above factors, as described, contribute to limitations in natural resource management, deteriorating environmental conditions, declining human resource quality, and increased demand due to uncontrolled population growth in developing countries (Maja & Ayano, 2021).

The concept of the circular economy presents a new paradigm for sustainable development, offering an alternative to the traditional linear economic model (take, make, dispose) (Oliveira et al., 2021). The circular economy emphasizes a sustainable cycle in the use of resources, namely through the principles of waste reduction, recycling, product life extension, and optimization of material reuse (Kandpal et al., 2024). Unlike the linear approach, which relies on the continuous exploitation of new resources, the circular economy aims to maintain the value of products, materials, and resources in the economy for as long as possible. Thus, this system not only has the potential to reduce pressure on the environment, but can also create new economic opportunities that are more efficient, inclusive, and sustainable (Krysovaty et al., 2024).

In comparison, the implementation of the circular economy in developed countries, especially in Northern Europe, has been a priority public policy agenda for the past decade (Domenech & Bahn-Walkowiak, 2019). The European Union, for example, launched the Circular Economy Action Plan, which provides a framework for policies, regulations, and financial support for companies and communities to adopt circular principles (Hartley et al., 2020). Several of these points can be used as a reference for the implementation of a circular economy in developing countries. This will enable environmental issues in developing countries to be resolved.

Previous bibliometric studies on the circular economy have focused only on global research trends, industrial applications, or specific sectors such as waste management and sustainable production. However, few studies have specifically examined the development of circular economy sustainability research in the context of developing countries in a comprehensive manner. In addition, previous studies often emphasize conceptual discussions or regional analyses without systematically mapping the evolution of research, thematic structures, and patterns of collaboration between countries. Therefore, this article aims to conduct a literature review and bibliometric analysis of the application of the circular economy in developing countries. The main focus of this study is to understand research trends, identify key academic actors, and explore the impact of the circular economy in various dimensions of development. Thus, it is hoped that this study will not only contribute to the development of knowledge but also serve as a reference for policymakers, practitioners, and researchers in formulating strategies for the transition to a circular economy in developing countries.

B. METHODOLOGY

Research Design

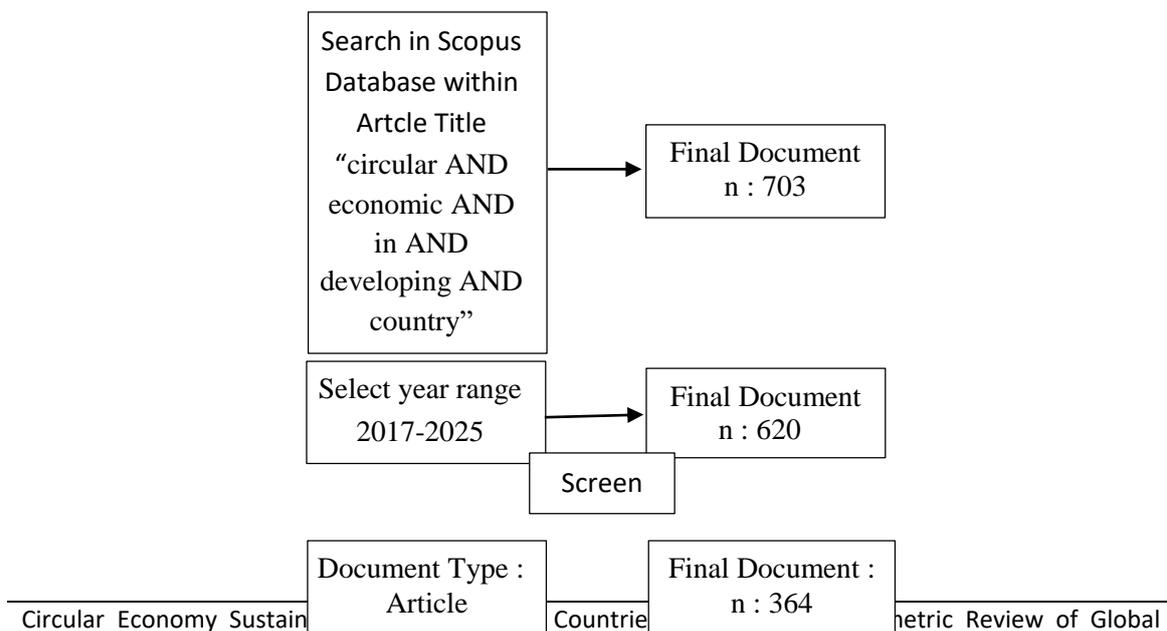
This study uses a bibliometric approach to identify and map publication trends on circular economy research in developing countries. Using this approach, researchers can identify the extent to which the circular economy has become a focus of researchers, as well as the topics that dominate scientific debate (Sauvé et al., 2016). This approach not only provides theoretical understanding but also serves as a basis for formulating more effective public policies and implementation strategies (Manazir, 2023).

In addition, the use of bibliometric analysis can also indirectly reveal data related to the intensity of circular economy research in the context of developing countries (Ruiz-Real et al., 2018). For example, an increasing trend in publications from year to year may reflect growing awareness and attention to this issue. The geographical distribution of research can show which countries are active in studying the circular economy. Meanwhile, patterns of international collaboration can illustrate the extent to which developing countries are connected to global networks in building knowledge related to the circular economy.

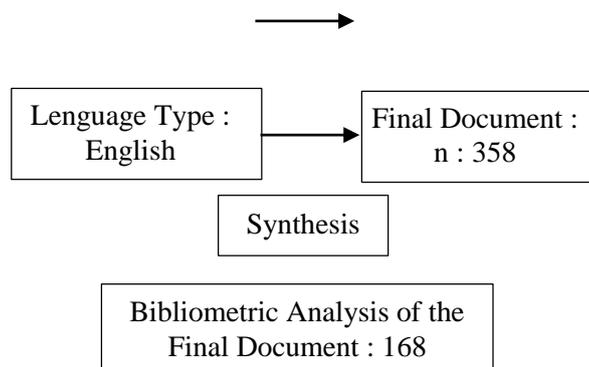
Bibliometric Data and Filtering Process

The bibliographic data collection process involved several stages. The first stage involved searching by entering the terms “circular AND economic AND in AND developing AND country” in the article title field in the Scopus database, resulting in an initial dataset of 703 documents. Next, the search was refined to include only publications from the period between 2017 and 2025, reducing the dataset to 620 documents. Further filtering was applied based on document type, specifically selecting “articles,” which reduced the number of documents to 364. Then, the language was limited to English, resulting in a narrower dataset of 358 articles. To ensure the relevance and accuracy of these articles, a recheck was performed using Microsoft Excel to review the titles, followed by a review of the abstracts, which resulted in a final total of 168 documents. This process was carried out to eliminate inappropriate articles, avoid data duplication, and adjust to research criteria such as year range, document type, or language. Therefore, the filtering process in Excel helped clean up the data so that the bibliometric analysis was more accurate and valid. This systematic approach ensured the quality and relevance of the data used for further analysis:

Table 1 – Bibliometric Filtering Process



Circular Economy Sustain
Trends, Key Themes, and Research Gaps (2017-2025)
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Data Analysis

The extraction of filtered documents was performed using comma-separated values (CSV) files generated from Microsoft Excel (Valova et al., 2025). For visualizing bibliographic data, this study utilized the Biblioshiny software, a powerful bibliometric tool. Biblioshiny provides standardized and consistent bibliometric measurements, ensuring that the analysis is both reliable and comparable with other studies in the field of circular economy (Esmaeili & Sobhanifard, 2025). Quantitative descriptive analysis was employed to extract critical insights into circular economy research, encompassing details such as article titles, the most productive journals, leading publishing countries, and top-affiliated institutions.

After the metadata was imported and converted, the system automatically generated main information containing the number of documents, sources, authors, keywords, and total citations, while also displaying the timespan showing the range of publication years in the dataset (Choi et al., 2023). Furthermore, the annual scientific production feature was used to visualize trends in the number of publications per year so that research growth patterns could be identified. To determine the contribution of scientific sources and actors, a sources analysis was conducted to identify the most productive journals, top authors to see the authors with the highest number of publications and citations, and top countries based on author affiliation to map geographical distribution and international collaboration (Rost et al., 2017). The conceptual structure of the research was analyzed using a tree map, which displays the dominance of keywords based on their frequency of appearance, as well as a thematic map, which maps research themes based on indicators of centrality (the level of connection between themes) and density (the level of theme development) into four quadrants, namely motor themes, basic themes, niche themes, and emerging or declining themes. In addition, thematic development is used to observe the evolution and shift in theme focus between time periods, so that the entire analysis process provides a comprehensive picture of the characteristics, dynamics, and direction of research development in the field being studied.

C. RESULTS AND DISCUSSION

1.1 Main Information

Table 2 – Main Information

Description	Result
Timespan	2017:2025
Sources (Journals, Books, etc)	98
Documents	168
Annual Growth Rate %	9.05

Document Average Age	2.86
Average citations per doc	29.93
References	10698
Authors	703
Authors of single-authored docs	7

The table above presents basic information about previous studies. The table shows that research on the circular economy has experienced consistent growth during the period 2017–2025. There were 168 documents from 98 scientific sources with an annual growth rate of 9.05% per year. However, the average age of these documents is still relatively young for research articles. Most have an average age of 2.86 years, indicating that this field is dynamic and still in the development phase.

Referring to the average number of citations per document, which is 29.93, and the use of 10,698 references, shows the rapid growth of research in the field of circular economy. This is supported by the high level of collaboration among authors, as indicated by 703 authors from various countries. However, this condition also indicates the potential for research gaps, particularly in the context of empirical contributions and the implementation of the circular economy in developing countries.

1.2 Annual Scientific Production

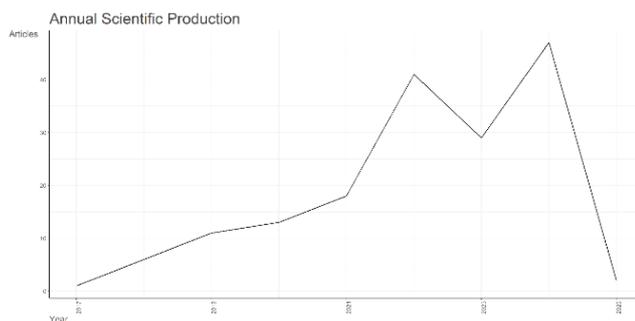


Figure 1 – Annual Scientific Production

Analysis of annual scientific production shows that research on the circular economy continued to grow from 2017 to 2025. In the early period of 2017–2018, research on the circular economy was still very limited and generally focused on introducing basic concepts. Studies in this year discussed waste management, resource use efficiency, and the life cycle assessment approach as the main analytical tool. Entering 2019, the number of publications began to increase and research topics expanded to include the identification of factors driving and inhibiting the implementation of the circular economy, both in terms of policy, institutions, and industry readiness. In general, research in this phase shares a commonality in placing the circular economy as an initial framework for addressing environmental issues, but it is still conceptual and not yet supported by much field data.

More rapid development was seen in the 2020–2024 period. The years 2020 and 2021 were marked by a surge in publications linking the circular economy to global issues such as the environmental crisis, human health, electronic waste, and the use of technology and cleaner production. In 2022, research focus increasingly shifted to the role of public policy, governance, and circular economy implementation in the context of developing countries. Scientific production peaked in 2023–2024, when research began to make extensive use of empirical approaches, sectoral case studies, and measurements of the real impact of the circular economy on sustainability. Meanwhile, the decline in publications in 2025 was mainly due to the cut-off for data collection in

the current year, so it did not reflect a decline in research interest. Overall, these annual developments show a clear shift from conceptual studies to more applied research, although the need for long-term empirical evidence and adaptation to the local conditions of developing countries remains a major challenge.

1.3 Thematic Development

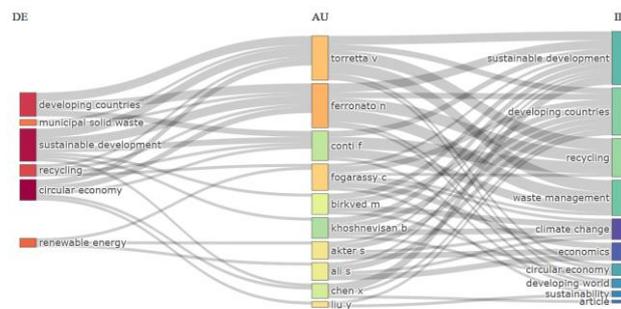


Figure 2 – Thematic Development

The results of bibliometric analysis through thematic development visualization show that research on circular economy sustainability in developing countries in the period 2017–2025 is dominated by basic themes such as developing countries, circular economy, sustainable development, recycling, and municipal solid waste. The keyword municipal solid waste, discussed by Ferronato, developed into the keyword waste management. Similarly, the keyword sustainable development, discussed by Torretta V, developed into sustainability. Thus, the relationship between these themes and a number of key authors shows that scientific contributions are concentrated among certain academic actors who play an important role in shaping and directing the circular economy discourse in the context of developing countries.

In addition, the results of the analysis also show a shift in themes towards broader and more multidimensional issues, such as waste management, climate change, economics, and sustainability. This reflects a shift in the focus of research from a technical-operational approach to a strategic approach that integrates environmental, economic, and global development dimensions. However, the relevance of the renewable energy theme is relatively weaker than other themes, indicating a research gap in the integration of renewable energy into the circular economy framework in developing countries during the study period.

1.4 Most Relevant Authors

An analysis of the most relevant authors shows that research developments on circular economy sustainability in developing countries during the period 2017–2025 were dominated by a number of authors with relatively high productivity levels. Authors such as Ferronato N and Torretta V rank at the top with the highest number of publications, indicating their central role in building and directing scientific discourse related to the circular economy, particularly on the issues of waste management, sustainable development, and the context of developing countries. This dominance indicates that knowledge contributions in this field of study are still concentrated among a core group of researchers who consistently produce publications and serve as key references in the literature.

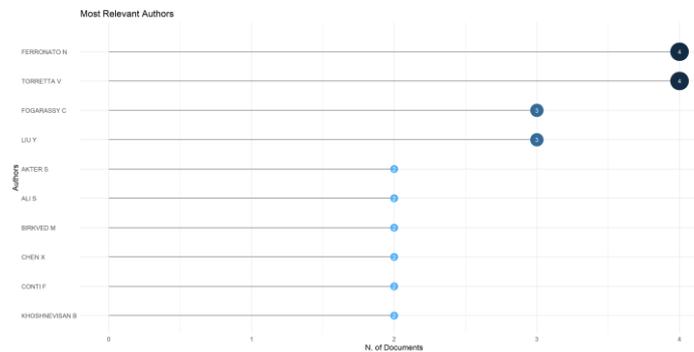


Figure 3 – Most Relevant Author

In addition to core authors, there are groups of authors with moderate productivity levels, such as Fogarassy C and Liu Y, who play a role in expanding the scope of research through the integration of the circular economy with issues of economics, sustainability, and global development. Meanwhile, authors with fewer publications reflect the entry of new contributions that enrich the research perspective, although they are not yet dominant. This distribution pattern shows that although the field of circular economy in developing countries already has a strong literature foundation, there are still limitations in the diversity of academic actors. This condition indicates a research gap, particularly opportunities for researchers from developing countries to increase empirical and contextual contributions, as well as expand discourse through interdisciplinary approaches and international collaboration.

1.5 Most Relevant Countries

Country Scientific Production

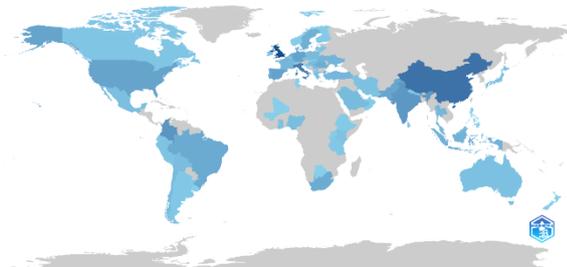


Figure 4 – Most Relevant Country

The three countries that dominated research publications related to the circular economy in developing countries during the period 2017–2025 were the United Kingdom (UK), China, and Italy. The United Kingdom contributed significantly to publications focusing on the development of the circular economy concept as a sustainability strategy, particularly in the integration of environmental policies, circular business models, and the transition to more sustainable production and consumption systems. Research from the UK has extensively discussed how the circular economy can support the achievement of sustainable development through policy approaches, industrial innovation, and the optimization of resource use in various economic sectors.

Meanwhile, China has become one of the countries with significant research output, focusing primarily on waste management, recycling practices, and the implementation of a circular economy in the industrial and urban sectors. Research from China generally highlights how developing countries can overcome environmental challenges through integrated waste management

systems and industry-based circular economy policies. On the other hand, Italy has contributed greatly to studies related to sustainability assessment, life cycle analysis, and sustainable production system innovation, particularly in assessing the economic and environmental impacts of implementing a circular economy. These three countries dominate research because they have strong research capacity, large funding support, and active government policies promoting the circular economy. In addition, environmental pressures resulting from industrialization, especially in China, have also encouraged much research on waste management and resource efficiency, supported by extensive international collaboration in research.

1.6 Country Collaboration Map

Country Collaboration Map

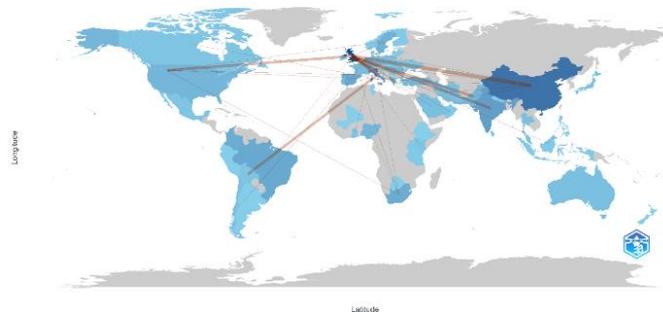


Figure 5 – Country Collaboration Map

The Country Collaboration Map shows collaborative relationships between several countries in producing scientific publications related to the circular economy. One particularly notable collaboration is between China and the United Kingdom, where several authors from both countries have collaborated on research discussing the implementation of the circular economy in the industrial sector and waste management strategies to support sustainable development. This collaboration demonstrates the exchange of perspectives between developed and developing countries in developing a more effective circular economy model.

In addition, collaboration is also evident between the United Kingdom and the United States, as well as between the United Kingdom and India. Cooperation between the UK and the US generally focuses on policy framework development, environmentally friendly technological innovation, and sustainability analysis in the implementation of a circular economy. Meanwhile, collaboration between the UK and India has focused more on the challenges of implementing a circular economy in developing countries, including issues of urban waste management, resource efficiency, and the social and economic impacts of the transition to a more sustainable economic system. This pattern of collaboration shows that research on the circular economy is not only developing nationally, but also through international cooperation networks that enrich research perspectives and strengthen the development of global solutions to sustainability issues.

1.7 Most Frequent Words

Some keywords are significantly larger than others. In word cloud analysis, the size of a word indicates its frequency of appearance in the analyzed articles, so the largest words are those most frequently used by authors in research related to the circular economy in developing countries. The most dominant keywords include circular economy, waste management, recycling, developing countries, and sustainable development. The dominance of these words shows that the main focus of research during the 2017–2025 period is still related to waste management, recycling practices, and

Figure 8 – Co-Occurance Network

As we know, the co-occurrence network produces three main clusters that are interconnected and form the conceptual structure of the research. The blue cluster, which focuses on sustainability, contains keywords such as sustainability, environmental impact, environmental economics, and supply chain management, indicating that sustainability issues form the normative and conceptual basis of circular economy research. The green cluster, which relates to management methods, is dominated by keywords such as waste management, recycling, solid waste, resource management, and human, emphasizing the technical and implementative aspects of waste management as the main instrument for implementing the circular economy. Meanwhile, the red cluster, which focuses on developing countries, includes keywords such as developing countries, circular economy, economics, economic growth, and climate change, which describe the geographical context and development challenges in developing countries. These three clusters are conceptually interrelated: sustainability (blue) is the normative goal, waste management and recycling (green) are the operational mechanisms, while developing countries (red) are the context for implementation as well as the arena for structural challenges such as economic growth and climate change. The interconnectedness between clusters shows that the research does not only discuss environmental aspects separately, but integrates policy, technical, and development dimensions within the circular economy framework.

The two small clusters that do not appear to be strongly linked to the main clusters are the yellow and purple clusters. The yellow cluster, which contains keywords such as human and social aspects, tends to stand alone because its focus is more on social dimensions and individual behavior, which in this dataset does not have a strong enough frequency correlation with technical management issues or the macro context of developing countries. Meanwhile, the purple cluster, which is grouped with business aspects, shows an orientation towards management, business models, and corporate strategy, which are relatively more specific and not yet intensively integrated with the main discourse on waste management and developing country development. The separation of these two clusters indicates a research gap, particularly in integrating social dimensions and business models more comprehensively into the framework of circular economy sustainability in developing countries.

1.9 Thematic Map

The figure shows that the research structure on circular economic sustainability in developing countries for the period 2017–2025 is organized into four thematic quadrants based on relevance (centrality) and emerging themes (density). The themes of developing countries, circular economy, and sustainable development are in the basic themes quadrant, which indicates that these three themes have a high level of connectivity with other themes, but are still conceptual and broad in nature. This position shows that the circular economy in developing countries serves as a basic research framework that connects various technical, economic, and environmental approaches, but has not yet fully developed in a specific and operational manner. In the motor themes quadrant, themes related to the human dimension and empirical approaches emerge, such as human, humans, and controlled study, indicating that social aspects and controlled study-based evaluations are becoming key drivers in circular economy research. Meanwhile, technical themes such as sewage, sludge, and wastewater treatment are in the niche themes quadrant, indicating a high level of methodological maturity but limited connection to the main discourse. On the other hand, themes such as carbon sequestration, carbon capture and utilization, and green development are in the declining or emerging themes quadrant, indicating that the integration of carbon mitigation and green transition issues in circular economy studies in developing countries is still relatively weak.

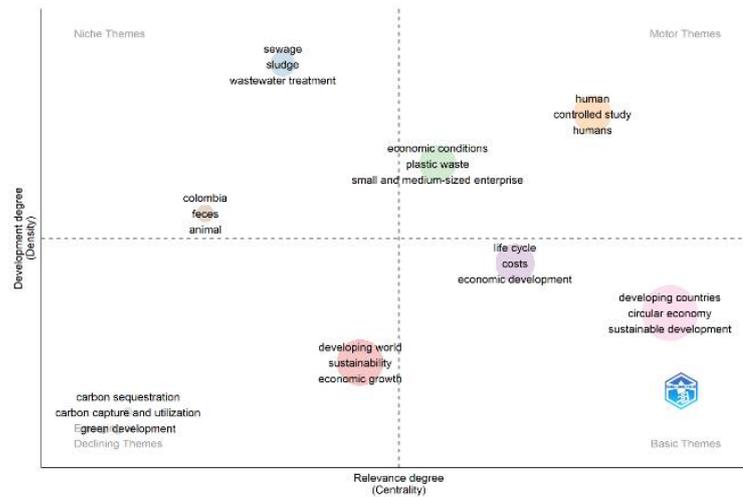


Figure 9 – Themativ Map

Therefore, we can see that themes such as humans, controlled studies, economic conditions, plastic waste, and small and medium-sized enterprises are the most relevant themes and are among the top trends that could be the subject of further research for researchers. Meanwhile, themes such as sewage, sludge, wastewater treatment, colombia, faces, and animals are currently developing themes. If researchers wish to focus on the circular economy, themes such as life cycle, costs, economic development, developing countries, circular economy, and sustainable development are the most relevant to this field.

D. CONCLUSION

This bibliometric review provides a comprehensive overview of the development of circular economy sustainability research in developing countries during the period 2017–2025. The findings show a consistent increase in scientific publications, indicating the importance of the circular economy as a strategic approach to addressing environmental degradation, resource scarcity, and sustainable development challenges. The analysis shows that the main research themes focus on waste management, recycling, and sustainable development, reflecting the operational focus of circular economy implementation in developing countries. As the concept of the circular economy becomes increasingly important for addressing environmental issues, resource constraints, and sustainable development, studies that specifically map research trends, main themes, academic actors, and research gaps in the context of developing countries are still relatively few. Therefore, this study was conducted to analyze and map the development of scientific publications on circular economy sustainability in developing countries during the period 2017–2025, so as to provide an overview of the direction of research, dominant topics, and future research opportunities. However, several research gaps remain, particularly in the integration of renewable energy systems, social dimensions, and circular business models within the circular economy framework. In addition, research contributions are still concentrated among a limited number of countries and authors, indicating the need for broader participation from academics in developing countries. Therefore, future research should prioritize empirical investigation, interdisciplinary collaboration, and policy-driven innovation to strengthen the implementation of circular economy practices and support the transition to sustainable development in the economies of developing countries.

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